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Momentum Crashes in The Nordic Stock Market

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Abstract

This thesis investigates momentum crashes in the Nordic stock market. We find that an unconditional price momentum strategy yields positive significant returns in the period 2003:01 to 2017:12 but experience severe drawdowns in the wake of the 2007 financial crisis. The crash is attributable to the short position in the portfolio of past losers who outperform past winners significantly when the market conditions ameliorate. We find that this can be explained by time variation in exposure to systematic factors as the momentum returns exhibit significant option-like behaviour. In bear markets, a non-linear relationship between up- and down-market betas show that the momentum portfolios have significant negative exposure when the market rebounds.

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1.0 Introduction

The profitability of momentum strategies is well documented in the academic literature. It is an anomaly in asset pricing that has been found in a broad range of asset classes worldwide in multiple time periods. The fundamental idea of momentum strategies is that the performance of assets prices will persist in the future. Hence, the momentum portfolio buys the best performing assets and sell the worst performing assets to construct a zero-cost portfolio, which have proven to generate a sharp ratio even greater than the market.

However, despite the remarkable positive average returns and favourable risk-reward relationship of momentum strategies, the strategies sometimes experience infrequent crashes. These crashes tend to occur following large economic crisis and market drawdowns, which further suggest that the changing beta of momentum portfolios can explain these crashes. The intuition is: during market declines, the worst performing stocks are likely to be high-beta stocks, and the best performing stocks are likely to be low-beta stocks. Thus, due to the mechanisms of momentum strategies, the zero-cost portfolio will have a long position in low-beta stocks and a short position in high-beta stocks. If the market experiences sudden rebounds, the zero-cost portfolio fails (i.e. high beta stock crashes upwards) and experiences severe drawdowns. This may reverse years of cumulative gains and in worst case cause significant losses for an investor's portfolio.

This thesis investigates conditional risk measures in line with Daniel and Moskowitz (2016) to explain the impact and magnitude of these crashes in the Nordic stock market. More specific, we investigate the time-variation in exposure to systematic factors and the difference between down- and up-market betas during bear markets, where a significant difference in up- and down-market betas suggest that there is option-like behaviour for the zero-cost portfolios. We investigate the Nordic market as an entity before further examine each individual country to see whether we find similar patterns across countries. Moreover, we split the data into subsamples to see the extent to which momentum returns have been different during the financial crisis.

Consequentially, the main questions we want to address in our thesis are:

"Did we see momentum crashes in the Nordic stock market the recent decade?"

Along with this we will answer the following sub-questions:

- *"To which extent is there price momentum in the Nordic stock market?"*
- *"Where and when did the crashes occur?"*
- *"Did we see any similarities across countries?"*

First, this study contributes to the literature by examine whether an unconditional price momentum strategy is significantly profitable when implemented on the Nordic stock market. The profitability of momentum strategies is widely documented; however, we do not find any existing research specifically on the Nordic stock market as an entity the recent decade. Second, in light of Daniel and Moskowitz's (2016) findings we extend their research on momentum crashes to the Nordic stock market. We investigate whether any crashes occurred and if they may be explained by option-like behaviour. There exists very little research on momentum crashes and nothing in specific on the Nordic countries, at least to our knowledge.

The thesis is structured as follows, section 2 provides an overview of existing literature on the profitability of momentum strategies, its explanations and crashes. Section 3 contains theory of momentum strategies and the measures used to evaluate their performance. Section 4 provides a description of the data and its constraints. Section 5 explains the methodology used to conduct the analysis. Finally, section 6 presents our empirical findings, their interpretations and analysis which is followed by a conclusion in section 7.

2.0 Literature Review

2.1 Evidence of momentum

US evidence

Jegadeesh and Titman (1993) document the profitability from momentum strategies that select stocks based on historical returns in the US stock market. Their sample include stocks listed on The New York Stock Exchange (NYSE) and American Stock Exchange (Amex) between 1965 to 1989. The authors examine different zero-cost strategies with formation and holding periods ranging from 1 to 4 quarters that buys and sells the 10% best and worst performing stocks respectively. Moreover, the most profitable portfolio rank stocks based on 12 months performance, then hold the portfolio for 3 months. This portfolio yields 1.31%, and 1.49% per month when there is a 1-week lag between the formation and holding period. However, a back test on a prior to 1965 sample document that momentum return experienced a significant mean reversion between 1927 and 1940. It was debated whether the profitability was compensation for additional risk or due to data-snooping. In response, Jegadeesh and Titman (2001) extend the data and document that the profitability of momentum strategies persisted in the 1990`s.

The profitability of momentum strategies in the US is supported by others in the academic literature. Conrad and Kaul (1998) test several trading strategies from 1926 to 1989 on the same universe of stocks as Jegadeesh and Titman (1993). However, the stocks in the momentum portfolio are weighted relative to their performance rather than equally weighted to capture whether large price movements will persist. Out of 55 strategies, 30 momentum strategies generate significant positive returns and perform especially well under medium horizons. Additionally, Moskowitz and Grinblatt (1999) find that momentum strategies are significantly profitable when conducted on industry portfolios.

Despite the robustness of momentum strategies across time and asset classes, Chordia et al (2013) and Avramov (2014) document that the profitability of momentum strategies has not been statistically significant the most recent decade. This is consistent with the result between 1927 and 1940 of Jegadeesh and Titman (1993).

International evidence

Rouwenhorst (1998) document the persistence of momentum profits internationally. The research includes 2190 stocks from 12 European countries in the period 1978 to 1995. Similar with our study, the sample includes among others Norway, Denmark and Sweden. Rouwenhorst (1998) applies the same methodology as Jegadeesh and Titman (1993) to construct the momentum portfolios and find that momentum strategies yield similar results as in the US. Equivalent with Jegadeesh and Titman (1993), the most profitable strategy is the 12-3 strategy. Due to the high correlation between developed European and US markets, Rouwenhorst (1999) conduct a similar study on 20 emerging markets. The results exhibit that the momentum returns are significantly profitable when implemented individually among the markets, but not on the universe of stocks.

Chui et al. (2000) examine the profitability of momentum strategies in eight different Asian markets and find no evidence of momentum. However, when Japan is excluded from the sample the average monthly returns are significant prior to the 1997 financial crisis. In the post-crisis period the results were negative.

Griffin et al. (2003) investigate 39 non-US countries between 1975 and 1995 and documents that momentum returns are significantly lower in times when GDP growth is negative. Similar as Chui et al. (2000) they find no evidence of momentum in Asian countries, but in their case, excluding Japan from the sample make no difference.

2.2 Momentum Crashes

Momentum returns are characterized with significant returns and high sharp ratio. However, recent papers argue that these features carry risk of large occasional crashes.

Daniel and Moskowitz (2016) examine the profitability of momentum strategies in the US between 1927 and 2013. They include the same universe of stocks as previous studies and find that the zero-cost portfolio generate excess returns of 17.9% on average per year during this period. But sometimes the loser portfolio outperforms the winner portfolio dramatically. Hence, causing the zero-cost

portfolio (which is short in loser and long in winners) to experience severe losses. The paper examines two periods in closer detail, which is 1932:06 to 1939:12 and 2009:03 to 2013:01. These periods have in common that they are in the wake of two economic crisis. Namely, The Great Depression and The Financial Crisis. The two worst months in the sample are July and August of 1932. During these months the loser and winner portfolio returned 232% and 32% respectively. In March to May of 2009, the loser and winner portfolio returned 163% and 8% respectively. Barroso and Santa-Clara (2015) applies a similar analysis of momentum returns and document the presence of momentum crashes at the same point in time. What separates Daniel and Moskowitz (2016) and Barroso and Santa-Clara (2015) is different suggestions of a hedging strategy to overcome the severe drawdowns in these periods.

Daniel and Moskowitz (2016) perform a further descriptive analysis of the returns in these periods and find that: for 14 of the 15 most extreme losses, the 2-year lagged market return is negative, and the contemporaneous market return is positive. They also show that the severe losses are clustered and have quite long durations. This is consistent with Cooper et al. (2004) who find that momentum returns are significantly time dependent. The latter authors document that momentum returns are reversed during times of market distress and fail to generate positive returns when market volatility is high.

Another important property of the extreme losses is that they tend to be driven by the past loser portfolio. Based on these properties, Daniel and Moskowitz (2016) conducts a further analysis to examine the relationship between the mean return of momentum and time variation in market beta. They find a significant asymmetric relationship between the betas in down- and up-markets. That is, the beta of the momentum portfolio is larger in up-markets than in down-markets following a bear market. Furthermore, they argue that this asymmetry makes the momentum portfolio behave like a written call option on the market.

Rouwenhorst (1998) document that this optionality is present outside the US, and Chan (1988) and DeBondt and Thaler (1987) documents this for longer-term momentum portfolios. Daniel and Moskowitz (2016) are the first to relate this behaviour to a written call option on the market, but the time-varying exposure to

systematic factors are documented by Kothari and Shanken (1992). The latter authors argue that the mechanism of the strategy causes the momentum portfolio to have positive and negative loading on the winners and losers respectively. Grundy and Martin (2001) extend this insight and find that the mean return of momentum strategies has a significant negative beta following the great depression, the same period Jegadeesh and Titman (1993) find momentum strategies to perform poorly.

3.0 Theory

3.1 Efficient Market Hypotheses

The Efficient Market Hypothesis (EMH), introduced by Eugene Fama in 1970, states that security prices should incorporate and reflect all relevant market information at any time. This implies that new information will affect prices immediately, hence it is impossible for investors to outperform the market without buying more risky securities, since they always trade at their fair value. Fama defines three forms of market efficiency; *weak, semi-strong, and strong form*. The weak form efficiency suggest that stock prices reflect all available historical data, the semi-strong form suggest that stock prices reflect all public information about a company. Furthermore, we say that the market is strong form efficient if stock prices reflect all relevant information. Positive statistically significant returns from momentum strategies would be a violation of the weak form efficient market.

3.2 Capital Asset Pricing Model

The capital asset pricing model (CAPM) is a market equilibrium model describing the relationship between systematic risk and expected return of an asset. The model's simple explanation of risk-reward makes it commonly used for pricing of risky assets (Fama & French, 2004). Based on the modern portfolio theory (Harry Markowitz,1952), the CAPM was developed from three separate papers written by William F. Sharpe (1964), John Lintner (1965) and Jan Mossin (1966). The CAPM is developed in a hypothetical setting, taking several assumptions about the investor and the market:

1) Investors are risk-averse and maximize their expected utility of wealth. 2) Investors are price takers and have homogeneous expectations. 3) Investors can lend and borrow unlimited capital at risk-free rate. 4) Number of assets are given, marketable and divisible. 5) The asset market is frictionless, and information is free and available for all. 6) No taxes and short-selling restrictions.

The formula for CAPM and beta respectively is:

$$E(r_p) = R_f + \beta[E(r_m) - R_f] \quad (1)$$

$$\beta = \frac{Cov_{rp,rm}}{Var_{rm}} \quad (2)$$

Where $E(r_p)$ is the expected return for portfolio p, R_f the risk-free rate, β is the market beta, $[E(r_m)$ the expected market return, $Cov_{rp,rm}$ is the covariance between portfolio p and the market return, and Var_{rm} is the market variance.

3.3 Explanations for momentum

The academic literature on momentums strategies can be separated into two explanations. Namely, risk-based and behavioural-based. Risk-based explanations emphasize economic risk and fundamental values and uses traditional assets pricing models such as the capital assets pricing model and the factor models by Fama and French. Behavioural finance debates that investors, the market and its participants not necessarily behave in a rational manner. Investors acting in an irrational manner often lead to cognitive and psychological errors known as behavioural bias.

3.3.1 Risk-based explanations

Johnson (2002) states that the momentum effect not necessarily indicates irrationality. By discounting a firms cashflow by an ordinary pricing kernel, strong positive correlation in past realized returns and current expected returns is observed. Given that risk exposure implies positive price, an increase in growth rates will increase expected returns. Hence, when there is a positive correlation between the exposure to growth rate risk and prices, there will also be a positive correlation between expected returns and changes in growth rates. This leads to large positive price moves, affecting the likelihood of positive growth rate shocks and results in greater expected end-of-period returns.

Conrad and Kaul (1998) find that the estimated cross-sectional dispersion in mean returns is an important driver for the profitability of momentum and contrarian trading strategies. Especially for momentum strategies implemented at medium horizons, the cross-sectional dispersion in mean returns of the stocks included in the portfolios yields profitable results.

Also, time-varying risk factors is proved to drive momentum by firms adjusting their investments regarding both systematic and unsystematic risk when exposed to both. Zhang (2004) argue that when these risks are being calculated for, the firm's beta will adjust to past returns and past winners face larger beta risk and larger expected return and vice versa.

3.3.2 Behavioural explanations

Theories on underreaction emphasize the investors ability to absorb information, this results in slow information flow; hence, security prices being biased (Hong and Stein, 1999). Further on, delayed overreaction argues that due to overconfidence, security prices are driven away from its fundamental value. This will in short-term create momentum opportunities, for then to be corrected when prices reverse to its fundamental value (Daniel, Hirshleifer and Subrahmanyam, 1998).

Kahneman and Tversky (1974) introduce heuristic biases and the rules of thumb used by investors in decision making. Barberis et al (1998) finds that representativeness is an important factor for investors underreaction to earnings announcement and overreaction to good and bad news. Announcement of good news or expected high returns can influence investors and result in a price run before being corrected by the market (Chopra, Lakonishok and Ritter (1992). Investors slowly updating their models in response to new evidence (Bodie and Kane, 2011. p. 411), which results in stock prices not reflecting the correct value and can result in the possibility of momentum.

The disposition effect is when investors keep on to their loosing shares only to sell shares that has increased in value (Shefrin and Statman, 1985). Investors tends to dislike losses more than they appreciate gains. Grinblatt and Han (2005) finds that the disposition effect creates a deviation between a stock's fundamental price and its market price. Even when a stocks fundamental price follows a random walk, its equilibrium price will underreact to information. Hence, the effect of good news will not result in an immediate price movement.

4.0 Data

This thesis investigates momentum strategies and momentum crashes in the Nordic stock market, including; Denmark, Finland, Norway and Sweden. The universe of stocks consist of each country's respective all-share index and the sample period is between January 2003 and December 2017, which gives us a total time frame of 15 years.

Thompson Reuters Eikon and Datastream is used to obtain daily historical prices (adjusted), market value, book/market-ratio for all stocks. Prices are adjusted for corporate actions (i.e. dividends, splits and rights offerings). Datastream calculate market value as: market share price multiplied with outstanding shares. All data is converted into a common currency, NOK, by Datastream before extracting it, using historical exchange rates.

The data retrieved from Thomson Reuters Eikon included several biases that were adjusted for. Output "noise" such as OTC companies and M&A actions were included in the raw-sample. "Errors" due to missing data for companies within the given sample period were removed. M&A´s were adjusted for to be consistent and prevent double-listings. Companies switching stock exchanges between the Nordic countries were accounted and corrected for. The adjusted sample includes both A and B stocks.

Thomson Reuters Eikon provides both currently listed companies and delisted companies that we include in the sample. Delisted companies are companies that has been removed from the respective stock exchange during the sample period due to defaults, M&A´s, etc. By including delisted companies in our sample, the risk of survivorship bias is reduced (Brown, Goetzmann, Ibbotson and Ross, 1992). That is, the tendency to not include companies that no longer exist.

The proxy estimate of risk-free rate for our universe is the average of the 10-year government bond for each of the Nordic country (Koller, Goedhart and Wessels, 2015). When analysing the countries individually, we use each country respective risk-free rate.

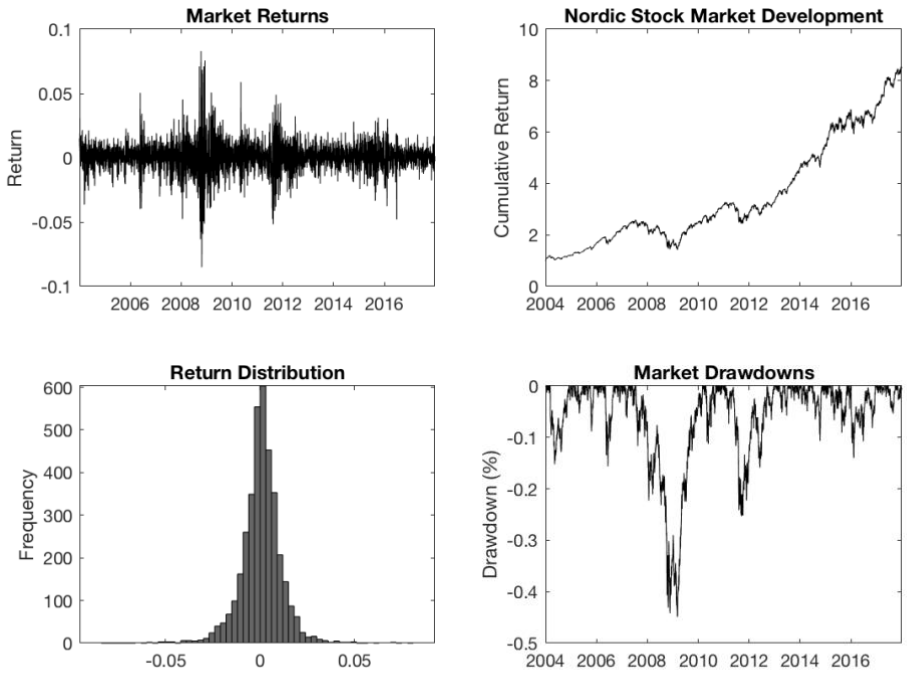
Table 1: Data description

Country	Stock Exchange	Stock Index	Number of listings	
			Raw	*Adjusted*
Denmark	Nasdaq OMX Copenhagen	OMXCPGI	413	301
Finland	Nasdaq OMX Helsinki	OMXHGI	229	199
Norway	Oslo Stock Exchange	OSEAX	464	387
Sweden	Nasdaq OMX Stockholm	OMXSGI	579	507
Total			**1685**	**1394**

To calculate the market return, we used the value-weighted approach (i.e. each stock is weighted by their market value), which is similar as Daniel and Moskowitz (2016). When examine the countries individually, the market portfolio only includes stocks from the respective country. While the universe of stocks is included as a benchmark when we consider all Nordic countries.

For computations and processing, Excel has been preferred for the preparation and handling of raw data as input for the programming tool, MATLAB. With MATLAB, momentum strategies have been computed by creating an algorithm following the methodology of Jegadeesh and Titman (1993). EViews is used to generate descriptive and regression outputs.

Figure 1: Plotted market return



Note: The market drawdown is the percentage loss of cumulative market return at a given time.

5.0 Methodology

5.1 Hypothesis

Hypothesis 1: Momentum effect

This hypothesis answer whether momentum strategies generated statistically significant, positive or negative, returns in the Nordic stock market during the period 2003:01 to 2017:12. If the returns are positive and statistically significant we may conclude that the momentum effect is present in the Nordic stock market. We expect the returns to be positive; however, there exist a chance of negative returns. Hence, we use a two-sided test. The hypothesis will be tested for 16 different strategies.

$$H_0: (\overline{r_W} - \overline{r_L}) = 0$$
$$H_1: (\overline{r_W} - \overline{r_L}) \neq 0$$

For the momentum strategy to generate significant positive returns, the winners ($\overline{r_W}$) must outperform the losers ($\overline{r_L}$). For the momentum strategy to generate negative returns, the losers must outperform the winners.

Hypothesis 2: Time-varying betas

This hypothesis test whether the loadings on systematic factors is state dependent for the zero-cost portfolio.

$$H_0: \hat{\beta}_B = 0$$
$$H_1: \hat{\beta}_B \neq 0$$

A positive significant $\hat{\beta}_B$ implies that the market beta of the zero-cost portfolio is greater in bear markets. A negative significant $\hat{\beta}_B$ implies that the market beta of the zero-cost portfolio is lower in bear markets.

Hypothesis 3: Option-like payoff

This hypothesis test whether the loadings on systematic factors differ when the contemporaneous market return is positive or negative (up- or down-market) in bear markets.

$$H_0: \hat{\beta}_{B,U} = 0$$

$$H_1: \hat{\beta}_{B,U} \neq 0$$

If $\hat{\beta}_{B,U}$ is significant, then there is a difference between the up- and down-market betas in bear markets.

5.2 Momentum portfolios

To identify potential momentum crashes in our sample, we first calculate the returns from the momentum strategies. The momentum portfolios are formed consistent with the methodology in Jegadeesh and Titman (1993) and the calculations are performed using MATLAB. The methodology consists of observing and select stocks based on 1 to 4 quarters past returns and hold the portfolio for 1 to 4 quarters. The formation and holding period are denoted by J and K respectively. One quarter is defined as 3 months and we calculate the return from 16 different strategies (i.e. J, K = $\{3, 6, 9, 12\}$) which include portfolios with overlapping holding periods. Hence, in any month t, the strategies hold several portfolios that are selected in the current month as well as in the previous K-1 months. The stocks are then divided into deciles where the bottom decile consist of the worst performing stocks (losers) and the top decile consist of the best performing stocks (winners). The zero-cost portfolio is then constructed by selling the losers and buying the winners. To avoid short-term reversals, shown by Jegadeesh and Lehmann (1990), we skip one month between the end of the formation period and the start of the holding period.

Companies that were not traded during the formation period will not be included in the zero-cost portfolio. To capture the effect of listing and delisting of companies, we replaced padded (i.e. last known value or zero) cells with "NaN" (not a number). This was necessary as Thomson Reuters Eikon were inconsistent on delisting-dates. Hence, the decile portfolios will only contain companies that have observations the entire formation period.

5.2.1 Return calculations

First, we compute monthly log returns for all the stocks in our sample, where $r_{i,t}$ is the return from stock i in month t. At the beginning of each month the stocks are ranked in ascending order based on their cumulative return ($Cr_{i,t}$) the past J months.

$$r_{i,t} = \ln(\frac{P_{i,t}}{P_{i,t-1}}) \tag{3}$$

$$Cr_{i,t} = \prod_{t=1}^{J}(1 + r_{i,T-t+1}) - 1 \tag{4}$$

The securities are divided into deciles and the equally weighted average return for each decile portfolio is calculated. However, the zero-cost portfolio only consider the winners and losers.

$$r_{W,t} = \frac{1}{N}\sum_{i=1}^{N}\left[\sum_{t=1}^{K} r_{i,t}^{W}\right] \tag{5}$$

$$r_{L,t} = \frac{1}{N}\sum_{i=1}^{N}\left[\sum_{t=1}^{K} r_{i,t}^{L}\right] \tag{6}$$

Where $r_{W,t}$ and $r_{L,t}$ are the return in month t for the winner and loser portfolio respectively and N is the number of stocks in each portfolio.

$$\overline{r_W} = \frac{1}{T}\sum_{t=1}^{T} r_{W,t} \tag{7}$$

$$\overline{r_L} = \frac{1}{T}\sum_{t=1}^{T} r_{L,t} \tag{8}$$

$$\tilde{r}_{mom} = \overline{r_W} - \overline{r_L} \tag{9}$$

Finally, we calculate the average return for the winners ($\overline{r_W}$) and losers ($\overline{r_L}$) during our sample, and the average return of the zero-cost portfolio ($\tilde{r}_{mom}$).

5.3 Statistical significance

5.3.1 T-statistics

To evaluate the validity of the results, we test for statistical significance to assess whether the results estimated occur by chance or not. For assessing whether the strategies have yielded returns greater than zero, we will use two-sided t-test because of the possibility of negative values to be estimated from the strategies.

$$t_{stat} = \frac{m - \mu}{\frac{s}{\sqrt{n}}} \tag{10}$$

5.3.2 Jarque-Bera test

The Jarque-Bera test (Bowman and Shenton, 1975, Jarque and Bera, (1987) is a goodness-of-fit test necessary to test the returns for departures from normality. Jarque-Bera assumes, from the properties of normal distribution, the skewness to be equal 0 and a coefficient of kurtosis of 3. The definition of excess kurtosis is equal the kurtosis coefficient subtracted the value of 3. We test whether the coefficient of skewness and the coefficient of the excess kurtosis are jointly zero (Chris Brooks, 2014).

$$Jarque - Bera = n\left[\frac{\left(\sqrt{b_1}\right)^2}{6} + \frac{(b_2 - 3)^2}{24}\right] \tag{11}$$

Where n is the sample size, $\sqrt{b_1}$ the skewness coefficient of the sample, and b_2 the kurtosis coefficient. Any deviation from the underlying assumptions increases the Jarque-Bera statistic.

5.4 Portfolio performance

5.4.1 Jensen's Alpha

Jensen's Alpha (Michael Jensen, 1968) is used to measure the risk-adjusted performance of the momentum strategies (i.e. abnormal returns). The alpha is generated by using an unconditional capital asset pricing model (CAPM). If the

alpha is positive and statistically significant, the strategy generates returns above what is expected from the CAPM considering the exposure to market risk. Jensen's Alpha is calculated from the following formula:

$$\alpha = R_p - (R_f + \beta_p(R_M - R_f)) \tag{12}$$

$$\beta_p = \frac{Cov(R_p, R_M)}{Var(R_M)} \tag{13}$$

Where R_p is the return on the portfolio, R_f is the risk-free rate, R_M the market return. The beta on the portfolio (β_p) is a measure to which extent the portfolio covaries with the market return.

5.4.2 Sharpe ratio

Sharpe ratio (William Sharpe, 1966) is used to evaluate the combined risk-reward relationship. By estimating the excess return (i.e. excess of the risk-free rate) per unit of total risk, we may assess the performance of a portfolio given the volatility and compare it to other investments.

$$SR_p = \frac{R_p - R_f}{\sigma_p} \tag{14}$$

Where R_p is the return from the portfolio, R_f the risk-free rate, and σ_p the standard deviation of the portfolio.

We use the ex-post measure as a performance indicator between the strategies and the market realized returns, so we can assess whether the momentum portfolios outperformed the market in terms of excess return per unit of risk. However, the sharp ratio does not tell anything about the skewness or the kurtosis of the returns, which affects the standard deviation and the validity of the ratio. Hence, we only use it for ranking purposes as one of several measures.

5.4.3 Maximum Drawdown

Maximum Drawdown (MDD) is important for the investor as it measures the down-side risk exposure of the portfolio. MDD is measured as the peak- to-trough decline of cumulative returns for a given time period. When a strategy yields negative returns, MDD represents the largest decline through a chosen sample in percentage. However, if it yields strictly positive returns MDD is equal to zero. The input variables are P (Peak value before a drop) and L (Lowest value before a new peak).

$$MDD_p = max(\frac{(P - L)}{P}) \tag{15}$$

The MDD only measures the size of the largest loss and does not take the frequency of the large losses into consideration and does not reveal any information about the recovery time of the strategy after the loss. Interpretation of MDD on the strategies should take the development of the market into consideration as a large drawdown from a strategy could be explained by large drawdowns in the market.

5.5 Momentum portfolio optionality

Daniel and Moskowitz (2016) argue that the infrequent large negative returns from momentum strategies occur contemporaneously with market rebounds when market volatility is high, following a bear market. Hence, momentum portfolio behaves like a written call option on the market. This is, when the market falls they gain a little, but when the market rises they lose much. To determine whether the momentum returns in the Nordic stock market exhibit any option-like behaviour we apply the same methodology as Daniel and Moskowitz (2016) and run the following unconditional and conditional regression models.

$$\tilde{r}_{mom,t} = \hat{\alpha}_0 + \hat{\beta}_0 \tilde{r}_{m,t} + \tilde{u}_t \tag{16}$$

$$\tilde{r}_{mom,t} = (\hat{\alpha}_0 + \hat{\alpha}_B I_{B,t-1}) + (\hat{\beta}_0 + \hat{\beta}_B I_{B,t-1})\, \tilde{r}_{m,t} + \tilde{u}_t \tag{17}$$

$$\tilde{r}_{mom,t} = (\hat{\alpha}_0 + \hat{\alpha}_B I_{B,t-1}) + [\hat{\beta}_0 + I_{B,t-1}(\hat{\beta}_B + I_{U,t})]\, \tilde{r}_{m,t} + \tilde{u}_t \tag{18}$$

Where $\tilde{r}_{mom,t}$ is the momentum return and $\tilde{r}_{m,t}$ is the excess market return. In equation (17) and (18), we include two different binary variables, an ex-ante bear market indicator ($I_{B,t-1}$) and a contemporaneous up-market indicator ($I_{U,t}$). The ex-ante bear market indicator has a value of 1 if the cumulative market returns the past 24 months is negative, and zero otherwise. In contrast, the up-market indicator has a value of 1 if the excess market return is positive at time t (i.e. $\tilde{r}_{m,t}$ is greater than the risk-free rate).

We then further examine the main source of the optionality in the zero-cost portfolio. That is, whether the optionality comes from the winner or loser portfolio. We also examine whether the option-like behaviour is present in bull markets. Hence, a bull market indicator is added to equation (19):

$$\tilde{r}_{p,t} = (\hat{\alpha}_0 + \hat{\alpha}_L I_{L,t-1}) + [\hat{\beta}_0 + I_{L,t-1}(\hat{\beta}_L + I_{U,t}\hat{\beta}_{L,U})]\, \tilde{r}_{m,t} + \tilde{u}_t \qquad (19)$$

The bull market indicator ($I_{L,t-1}$) is a binary variable that has a value of 1 if the cumulative market returns the past 24 months are positive. That is, $I_{L,t-1}$ =1 - $I_{B,t-1}$. Returns from the loser, winner and zero-cost portfolio is used as dependent variables, $\tilde{r}_{p,t}$.

6.0 Empirical Findings

In this section we present the results of our empirical study. We will analyse the results and provide interpretations as well as comparisons with previous findings.

6.1 Momentum returns in the Nordic stock market

To identify momentum crashes in the Nordic stock market we calculate the momentum returns. Positive significant returns are not crucial regarding the motivation for the analysis of the crashes, as they might be the reason for non-profitable momentum portfolios. We get the following results by applying the methodology outlined in chapter 5.2.

Table 2: Returns from momentum portfolios – Nordic

		Momentum returns			
J	K=	3	6	9	12
3	Winner	1.28	1.19	1.17	1.12
3	Loser	-0.14	0.22	0.24	0.28
3	Zero-cost	1.14***	0.97***	0.93***	0.84***
		(3.82)	(3.86)	(4.10)	(4.07)
6	Winner	1.39	1.33	1.24	1.11
6	Loser	0.02	0.08	0.09	0.19
6	Zero-cost	1.36***	1.25***	1.15***	0.92**
		(3.85)	(4.05)	(4.03)	(3.51)
9	Winner	1.47	1.32	1.20	1.09
9	Loser	-0.07	-0.06	0.05	0.15
9	Zero-cost	1.55***	1.39***	1.15***	0.95***
		(4.27)	(4.19)	(3.71)	(3.26)
12	Winner	1.39	1.20	1.09	0.99
12	Loser	-0.16	-0.06	0.06	0.14
12	Zero-cost	1.55***	1.27***	1.03***	0.85**
		(4.20)	(3.71)	(3.19)	(2.12)

Note: This table presents the monthly average returns from 16 different momentum portfolios with overlapping holding periods, implemented on the Nordic stock market from 2004:01 to 2017:12. The stocks are ranked in ascending order and divided into deciles based on J-months lagged returns. The zero-cost portfolio is formed one month after the end of the formation period by selling the bottom decile (losers) and buying the top decile (winners), then held for K months. Level of significance is denoted by (*), (**) and (***) for 10%, 5% and 1% respectively and t-statistics are in parenthesis.

We find that all zero-cost portfolios yield positive average monthly returns and that 15 of the strategies are statistically significant at any level. The average monthly

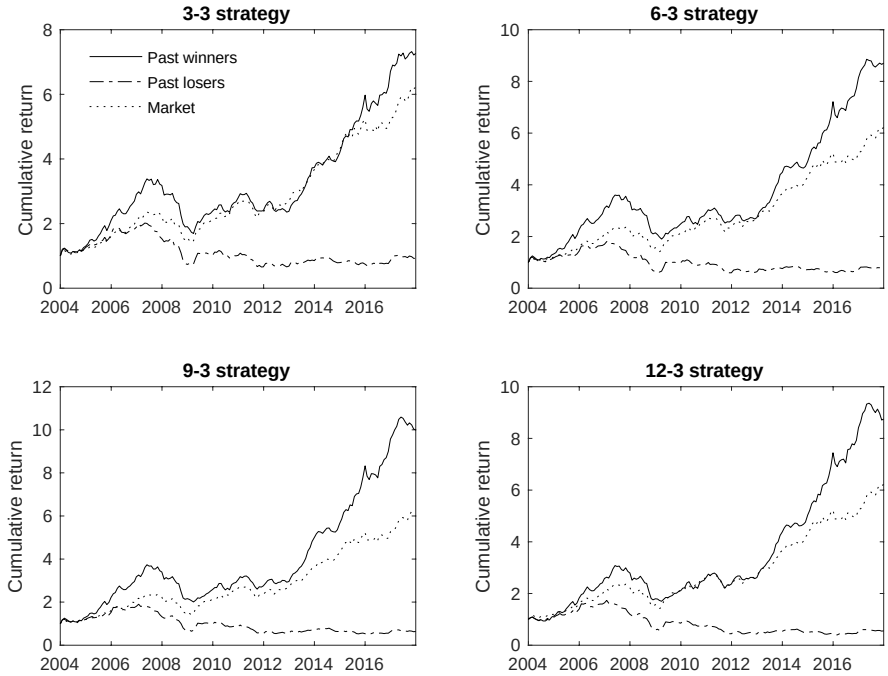
return from the portfolio, that selects stocks based on 12 months performance (J=12) then hold the portfolio for 12 months (K=12), are significant at the 5% level. From now the different strategies will be referred to as "the J-K strategy", so the latter case would be "the 12-12 strategy". Moreover, the 9-3 and 12-3 strategies are the most successful and yielded equal results of 1.55% per month. It's interesting to notice that holding period seems to be negatively related with return (i.e. return decrease with holding period), and consistent with the academic literature momentum return is driven by the winner portfolio in all cases.

It is common to use quarterly intervals as formation and holding periods when investigating momentum returns, and by computing 16 different combinations, in line with Jegadeesh and Titman (1993), our results is more robust. However, Daniel and Moskowitz (2016) analyse the 12-2 strategy in detail; hence, to make our research more comparable we chose to assess the 12-3 strategy. In addition, we asses all strategies with holding period of 3 months to strengthen our results.

We divide our sample into individual countries, and the returns from the 16 momentum portfolios for each country is presented in Table A.1 with the respective descriptive statistics in Table A.2 in the Appendix. Sweden show similar results as the whole Nordic sample. In contrast, Denmark, Finland and Norway exhibit weaker significance and broader dispersion in mean returns. This may be related to different amount of securities, where Finland has the smallest sample. The 12-3 strategy is the best performing strategy for all countries except for Finland who yields the highest monthly average returns with the 6-6 strategy.

Since we include the financial crisis in our sample the level of significance and the magnitude of the momentum returns exceed our expectations. Hence, we split our sample into three groups to examine the results in different time periods: pre-crisis (2003-2006), crisis (2007-2009) and post-crisis (2010-2017). From Table A.3 in the Appendix we see that momentum returns are still statistically significant at any level, both pre- and post-crisis, for all strategies. A similar pattern appears also for each individual country as displayed in table A.4 in the Appendix. The number of observations is smaller for the crisis period, but we see that the pre-crisis period is highly significant with approximately similar amount of observations. Hence, it seems that momentum strategies were not profitable during the financial crisis.

Figure 2: Cumulative return for the past winner and loser portfolios – Nordic



Note: The figure plots the cumulative return from the market and the portfolios of past winners and losers for the four chosen strategies, from 2004:01 to 2017:12. It illustrates a long position in the portfolios, given a NOK 1 investment.

6.2 Descriptive statistics

Table 3: Descriptive statistics – Nordic

	Momentum portfolios				Market
	3-3	6-3	9-3	12-3	
$\tilde{r} - r_f$	0.95	1.17	1.35	1.36	0.97
σ	3.88	4.60	4.70	4.79	3.96
α	1.12	1.37	1.53	1.50	0
$t(\alpha)$	3.69	3.78	4.11	3.94	0
β	-0.18	-0.21	-0.18	-0.15	1
$Sharp\ ratio$	0.24	0.25	0.29	0.28	0.25
$MDD\ (\%)$	29.96	42.38	39.30	38.17	40.26
$MDDur\ (mnt)$	5	5	5	5	16
$Skewness$	-0.64	-1.11	-1.01	-0.98	-0.48
$Kurtosis$	4.28	6.43	5.66	5.24	4.63
$Jarque-Bera$	23.03	117.02	78.10	58.66	25.19
$p-value\ (JB)$	0.00	0.00	0.00	0.00	0.00

Note: This table presents descriptive statistics for the monthly momentum portfolios excess return (r-rf). Standard deviation (σ) and sharp ratio are monthly measures. The α, t(α) and β are estimated from fitting an unconditional capital asset pricing model (CAPM) to the excess momentum returns. MaxDD is the maximum drawdown (in %) of the cumulative return and MDDur is the duration of the drawdowns in number of months. For example, the largest drawdown for the 6-3 strategy was an accumulated loss of 42.38% which occurred over 5 months

The momentum portfolios exceed the market in monthly excess return, volatility and sharp ratio. However, the 3-3 strategy is inadequate on all these points compared to the market. The negative beta show that momentum returns is on average negatively related to market fluctuations, which correspondingly yielded positive risk-adjusted returns (i.e. abnormal returns) that are economically large and statistically significant at any level, for all strategies. These properties are in line with the academic literature except the aberration of the risk-reward relationship for the 3-3 strategy. An interesting observation is that the sharp ratio for the momentum portfolios is higher for the Nordic sample than for each individual country, for all strategies. In other words, the momentum portfolio seems to benefit from including stocks from all countries with a higher reward per unit of risk.

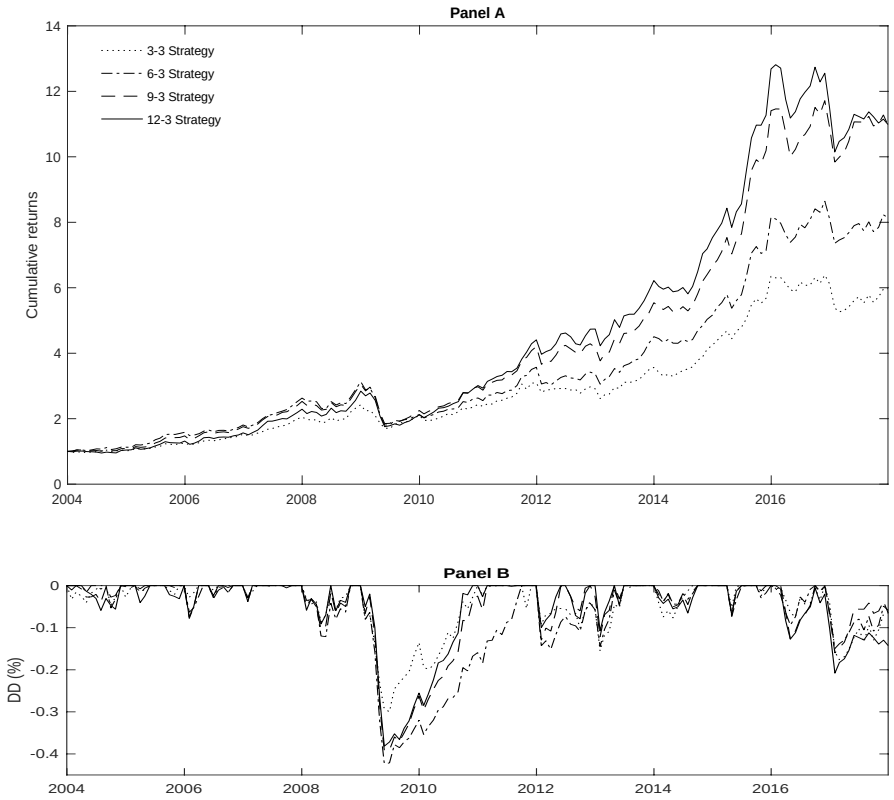
Moreover, the momentum returns are negatively skewed (to the left) and have excess kurtosis (leptokurtic). That is, the mass of the distribution is concentrated to the right of the mean with positive excess returns but have some severe negative outliers. The excess kurtosis indicates that the volatility of the momentum returns is a result of infrequent large deviations from the mean, rather than frequent even deviations. These characteristics is consistent with previous research and is interpreted as crash risk (Barroso and Santa-Clara, 2015). Furthermore, based on the Jarque-Bera normality test we may conclude that the momentum return for the four different strategies are not normally distributed, as would be expected for financial metrics.

6.3 Momentum Crashes

We identify a drawdown period for the Nordic momentum portfolios from January to May 2009, which is noteworthy similar as the crash periods in the US documented by Daniel and Moskowitz (2016). This similarity also applies to the market who experienced severe drawdowns from November 2007 to February 2009. That is, the largest percentage loss of cumulative returns in our sample was during the financial crisis for the market, and subsequently in the wake of the financial crisis for the momentum portfolios. The maximum drawdowns for the strategies in % are shown in Table 3 and varies from 29.96% to 42.38%. The impact of the losses seems to be lower in the Nordic stock market than in the US, they also

have shorter duration. However, the crashes are still large as they occur over five months and take approximately two or three years to recover from.

Figure 3: Cumulative returns and DD for the momentum portfolios – Nordic



Note: The figure plots the cumulative monthly returns in panel A and drawdowns (DD) in panel B from the zero-cost portfolios for the 3-3, 6-3, 9-3 and 12-3 strategies. Cumulative returns exhibit the value of an investment from 2004:01 to 2017:12 in the zero-cost portfolios given a NOK 1 investment. DD exhibit the percentage loss of cumulative return.

From Table 4 we can see that the portfolio of past losers outperforms the portfolio of past winners significantly. Hence, the momentum reversal is caused by the strong performance of past losers. Table A.5 in the Appendix exhibit the 15 worst returns from the different strategies in our sample, it shows that the vast majority of the worst returns originate from a short position in past losers. Furthermore, we find that April and May 2009 seem to occur frequently, which is some of the same months that Daniel and Moskowitz (2016) find the most extreme losses.

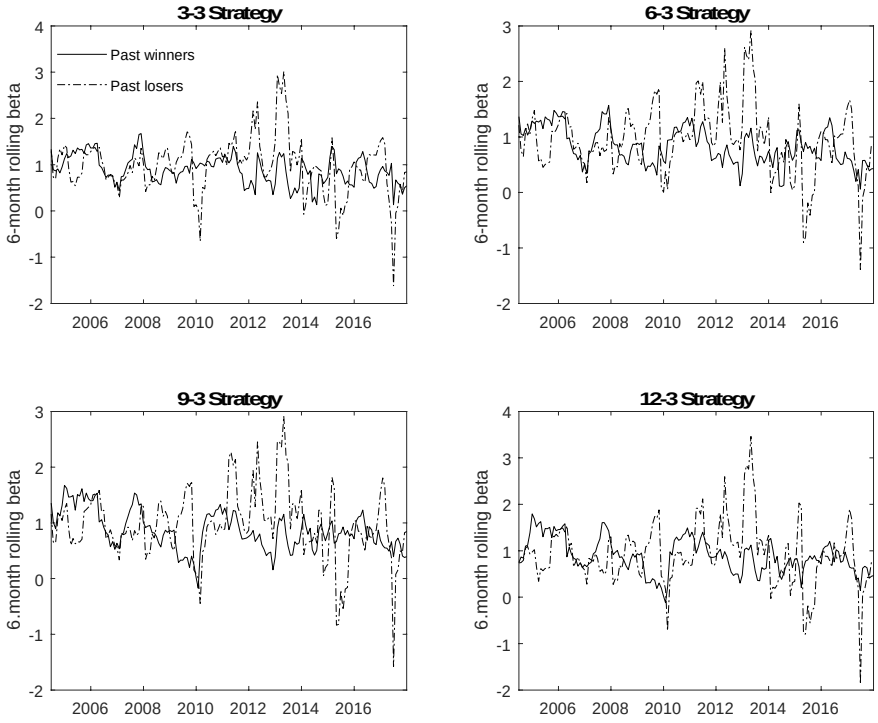
Table 4: Cumulative returns during the crash period – Nordic

	Strategies			
	3-3	6-3	9-3	12-3
Winner	8.84	1.24	2.95	5.21
Loser	40.78	47.22	43.58	39.97
Market	21.96	21.96	21.96	21.96

Note: This table presents the cumulative monthly return (in %) for the market, past winner and loser portfolio during the drawdown period from 2008:01 to 2009:05.

In addition, the portfolio of past loser also outperforms the market with approximately the double in the crash period, and we find that the companies in the past winner and loser portfolio tend to be large and small companies respectively. The companies in the winner portfolio tend to be twice as large as losers, this measured by the median market value in the portfolios (Figure A.9 in the Appendix). Hence, the large beta of the loser portfolio may be related to volatile small firms that are less liquid and have less access to capital.

Figure 4: 6-month rolling beta for the winner and loser portfolios – Nordic



Note: The figure plots the market betas for the winner and loser portfolios. The betas are estimated by running a 6-months rolling regression with the momentum portfolio returns as the dependent variable and market return as the independent variable.

From figure 4 we see that the market beta for the past losers is close to 2 and below 1 for the past winners in the wake of the financial crisis. These patterns suggest that the market beta may be an explanation of the crashes, as argued by Grundy and Martin (2001). The beta from the past loser portfolio is substantially higher around 2013, but this will most likely not have a significant impact unless the market return is high.

6.4 Option-like payoff

6.4.1 Nordic

Regression statistics for the market timing regressions, outlined in chapter 5.5, are presented in Table 5. The first regression (1) is a similar unconditional CAPM regression as in part 6.2, but the market return is excess of the risk-free rate. The regressions reveal that the momentum portfolios yielded economically large and statistically significant positive alpha and have negative market betas, regardless of which regression model that is used.

From the second regression (2) we find weak support for different alpha in bear markets, measured by $\hat{\alpha}_B$. On the other hand, Table 5 exhibit that the market betas are state dependent for the momentum portfolios, except for the 3-3 strategy. That is, in bear markets the loadings on the market factor for the 6-3, 9-3 and 12-3 strategy are reduced with -0.47, -0.55, and -0.60 respectively, all statistically significant. An interpretation of this may be: in bear markets the momentum portfolio is on average positively affected since the market has fallen. However, we find that the negative relationship seems to be attributable to negative returns of the momentum portfolio when the market rebounds.

From the third regression (3) we find that the 3-3 strategy do not exhibit any significant difference between down- and up-market betas in bear markets, measured by $\hat{\beta}_{B,U}$. Again, the 6-3, 9-3 and 12-3 strategies exhibit a difference of -1.60, -1.74 and -1.79 respectively in bear markets when the contemporaneous market return is positive, which indicates that the momentum portfolios perform poorly when the market rebounds following a bear market. The coefficients are significant at any level and from regression (4) we can see that they are robust as they are similar when variation in returns is not captured by difference in alpha.

The point estimates of the market beta for the 6-3, 9-3 and 12-3 strategies in bear markets are ($\hat{\beta}_0$ + $\hat{\beta}_B$) 0.02, -0.04, and -0.01 respectively. When the market rebounds following bear markets, the point estimates are ($\hat{\beta}_0$ + $\hat{\beta}_B$ + $\hat{\beta}_{B,U}$) -1.13, -1.17 and -1.13 which is substantially lower.

Table 5: Regression results – Nordic

Coefficient	Variable	Regression			
		(1)	(2)	(3)	(4)
Panel A: 3-3 Strategy					
$\hat{\alpha}_0$	1	1.38***	1.42***	1.42***	1.45***
		(4.31)	(4.16)	(3.18)	(4.41)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.01	0.01	
			(-0.86)	(0.60)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.21**	-0.13	-0.13	-0.13
		(-2.48)	(-1.32)	(-1.33)	(-1.38)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.24	0.12	0.02
			(-1.39)	(0.40)	(0.07)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-0.70	-0.49
				(-1.50)	(-1.62)
R^2_{adj}		0.0318	0.0382	0.0460	0.0410
Panel B: 6-3 Strategy					
$\hat{\alpha}_0$	1	1.61***	1.73***	1.73***	1.81***
		(4.25)	(4.39)	(4.51)	(4.83)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.02*	0.02	
			(-1.83)	(1.11)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.25**	-0.11	-0.12	-0.12
		(-2.63)	(-1.02)	(-1.07)	(-1.14)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.47**	0.35	0.14
			(-2.33)	(1.04)	(0.50)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-1.60***	-1.15***
				(-3.01)	(-3.37)
R^2_{adj}		0.0366	0.0844	0.1303	0.1289

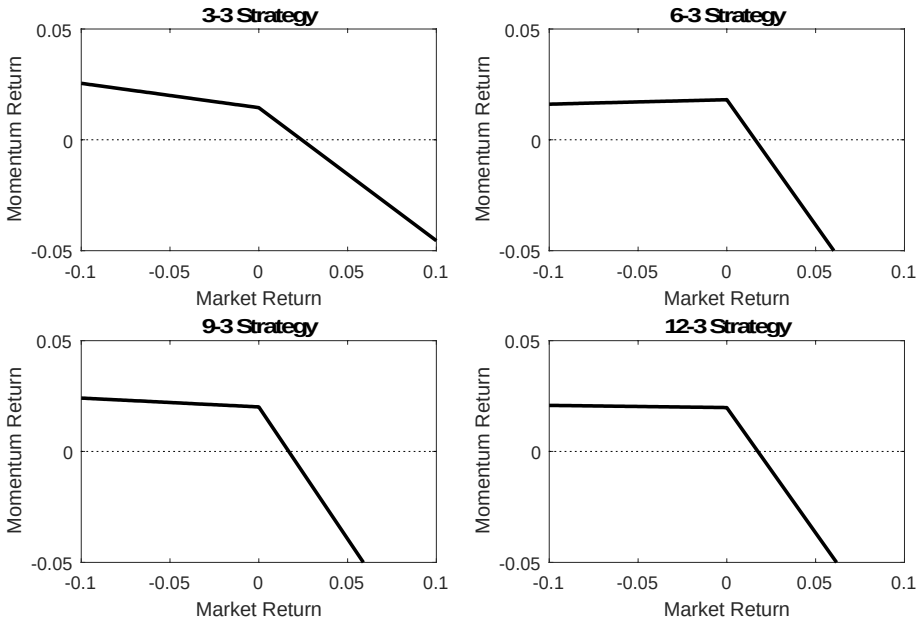
Panel C: 9-3 Strategy					
$\hat{\alpha}_0$	1	1.82***	1.89***	1.89***	2.01***
		(4.67)	(4.66)	(4.81)	(5.20)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.02	0.03	
			(-1.53)	(1.45)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.23**	-0.07	-0.07	-0.09
		(-2.40)	(-0.62)	(-0.67)	(-0.77)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.55***	0.34	0.05
			(-2.66)	(0.99)	(0.19)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-1.74***	-1.13***
				(-3.20)	(-3.24)
R^2_{adj}		0.0296	0.0811	0.1333	0.1271
Panel D: 12-3 Strategy					
$\hat{\alpha}_0$	1	1.81***	1.85***	1.86***	1.98***
		(4.55)	(4.49)	(4.63)	(5.04)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.20	0.03	
			(-1.39)	(1.57)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.19*	-0.01	-0.01	-0.02
		(-1.85)	(-0.08)	(-0.10)	(-0.21)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.60***	0.33	0.01
			(-2.81)	(0.92)	(0.03)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-1.79***	-1.12***
				(-3.23)	(-3.15)
R^2_{adj}		0.0154	0.0697	0.1236	0.1153

Note: The monthly time-series regressions run from 2004:01 to 2017:12. Momentum return is the dependent variable. $\tilde{r}_{m,t}$ is the market return excess of the risk-free rate and $I_{B,t-1}$ is an ex-ante bear market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is less than zero. $I_{U,t}$ is a up-market indicator that equals one if the contemporaneous market return is positive. $\hat{\alpha}_0$ is denoted in percent.

This means that the 9-3 and 12-3 strategy gain a little in bear markets when the contemporaneous market return is negative but lose much when the market rebounds. Since ($\hat{\beta}_0$ + $\hat{\beta}_B$) is 0.02 (positive) for the 6-3 strategy a more precise interpretation would be that: in bear markets, when the contemporaneous market return is negative it loses a little but lose much when the market rebounds. However, considering the optionality enlightened by Daniel and Moskowitz (2016), the

variable of interest is $\hat{\beta}_{B,U}$. The fact that it makes the market beta significantly lower implies that the zero-cost portfolios exhibit option-like behaviour. The 3-3 strategy is not statistically significant, but from Figure 5 it is evident that it shows a similar pattern.

Figure 5: Optionality of the zero-cost portfolios – Nordic



Note: This figure plots the zero-cost portfolios exposure to market risk in bear markets. When the contemporaneous market return is negative the point estimate for the portfolios are $(\hat{\beta}_0 + \hat{\beta}_B)$ and $(\hat{\beta}_0 + \hat{\beta}_B + \hat{\beta}_{B,U})$ when the contemporaneous market return is positive.

6.4.2 Individual country

We investigate the difference between down- and up-market betas for each individual country. We present the results from regression (3) for the 12-3 strategy in Table 6 and analyse these differences, as these results are representative for the individual countries. The $\beta_{B,U}$ coefficient is statistically significant for each individual country.

This makes our results of the option-like behaviour in the Nordic stock market more robust. The fact that the option-like behaviour is present in the cross-country samples may imply that this pattern is not simply a bias from a few stocks in the Nordic sample. The cumulative return from the zero-cost portfolios for each individual country is illustrated in Figure 6, and interestingly they all experience significant drawdowns in the wake of the financial crisis, but with a great difference

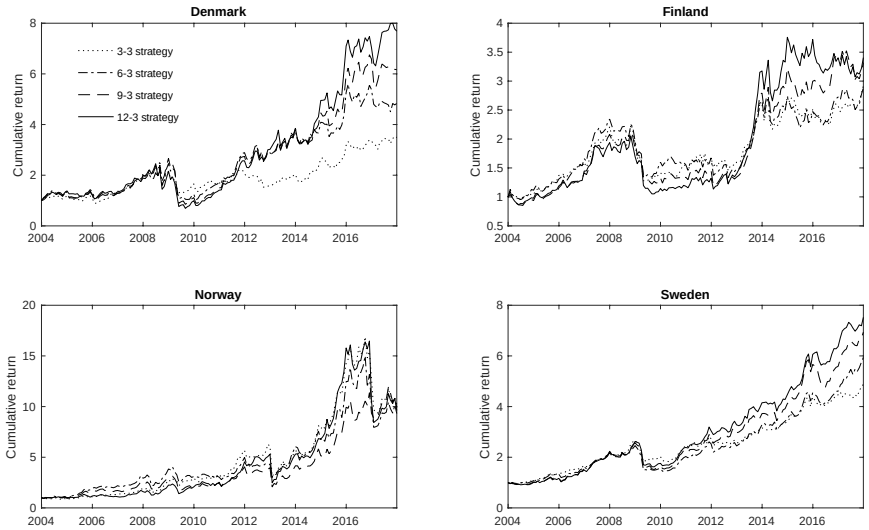
in duration. A closer examination reveals that the crashes occurred at different times in Norway. However, the significant optionality may still be an explanation.

Table 6: Regression results, individual country

Coefficient	Country				Nordic
	Denmark	Finland	Norway	Sweden	
$\hat{\alpha}_0$	2.51***	1.12**	2.76***	1.88***	1.86***
	(3.32)	(2.17)	(3.38)	(5.08)	(4.63)
$\hat{\alpha}_B$	0.04*	0.01	0.04	0.01	0.03
	(1.96)	(1.02)	(0.93)	(0.43)	(1.57)
$\hat{\beta}_0$	-0.26*	0.07	-0.26	-0.14	-0.01
	(-1.91)	(0.71)	(-1.55)	(-1.41)	(-0.10)
$\hat{\beta}_B$	0.89**	-0.07	0.64	0.06	0.33
	(2.54)	(-0.23)	(1.00)	(0.17)	(0.92)
$\hat{\beta}_{B,U}$	-2.83***	-0.89**	-2.41**	-1.31***	-1.79***
	(-5.28)	(-2.08)	(2.02)	(-2.74)	(-3.23)

Note: The table presents the results from $\tilde{r}_{i,t} = (\hat{\alpha}_0 + \hat{\alpha}_B I_{B,t-1}) + [\hat{\beta}_0 + I_{B,t-1}(\hat{\beta}_B + I_{U,t})]\,\tilde{r}_{m,t} + \tilde{u}_t$ for each individual country, run from 2004:01 to 2017:12. Momentum return is the dependent variable and $\tilde{r}_{m,t}$ is the market return excess of the risk-free rate. $I_{B,t-1}$ is an ex-ante bear market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is less than zero. $I_{U,t}$ is an up-market indicator that equals one if the contemporaneous market return is positive. $\hat{\alpha}_0$ is denoted in percent.

Figure 6: Cumulative returns for the zero-cost portfolios – Individual countries



Note: The figure plots the cumulative returns from the zero-cost portfolios for the 3-3, 6-3, 9-3 and 12-3 strategy, for each individual country. Cumulative return exhibits the value of an investment from 2004:01 to 2017:12 in the zero-cost portfolios, given a NOK 1 investment

6.4.5 Source of optionality

By running regression (3) on the past loser and winner portfolio, we were able to identify the primary source of the optionality in the zero-cost portfolio. The 3-3 strategy does not exhibit significant optionality as found in chapter 6.4.1, but it reveals the same pattern as the other strategies.

First, recall that the $\hat{\beta}_{B,U}$ coefficient imply the difference in the market beta in bear markets when the contemporaneous market return is positive. Hence, the negative significant $\hat{\beta}_{B,U}$ for winners suggests that the market beta is lower in this state. Note that both ($\hat{\beta}_0 + \hat{\beta}_B$) and ($\hat{\beta}_0 + \hat{\beta}_B + \hat{\beta}_{B,U}$) are positive but ($\hat{\beta}_0 + \hat{\beta}_B$) > ($\hat{\beta}_0 + \hat{\beta}_B + \hat{\beta}_{B,U}$) for all strategies. That is, the past winners fell in tandem with the market and it also increased when the market rebounds, but in a smaller scale since the market beta is much lower.

Second, the $\hat{\beta}_{B,U}$ coefficient is always larger for the past losers than winners. Hence, despite the lack of significance it is the largest attribute to the option-like behaviour in the zero-cost portfolio. Note that ($\hat{\beta}_0 + \hat{\beta}_B$) and ($\hat{\beta}_0 + \hat{\beta}_B + \hat{\beta}_{B,U}$) is always positive but ($\hat{\beta}_0 + \hat{\beta}_B$) < ($\hat{\beta}_0 + \hat{\beta}_B + \hat{\beta}_{B,U}$). That is, the past losers fell in tandem with the market and increased when the market rebounds, but in a larger scale since the market beta is much higher.

Table 7: Source of optionality – Nordic

Coef	Bear market			Coef	Bull market		
	Loser	Winner	Z-C		Loser	Winner	Z-C
Panel A: 3-3							
$\hat{\alpha}_0$	-0.93**	0.49**	1.42***	$\hat{\alpha}_0$	-1.33	-0.89	0.44
	(-2.59)	(2.60)	(3.18)		(-1.25)	(-1.60)	(0.43)
$\hat{\alpha}_B$	-0.02	-0.01	0.01	$\hat{\alpha}_L$	0.00	0.02**	0.01
	(-1.16)	(-1.12)	(0.60)		(0.38)	(2.43)	(0.93)
$\hat{\beta}_0$	1.04***	0.91***	0.13	$\hat{\beta}_0$	1.29***	0.92***	-0.37***
	(10.21)	(17.04)	(-1.33)		(8.56)	(11.70)	(-2.58)
$\hat{\beta}_B$	-0.05	0.07	0.12	$\hat{\beta}_L$	-0.25	0.05	0.30
	(-0.15)	(0.43)	(0.40)		(-0.98)	(0.36)	(1.23)

$\hat{\beta}_{B,U}$	0.58	-0.13	-0.70	$\hat{\beta}_{L,U}$	-0.01	-0.11	-0.11
	(1.16)	(-0.49)	(-1.50)		(-0.03)	(-0.66)	(0.34)
Panel B: 6-3							
$\hat{\alpha}_0$	-1.09***	0.64***	1.73***	$\hat{\alpha}_0$	-0.42	-1.09**	-0.67
	(-2.82)	(3.28)	(4.51)		(-0.37)	(-1.84)	(-0.57)
$\hat{\alpha}_B$	-0.02	0.00	0.02	$\hat{\alpha}_L$	-0.00	0.02***	0.02
	(-0-92)	(0.35)	(1.11)		(-0.28)	(2.69)	(1.64)
$\hat{\beta}_0$	1.01***	0.90***	-0.12	$\hat{\beta}_0$	1.27***	0.70***	-0.58***
	(9.20)	(16.08)	(-1.07)		(7.79)	(8.29)	(-3.47)
$\hat{\beta}_B$	-0.18	0,17	0.35	$\hat{\beta}_L$	-0.17	0.25*	0.42
	(-0.54)	(0.99)	(0.35)		(-0.61)	(1.72)	(1.47)
$\hat{\beta}_{B,U}$	0.86	-0.74**	-1.60***	$\hat{\beta}_{L,U}$	-0.18	-0.09	0.08
	(1.61)	(-2.46)	(-3.01)		(-0.49)	(-0.50)	(0.23)
Panel C: 9-3							
$\hat{\alpha}_0$	-1.19***	0.70***	1.89***	$\hat{\alpha}_0$	-0.70	-0.91	-0.21
	(-3.01)	(3.63)	(4.81)		(-0.59)	(-1.53)	(-0.17)
$\hat{\alpha}_B$	-0.02	0.01	0.03	$\hat{\alpha}_L$	-0.00	0.01**	0.02
	(-0.86)	(1.19)	(1.45)		(-0.16)	(2.04)	(1.16)
$\hat{\beta}_0$	1.02***	0.94	-0.07	$\hat{\beta}_0$	1.24***	0.63***	-0.61***
	(9.03)	(17.31)	(-0.67)		(7.43)	(7.50)	(-3.61)
$\hat{\beta}_B$	-0.18	0.17	0.34	$\hat{\beta}_L$	-0.14	0.25*	0.39
	(-0.50)	(1.97)	(0.99)		(-0.48)	(1.74)	(1.33)
$\hat{\beta}_{B,U}$	0.96	-0.77***	-1.74***	$\hat{\beta}_{L,U}$	-0.17	0.12	0.29
	(1.41)	(-3.64)	(-3.20)		(-0.46)	(0.65)	(0.77)
Panel D: 12-3							
$\hat{\alpha}_0$	-1.17***	0.69**	1.86***	$\hat{\alpha}_0$	-0.89	-0.99*	-0.10
	(-2.87)	(3.62)	(4.63)		(-0.73)	(-1.70)	(-0.09)
$\hat{\alpha}_B$	-0.02	0.01	0.03	$\hat{\alpha}_L$	0.00	0.01**	0.01
	(-1.00)	(1.16)	(1.57)		(0.03)	(2.21)	(1.03)
$\hat{\beta}_0$	0.99***	0.97***	-0.01	$\hat{\beta}_0$	1.24**	0.64***	-0.60***
	(8.50)	(18.08)	(-0.10)		(7.21)	(7.76)	(-3.40)
$\hat{\beta}_B$	-0.17	0.16	0.33	$\hat{\beta}_L$	-0.16	0.28*	0.43
	(-0.46)	(0.95)	(0.92)		(0.53)	(1.94)	(0.46)
$\hat{\beta}_{B,U}$	0.98	-0.81***	-1.79***	$\hat{\beta}_{L,U}$	-0.20	0.10	0.29

(1.44)	(-3.73)	(-3.23)	(-0.52)	(0.54)	(0.78)

Note: This table presents results from the following regressions, run from 2004:01 to 2017:12: $\tilde{r}_{i,t} = (\hat{\alpha}_0 + \hat{\alpha}_B I_{B,t-1}) + [\hat{\beta}_0 + I_{B,t-1}(\hat{\beta}_B + I_{U,t})]\, \tilde{r}_{m,t} + \tilde{u}_t$ to test for optionality in bear markets and $\tilde{r}_{i,t} = (\hat{\alpha}_0 + \hat{\alpha}_L I_{L,t-1}) + [\hat{\beta}_0 + I_{L,t-1}(\hat{\beta}_L + I_{U,t})]\, \tilde{r}_{m,t} + \tilde{u}_t$ to test for optionality in bull markets. $\tilde{r}_{m,t}$ is the market return excess of the risk-free rate and $I_{B,t-1}$ is an ex-ante bear market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is less than zero. $I_{U,t}$ is a up-market indicator that equals one if the contemporaneous market return is positive. $I_{L,t-1}$ is a bull market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is greater than zero and defined as 1- $I_{B,t-1}$. $\hat{\alpha}_0$ is in percent and the zero-cost portfolio is denoted Z-C.

Due to the short position in the past losers the net effect is that the zero-cost portfolio exhibit significant optionality and performs poorly when the market rebound after bear markets. This net effect was plotted in Figure 5, but a more detailed illustration is found in Figure A.8 in the Appendix. Consistent with Daniel and Moskowitz (2016), the insignificant $\hat{\beta}_{L,U}$ coefficient imply that the option-like behaviour of the zero-cost portfolio is not present in bull markets.

The $\hat{\beta}_{L,U}$ coefficient is not significant for any country. The pattern in the past loser and winner portfolios is also found for the 6-3, 9-3 and 12-3 strategy for each individual country. There is a large dispersion in level of significance, but the same pattern occurs. This can be seen in Table A.14 to A.17 in the Appendix.

7.0 Conclusion

Trading strategies that buy past winners and sell past losers in the Nordic stock market over the period 2004:01 to 2017:12 generate positive significant returns. Momentum strategies provide investors with a high risk-reward relationship, but also returns that are negatively skewed. The 16 momentum portfolios, constructed consistent with Jegadeesh and Titman (1993), are driven by the past winners and also profitable when conducted on each individual country. We emphasize the 12-3 strategy to make our results more comparable to Daniel and Moskowitz (2016). In addition, we examine the 3-3, 6-3 and 9-3 strategies to strengthen our results.

The momentum returns experienced severe drawdowns following the financial crisis and consistent with Daniel and Moskowitz (2016), these crashes originate from an upward crash in the past loser portfolio in the wake of the financial crisis. We find that these crashes can be explained by time variation in exposure to systematic factors for the Nordic sample and for each individual country as well. The large difference in down- and up-market betas for the past winner and loser portfolio, in bear markets, shows that both portfolios are positively affected when the market rebounds. The past loser portfolio has the largest loading on the market factor but the difference in beta is not statistically significant. However, the net effect is that the zero-cost portfolio, which is long past winners and short past losers, exhibit option-like behaviour with significant negative market exposure when the market increase in a rapid pace, and therefore suffering large losses that is attributable to the past losers.

Hence, we can conclude that significant crashes occurred in the Nordic stock market after the financial crisis. The crashes are different in magnitude from the US, but they are still large as they take between 2-3 years to recover from. We can also conclude that these crashes can be explained by the dynamic risk exposure to the market because the mechanisms of momentum strategies lead to a low-beta portfolio with past winners and high-beta portfolio with past losers, following large market declines.

We recognize the limitation of our chosen sample length. For further research it would be interesting to investigate a longer sample and include the 1987 bank crisis

and the dot com bubble. Another implication to further research would be to investigate the dynamic risk exposure for other types of momentum strategies.

References

Avramov, D., Cheng, S., & Hameed, A. (2013). Time-varying momentum payoffs and illiquidity. *Available at SSRN*.

Barberis, N., Shleifer, A., & Vishny, R. (1998). A model of investor sentiment1. *Journal of financial economics*, *49*(3), 307-343.

Barroso, P., & Santa-Clara, P. (2015). Momentum has its moments. *Journal of Financial Economics*, *116*(1), 111-120.

Bodie, Z., Kane, A., & Marcus, A. J. (2011). *Investment and portfolio management*. McGraw-Hill Irwin.

Bowman, K. O., & Shenton, L. R. (1975). Omnibus test contours for departures from normality based on√ b 1 and b 2. *Biometrika*, *62*(2), 243-250.

Brooks, C. (2014). *Introductory econometrics for finance*. Cambridge university press.

Brown, S. J., Goetzmann, W., Ibbotson, R. G., & Ross, S. A. (1992). Survivorship bias in performance studies. *The Review of Financial Studies*, *5*(4), 553-580.

Chopra, N., Lakonishok, J., & Ritter, J. R. (1992). Measuring abnormal performance: do stocks overreact?. *Journal of financial Economics*, *31*(2), 235-268.

Chordia, T., Subrahmanyam, A., & Tong, Q. (2013). Trends in capital market anomalies. *Unpublished working paper, Emory University, UCLA, Singapore Management University*.

Chui, A., Wei, K. C., & Titman, S. (2000). Momentum, legal systems and ownership structure: An analysis of Asian stock markets.

Conrad, J., & Kaul, G. (1998). An anatomy of trading strategies. *The Review of Financial Studies*, *11*(3), 489-519

Cooper, M. J., Gutierrez Jr, R. C., & Hameed, A. (2004). Market states and momentum. *The Journal of Finance*, *59*(3), 1345-1365.

Daniel, K., Hirshleifer, D., & Subrahmanyam, A. (1998). Investor psychology and security market under-and overreactions. *the Journal of Finance*, *53*(6), 1839-1885.

Daniel, K., & Moskowitz, T. J. (2016). Momentum crashes. *Journal of Financial Economics*, *122*(2), 221-247.

Fama, E. F., & French, K. R. (1992). The cross-section of expected stock returns. *the Journal of Finance*, *47*(2), 427-465.

Fama, E. F., & French, K. R. (2004). The capital asset pricing model: Theory and evidence. *Journal of economic perspectives*, *18*(3), 25-46.

Griffin, J. M., Ji, X., & Martin, J. S. (2003). Momentum investing and business cycle risk: Evidence from pole to pole. *The Journal of Finance*, *58*(6), 2515-2547.

Griffin, J. M., Ji, X., & Martin, J. S. (2005). Global momentum strategies. *Journal of Portfolio Management*, *31*(2), 23-39.

Grinblatt, M., & Han, B. (2005). Prospect theory, mental accounting, and momentum. *Journal of financial economics*, *78*(2), 311-339.

Grundy, B. D., & Martin, J. S. M. (2001). Understanding the nature of the risks and the source of the rewards to momentum investing. *The Review of Financial Studies*, *14*(1), 29-78.

Hong, H., & Stein, J. C. (1999). A unified theory of underreaction, momentum trading, and overreaction in asset markets. *The Journal of finance*, *54*(6), 2143-2184.

Jarque, C. M., & Bera, A. K. (1987). A test for normality of observations and regression residuals. *International Statistical Review/Revue Internationale de Statistique*, 163-172.

Jegadeesh, N. (1990). Evidence of predictable behavior of security returns. *The Journal of finance*, *45*(3), 881-898.

Jegadeesh, N., & Titman, S. (1993). Returns to buying winners and selling losers: Implications for stock market efficiency. *The Journal of finance*, *48*(1), 65-91.

Jegadeesh, N., & Titman, S. (2001). Profitability of momentum strategies: An evaluation of alternative explanations. *The Journal of finance*, *56*(2), 699-720.

Jensen, M. C. (1968). The performance of mutual funds in the period 1945–1964. *The Journal of finance*, *23*(2), 389-416.

Johnson, T. C. (2002). Rational momentum effects. *The Journal of Finance*, *57*(2), 585-608.

Koller, T., Goedhart, M., & Wessels, D. (2010). *Valuation: measuring and managing the value of companies* (Vol. 499). john Wiley and sons.

Lehmann, B. N. (1990). Fads, martingales, and market efficiency. *The Quarterly Journal of Economics*, *105*(1), 1-28.

Lintner, J. (1965). Security prices, risk, and maximal gains from diversification. *The journal of finance*, *20*(4), 587-615.

Malkiel, B. G., & Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *The journal of Finance*, *25*(2), 383-417.

Markowitz, H. (1952). Portfolio selection. *The journal of finance*, *7*(1), 77-91.

Moskowitz, T. (2010). Explanations for the momentum premium.

Moskowitz, T. J., & Grinblatt, M. (1999). Do industries explain momentum?. *The Journal of Finance*, *54*(4), 1249-1290.

Mossin, J. (1966). Equilibrium in a capital asset market. *Econometrica: Journal of the econometric society*, 768-783.

Rollinger, T., & Hoffman, S. (2013). Sortino ratio: A better measure of risk. *Futures Magazine*, *1*(02).

Rouwenhorst, K. G. (1998). International momentum strategies. *The Journal of Finance*, *53*(1), 267-284.

Rouwenhorst, K. G. (1999). Local return factors and turnover in emerging stock markets. *The journal of finance*, *54*(4), 1439-1464.

Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The journal of finance*, *19*(3), 425-442.

Sharpe, W. F. (1966). Mutual fund performance. *The Journal of business*, *39*(1), 119-138.

Shefrin, H., & Statman, M. (1985). The disposition to sell winners too early and ride losers too long: Theory and evidence. *The Journal of finance*, *40*(3), 777-790.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *science*, *185*(4157), 1124-1131.

Zhang, H. (2004). Dynamic Beta, Time-Varying Risk Premium, and Momentum.

Ødegaard, B.A. (2018). Empirics of the Oslo Stock Exchange. Basic, descriptive, results 1980-2017

Appendices

Tables

***Table A.1**:* Momentum returns – individual countries

Panel A: Denmark

		Momentum returns			
J	K=	3	6	9	12
3	Winner	1.35	1.12	1.12	1.09
3	Loser	0.35	0.32	0.28	0.35
3	Zero-cost	1.01*	0.8*	0.85**	0.74**
		(1.87)	(1.86)	(2.24)	(2.03)
6	Winner	1.47	1.45	1.19	1.34
6	Loser	0.18	0.07	0.14	0.32
6	Zero-cost	1.29**	1.38**	1.20**	0.87*
		(2.07)	(2.55)	(2.41)	(1.85)
9	Winner	1.45	1.32	1.21	1.10
9	Loser	-0.03	-0.07	0.14	0.23
9	Zero-cost	1.47**	1.39**	1.08**	0.87*
		(2.27)	(2.38)	(1.99)	(1.73)
12	Winner	1.47	1.34	1.23	1.07
12	Loser	-0.16	0.04	0.16	0.24
12	Zero-cost	1.63**	1.31**	1.07*	0.82
		(2.43)	(2.18)	(1.90)	(1.52)

Panel B: Finland

		Momentum returns			
J	K=	3	6	9	12
3	Winner	0.86	0.92	0.86	0.78
3	Loser	0.01	0.04	0.01	0.06
3	Zero-cost	0.76**	0.88****	0.85***	0.71***
		(2.02)	(2.91)	(3.12)	(2.98)
6	Winner	0.91	0.89	0.82	0.76
6	Loser	0.13	-0.01	0.02	0.14
6	Zero-cost	0.786*	0.90**	0.79**	0.62**
		(1.89)	(2.49)	(2.45)	(2.08)
9	Winner	0.86	0.72	0.67	0.59
9	Loser	-0.01	-0.12	-0.01	0.12
9	Zero-cost	0.88**	0.84**	0.68*	0.47
		(2.03)	(2.24)	(1.93)	(1.41)
12	Winner	0.87	0.76	0.70	0.66
12	Loser	-0.02	-0.01	0.09	0.18
12	Zero-cost	0.89**	0.77*	0.61	0.49
		(2.06)	(1.94)	(1.59)	(1.32)

Panel C: Norway

		Momentum returns			
J	K=	3	6	9	12
3	Winner	1.55	1.32	1.24	1.15
3	Loser	-0.23	0.08	0.17	0.20
3	Zero-cost	1.78***	1.24**	1.08**	0.95**
		(2.77)	(2.51)	(2.36)	(2.11)
6	Winner	1.68	1.50	1.32	1.18
6	Loser	-0.02	0.04	0.03	0.15
6	Zero-cost	1.70***	1.46***	1.29**	1.03**
		(2.62)	(2.70)	(2.45)	(1.95)
9	Winner	1.71	1.45	1.25	1.06
9	Loser	-0.08	-0.04	0.09	0.24
9	Zero-cost	1.79***	1.48**	1.16*	0.82
		(2.68)	(2.28)	(1.80)	(1.29)
12	Winner	1.55	1.17	0.96	0.86
12	Loser	-0.31	0.06	0.11	0.20
12	Zero-cost	1.86***	1.11	0.85	0.66
		(2.58)	(1.56)	(1.21)	(0.95)

Panel D: Sweden

		Momentum returns			
J	K=	3	6	9	12
3	Winner	1.34	1.27	1.23	1.17
3	Loser	0.33	0.37	0.44	0.46
3	Zero-cost	1.01***	0.90***	0.79***	0.72***
		(3.61)	(3.66)	(3.36)	(3.75
6	Winner	1.45	1.38	1.31	1.17
6	Loser	0.28	0.29	0.35	0.41
6	Zero-cost	1.17***	1.08***	0.96***	0.76***
		(3.45)	(3.71)	(3.72)	(3.24)
9	Winner	1.43	1.32	1.23	1.17
9	Loser	0.16	0.18	0.28	0.37
9	Zero-cost	1.27***	1.14***	0.95***	0.80***
		(3.57)	(3.62)	(3.37)	(3.06)
12	Winner	1.44	1.31	1.21	1.13
12	Loser	0.13	0.23	0.34	0.40
12	Zero-cost	1.31***	1.08***	0.87***	0.73***
		(3.77)	(3.41)	(2.98)	(2.67)

Note: This table presents the monthly average returns from 16 different momentum portfolios with overlapping holding periods, implemented on the Nordic stock market from 2004:01 to 2017:12. The stocks are ranked in ascending order and divided into deciles based on J-months lagged returns. The zero-cost portfolio is formed one month after the end of the formation period by selling the bottom decile (losers) and buying the top decile (winners), then held for K months. Level of significance is denoted by (*), (**) and (***) for 10%, 5% and 1% respectively and t-statistics are in parenthesis.

Table A.2 Descriptive statistic – Individual countries

Panel A: Denmark

	Momentum portifolios				Market
	3-3	6-3	9-3	12-3	
r-rf	0.81	1.09	1.28	1.43	0.82
σ (%)	6.97	8.08	8.43	8.70	4.83
α	0.95	1.45	1.68	1.75	0
t(α)	1.74	2.37	2.64	2.62	0
β	-0.17	-0.44	-0.49	-0.39	1
Sharp Ratio	0.12	0.13	0.15	0.16	0.17
MaxDD (%)	50.03	58.26	68.11	71.89	49.83
MDDur (mnt)	10	13	8	14	22
Skewness	-1.26	-1.08	-1.42	-1.33	0.02
Kurtosis	9.01	6.39	7.18	6.68	4.62
Jarque-Bera	297.03	113.07	178.27	144.92	18.41
p-value (JB)	0.00	0.00	0.00	0.00	0.00

Panel B: Finland

	Momentum portifolios				Market
	3-3	6-3	9-3	12-3	
r-rf	0.56	0.58	0.68	0.69	0.77
σ (%)	4.85	5.34	5.62	5.62	5.15
α	0.61	0.60	0.74	0.75	0
t(α)	1.61	1.43	1.69	1.70	0
β	-0.06	-0.03	-0.08	-0.07	1
Sharp Ratio	0.12	0.11	0.12	0.12	0.15
MaxDD (%)	43.28	43.11	44.42	48.61	48.82
MDDur (mnt)	6	56	39	11	20
Skewness	-0.73	-0.72	-0.79	-0.72	-0.09
Kurtosis	4.71	4.15	5.17	5.31	4.59
Jarque-Bera	35.37	23.84	50.56	52.55	17.90
p-value (JB)	0.00	0.00	0.00	0.00	0.00

Panel C: Norway

	Momentum portifolios				Market
	3-3	6-3	9-3	12-3	
r-rf	1.58	1.51	1.59	1.66	1.07
σ (%)	8.33	8.42	8.64	9.32	4.97
α	2.31	2.18	2.18	2.29	0
t(α)	3.58	3.32	3.21	3.12	0
β	-0.42	-0.38	-0.32	-0.34	1
Sharp Ratio	0.19	0.18	0.18	0.18	0.22
MaxDD (%)	50.25	47.03	49.36	53.36	44.56
MDDur (mnt)	2	4	13	1	13
Skewness	-1.58	-0.77	-1.48	-1.77	-0.84
Kurtosis	10.15	4.67	9.48	10.96	5.55
Jarque-Bera	428.38	36.49	355.97	530.92	65.13
p-value (JB)	0.00	0.00	0.00	0.00	0.00

Panel D: Sweden

	Momentum portifolios				Market
	3-3	6-3	9-3	12-3	
r-rf	0.82	0.97	1.07	1.12	0.97
σ (%)	3.64	4.38	4.61	4.51	3.98
α	1.01	1.21	1.33	1.37	0
t(α)	3.60	3.56	3.75	3.94	0
β	-0.21	-0.26	-0.28	-0.28	1
Sharp Ratio	0.22	0.22	0.23	0.25	0.23
MaxDD (%)	32.00	41.07	40.95	38.23	41.19
MDDur (mnt)	4	14	9	9	22
Skewness	-0.89	-1.75	-1.65	-1.51	-0.31
Kurtosis	5.73	10.21	10.90	10.32	3.64
Jarque-Bera	74.61	448.68	513.75	439.24	5.70
p-value (JB)	0.00	0.00	0.00	0.00	0.06

Note: This table presents descriptive statistics for the monthly momentum portfolios excess return (r-rf). Standard deviation (σ) and sharp ratio are monthly measures. The α, t(α) and β are estimated from fitting an unconditional capital asset pricing model (CAPM) to the excess momentum returns. MaxDD is the maximum drawdown (in %) of the cumulative return and MDDur is the duration of the drawdowns in number of months.

Table A.3: Split-sample – Nordic

Portifolio	Sub-sample			Total
	Pre	Crisis	Post	
Panel A: 3-3				
Winner	3.13	-0.39	1.22	1.28
Loser	1.92	-1.39	0.04	0.14
Zero-cost	1.21***	1.00	1.18***	1.14***
(t-stat)	(2.92)	(1.26)	(2.88)	(3.82)
Panel B: 6-3				
Winner	3.32	-0.49	1.37	1.39
Loser	1.61	-1.16	-0.13	0.02
Zero-cost	1.71***	0.67	1.50***	1.36***
(t-stat)	(3.26)	(0.62)	(3.43)	(3.85)
Panel C: 9-3				
Winner	3.41	-0.46	1.47	1.47
Loser	1.78	-1.35	-0.29	-0.07
Zero-cost	1.63***	-0.89	1.78***	1.55***
(t-stat)	(2.96)	(0.85)	(3.85)	(4.27)
Panel C: 12-3				
Winner	2.79	-0.44	1.55	1.39
Loser	1.48	-1.49	-0.28	-0.16
Zero-cost	1.31**	1.05	1.84***	1.55***
(t-stat)	(2.32)	(0.98)	(3.91)	(4.20)

Note: this table presents the average monthly return for the past winner and loser portfolios and the zero-cost portfolio, with different combinations of formations period (J) and holding period (K), in different split samples. Where pre-crisis (2003-2006), crisis (2007-2009) and post-crisis (2010-2017).

Table A.4: Split-sample – Each individual country

Denmark				
Portifolio	Sub-sample			Total
	Pre	Crisis	Post	
Panel A: 3-3				
Winner	4.11	-0.82	1.13	1.35
Loser	3.05	-1.99	0.18	0.35
Zero-cost	1.07	1.10	0.95	1.01*
(t-stat)	(1.05)	(0.65)	(1.61)	(1.87)
Panel B: 6-3				
Winner	3.88	-1.23	1.59	1.47
Loser	2.95	-1.95	-0.05	0.18
Zero-cost	0.93	0.72	1.64***	1.29**
(t-stat)	(0.85)	(0.35)	(2.43)	(2.07)
Panel C: 9-3				
Winner	3.82	-1.68	1.73	1.45
Loser	2.92	-2.24	-0.30	-0.03
Zero-cost	0.90	0.55	2.03***	1.47**
(t-stat)	(0.84)	(0.26)	(2.91)	(2.27)
Panel D: 12-3				
Winner	3.71	-1.84	1.88	1.47
Loser	2.70	-2.05	-0.52	-0.16
Zero-cost	1.01	0.21	2.40***	1.63**
(t-stat)	(0.99)	(0.09)	(3.38)	(2.43)

Finland				
Portifolio	Sub-sample			Total
	Pre	Crisis	Post	
Panel A: 3-3				
Winner	2.03	-0.53	0.95	0.86
Loser	0.66	-0.40	0.09	0.01
Zero-cost	1.37***	-0.13	0.86*	0.76**
(t-stat)	(2.33)	(-0.12)	(1.83)	(2.02)
Panel B: 6-3				
Winner	2.09	-0.54	1.00	0.91
Loser	0.58	-0.60	0.23	0.13
Zero-cost	1.51**	0.07	0.77	0.79*
(t-stat)	(2.04)	(0.07)	(1.38)	(1.98)
Panel C: 9-3				
Winner	1.78	-0.86	1.17	0.86
Loser	0.71	-0.88	0.04	-0.01
Zero-cost	1.07	0.02	1.13*	0.88**
(t-stat)	(1.44)	(0.02)	(1.91)	(2.03)
Panel D: 12-3				
Winner	1.48	-0.70	1.23	0.87
Loser	0.37	-0.29	-0.07	-0.02
Zero-cost	1.11*	-0.41	1.30**	0.89**
(t-stat)	(1.44)	(0.02)	(1.91)	(2.06)

Norway				
Portifolio	Sub-sample			Total
	Pre	Crisis	Post	
Panel A: 3-3				
Winner	4.20	0.18	1.07	1.55
Loser	3.14	-2.26	-0.73	-0.23
Zero-cost	1.06	2.44*	1.80*	1.78***
(t-stat)	(1.10)	(1.85)	(1.90)	(2.77)
Panel B: 6-3				
Winner	4.54	0.17	1.18	1.68
Loser	2.13	-1.25	-0.37	-0.02
Zero-cost	2.40**	1.41	1.55*	1.70***
(t-stat)	(2.24)	(0.91)	(1.73)	(2.62)
Panel C: 9-3				
Winner	3.99	0.21	1.41	1.71
Loser	2.32	-0.81	-0.71	-0.08
Zero-cost	1.67*	1.02	2.12**	1.79***
(t-stat)	(1.78)	(0.64)	(2.25)	(2.68)
Panel D: 12-3				
Winner	2.97	0.39	1.45	1.55
Loser	2.53	-1.84	-0.80	-0.31
Zero-cost	0.44	2.23	2.25**	1.86***
(t-stat)	(0.46)	(1.41)	(2.13)	(2.58)

Sweden				
Portifolio	Sub-sample			Total
	Pre	Crisis	Post	
Panel A: 3-3				
Winner	2.58	-0.18	1.45	1.34
Loser	1.90	-0.81	0.47	0.33
Zero-cost	1.50***	0.63	0.98***	1.01***
(t-stat)	(3.32)	(0.78)	(2.78)	(3.61)
Panel B: 6-3				
Winner	2.81	-0.50	1.67	1.45
Loser	1.38	-0.60	0.20	0.28
Zero-cost	1.42**	0.10	1.47***	1.17***
(t-stat)	(2.12)	(0.10)	(3.78)	(3.45)
Panel C: 9-3				
Winner	2.84	-0.35	1.56	1.43
Loser	1.52	-0.75	-0.01	0.16
Zero-cost	1.32*	0.40	1.58***	1.27***
(t-stat)	(1.82)	(0.38)	(3.99)	(3.57)
Panel D: 12-3				
Winner	2.17	-0.08	1.74	1.44*
Loser	0.94	-0.74	0.15	0.13
Zero-cost	1.23	0.66	1.59***	1.31***
(t-stat)	(1.63)	(0.63)	(4.26)	(3.77)

Note: this table presents the average monthly return for the past winner and loser portfolios and the zero-cost portfolio, with different combinations of formations period (J) and holding period (K), in different split samples. Where pre-crisis (2003-2006), crisis (2007-2009) and post-crisis (2010-2017).

Table A.5: 15 most extreme losses – Nordic

3-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2017:01	-12.03	2.89	14.93	18.25	0.27
2	2009:04	-11.00	12.44	23.45	-26.02	15.44
3	2013:01	-10.30	7.44	17.75	5.80	6.06
4	2012:01	-9.25	6.46	15.71	15.44	4.54
5	2003:09	-9.05	8.74	17.78	-11.52	-2.23
6	2009:05	-8.06	8.48	16.54	-20.93	7.49
7	2009:01	-7.91	-4.01	3.90	-35.61	-5.92
8	2009:03	-7.22	-2.10	5.12	-36.37	4.29
9	2010:01	-6.79	2.48	9.27	12.10	0.81
10	2011:10	-5.40	0.20	5.60	15.31	6.64
11	2008:06	-5.30	-3.08	2.22	15.63	-8.37
12	2015:04	-5.19	-0.70	4.49	45.07	-2.11
13	2008:04	-5.14	-0.76	4.38	16.35	4.34
14	2004:09	-4.79	5.25	10.03	5.23	4.17
15	2003:08	-4.38	5.94	10.32	-9.15	2.89

6-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2009:04	-19.56	4.68	24.23	-26.02	15.44
2	2003:09	-18.10	8.04	26.14	-11.52	-2.23
3	2009:05	-15.05	7.13	22.19	-20.93	7.49
4	2012:01	-14.30	4.22	18.51	15.44	4.54
5	2009:03	-9.96	-4.26	5.71	-36.37	4.29
6	2013:01	-9.29	7.64	16.93	5.80	6.06
7	2017:01	-9.13	3.28	12.42	18.25	0.27
8	2008:04	-8.14	0.30	8.44	16.35	4.34
9	2009:01	-8.02	-3.30	4.72	-35.61	-5.92
10	2015:04	-7.33	-1.24	6.10	45.07	-2.11
11	2016:12	-6.39	5.36	11.75	22.05	5.81
12	2006:01	-6.34	7.08	13.41	48.10	4.74
13	2004:09	-5.36	5.44	10.80	5.23	4.17
14	2010:01	-5.04	2.77	7.80	12.10	0.81
15	2016:03	-4.30	4.21	8.51	26.58	0.61

9-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2009:04	-19.00	3.88	22.88	-26.02	15.44
2	2009:05	-18.18	5.24	20.41	-20.93	7.49
3	2012:01	-12.97	4.42	17.39	15.44	4.54
4	2013:12	-9.81	6.77	16.58	45.46	2.29
5	2017:01	-9.63	2.15	11.78	18.25	0.27
6	2009:03	-9.22	-3.00	6.22	-36.37	4.29
7	2006:01	-7.79	7.67	15.45	48.10	4.74
8	2016:12	-7.07	6.39	13.46	22.05	5.81
9	2016:04	-6.90	-0.10	6.79	24.58	-0.67
10	2015:04	-6.75	-0.69	6.06	45.07	-2.11
11	2009:01	-6.62	-1.84	4.79	-35.61	-5.92
12	2016:03	-6.21	3.51	9.71	26.58	0.61
13	2008:04	-5.77	1.17	6.94	16.35	4.34
14	2008:06	-5.07	-4.73	0.34	15.63	-8.37
15	2008:01	-4.85	-10.08	-5.22	18.25	-10.47

12-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2009:04	-18.58	4.42	23.00	-26.02	15.44
2	2009:05	-15.66	4.12	19.78	-20.93	7.49
3	2017:01	-11.77	2.89	14.66	18.25	0.27
4	2013:01	-10.77	7.32	18.09	5.80	6.06
5	2012:01	-9.97	6.77	16.73	15.44	4.54
6	2016:12	-8.40	6.20	14.60	22.05	5.81
7	2009:03	-8.13	-1.99	6.14	-36.37	4.29
8	2016:03	-7.54	2.97	10.51	26.58	0.61
9	2006:01	-7.47	7.55	15.02	48.10	4.74
10	2015:04	-6.97	-0.71	6.26	45.07	-2.11
11	2008:07	-5.96	-5.07	0.89	14.48	-1.43
12	2008:01	-5.85	-9.94	-4.09	18.25	-10.47
13	2009:01	-5.01	-0.49	4.51	-35.61	-5.92
14	2008:04	-4.97	1.55	6.52	16.35	4.34
15	2016:04	-4.84	0.86	5.70	24.58	-0.67

Note: This table presents the 15 most extreme monthly losses, between 2004:01 and 2017:12

Table A.6: 15 most extreme losses – Denmark

Panel A: 3-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2008:09	-38.45	-24.16	14.28	-3.03	-10.06
2	2006:01	-17.63	8.06	25.69	30.06	4.16
3	2012:09	-17.03	-1.01	16.02	-16.54	3.30
4	2010:01	-16.96	0.29	17.25	-10.05	5.61
5	2009:04	-15.17	10.23	25.40	-66.98	17.89
6	2012:07	-13.44	1.58	15.03	-15.08	2.34
7	2009:01	-12.85	-9.37	3.48	-45.88	-13.35
8	2014:01	-11.36	9.39	20.75	27.87	9.11
9	2009:03	-10.56	-7.58	2.98	-64.13	-1.86
10	2009:05	-10.38	22.85	33.23	-52.83	16.95
11	2015:04	-9.11	-0.95	8.16	48.72	-3.22
12	2005:12	-8.19	12.62	20.81	49.45	9.06
13	2008:07	-6.75	3.79	10.54	3.82	-1.98
14	2005:01	-6.74	5.18	11.92	50.47	6.37
15	2011:12	-6.66	-0.09	6.57	-14.79	1.92

Panel B: 6-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2009:04	-33.01	0.25	33.26	-66.98	17.89
2	2008:09	-31.31	-17.77	13.54	-3.03	-10.06
3	2009:05	-26.31	9.96	36.27	-52.83	16.95
4	2006:01	-18.40	6.18	24.58	30.06	4.16
5	2010:01	-17.91	1.23	19.14	-10.05	5.61
6	2012:07	-15.90	0.46	16.35	-15.08	2.34
7	2005:01	-14.87	4.87	19.74	50.47	6.37
8	2012:09	-13.03	1.27	14.30	-16.54	3.30
9	2009:01	-12.25	-8.68	3.57	-45.88	-13.35
10	2015:04	-12.25	-2.00	10.24	48.72	-3.22
11	2017:01	-10.72	10.26	20.97	8.46	5.82
12	2016:07	-10.01	5.92	15.92	2.82	3.55
13	2009:08	-9.45	7.19	16.64	-36.09	5.86
14	2016:02	-8.98	-3.37	5.62	13.16	-3.96
15	2008:04	-8.93	-1.81	7.12	-4.34	1.24

Panel C: 9-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2009:05	-38.64	4.38	43.01	-52.83	16.95
2	2009:04	-33.29	-0.75	32.54	-66.98	17.89
3	2008:09	-25.82	-14.00	11.81	-3.03	-10.06
4	2010:01	-19.54	1.79	21.32	-10.05	5.61
5	2006:01	-18.73	5.07	23.80	30.06	4.16
6	2017:01	-14.57	6.12	20.69	8.46	5.82
7	2009:01	-14.13	-9.12	5.01	-45.88	-13.35
8	2009:08	-13.71	1.52	15.23	-36.09	5.86
9	2005:01	-13.47	-5.12	18.58	50.47	6.37
10	2015:04	-12.95	-1.59	11.36	48.72	-3.22
11	2014:01	-12.34	10.04	22.38	27.87	9.11
12	2012:07	-11.74	1.54	13.28	-15.08	2.34
13	2013:05	-11.18	1.98	13.16	-29.50	-0.04
14	2012:01	-10.92	3.21	14.13	-13.63	5.29
15	2012:09	-10.64	0.50	11.14	-16.54	3.30

Panel D: 12-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2009:05	-36.69	4.07	40.75	-52.83	16.95
2	2008:09	-34.18	-21.47	12.70	-3.03	-10.06
3	2009:04	-28.56	-0.78	27.71	-66.98	17.89
4	2008:07	-19.44	-7.51	11.93	3.82	-1.98
5	2010:01	-18.87	3.15	22.02	-10.05	5.61
6	2009:08	-17.74	-1.47	16.27	-36.09	5.86
7	2013:05	-16.71	1.71	18.42	-29.50	-0.04
8	2009:01	-15.22	-9.69	5.53	-45.88	-13.35
9	2006:01	-14.64	7.37	22.01	30.06	4.16
10	2009:03	-12.34	-10.20	2.14	-64.13	-1.86
11	2014:01	-11.83	10.37	22.20	27.87	9.11
12	2015:04	-11.82	-1.03	10.79	48.72	-3.22
13	2012:07	-11.73	2.15	13.88	-15.08	2.34
14	2012:01	-10.17	4.74	14.92	-13.63	5.29
15	2013:08	-9.94	0.69	10.63	-11.17	9.34

Note: This table presents the 15 most extreme monthly losses, between 2004:01 and 2017:12

Table A.7: 15 most extreme losses – Finland

Panel A: 3-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2009:04	-19.92	11.11	31.04	-27.52	17.77
2	2009:01	-12.97	-7.31	5.66	-34.35	-7.72
3	2008:12	-11.84	0.30	12.14	-23.70	-0.21
4	2014:01	-11.03	-1.11	9.92	24.70	-0.87
5	2012:01	-10.33	6.35	16.68	16.38	9.42
6	2014:04	-10.02	-0.01	10.01	10.80	1.30
7	2011:10	-9.75	0.04	9.79	13.31	5.85
8	2012:08	-8.98	-0.03	8.95	-0.93	1.62
9	2008:01	-7.35	-6.40	0.95	44.67	-5.56
10	2011:08	-7.23	-8.90	-1.67	21.68	-9.38
11	2009:03	-6.75	-10.85	-4.11	-40.63	-3.35
12	2008:02	-5.79	-1.71	4.08	43.06	9.23
13	2016:01	-5.71	-3.92	1.79	21.30	-3.83
14	2004:06	-5.55	4.24	9.79	69.57	6.53
15	2011:01	-5.54	1.62	7.15	61.55	3.38

Panel B: 6-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2012:01	-18.02	1.94	19.96	16.38	9.42
2	2009:04	-16.01	4.26	20.27	-27.52	17.77
3	2014:04	-15.70	-0.20	15.50	10.80	1.30
4	2012:08	-14.57	0.10	14.67	-0.93	1.62
5	2009:01	-12.07	-7.67	4.40	-34.35	-7.72
6	2008:12	-11.15	3.79	14.94	-23.70	-0.21
7	2014:01	-10.93	0.00	10.93	24.70	-0.87
8	2015:10	-8.99	0.93	9.92	24.61	5.88
9	2011:08	-8.35	-9.33	-0.99	21.68	-9.38
10	2004:02	-7.94	-1.50	6.44	61.03	2.88
11	2005:03	-7.81	-2.42	5.38	85.01	-3.71
12	2017:08	-6.31	-3.20	3.10	27.46	-0.12
13	2011:01	-6.09	0.90	6.99	61.55	3.38
14	2006:03	-6.07	1.32	7.39	53.33	3.35
15	2015:04	-5.76	-5.04	0.72	28.05	-3.70

Panel C: 9-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2009:04	-23.03	1.70	24.73	-27.52	17.77
2	2012:01	-18.56	1.45	20.01	16.38	9.42
3	2012:08	-15.62	0.28	15.90	-0.93	1.62
4	2014:04	-14.70	0.23	14.93	10.80	1.30
5	2011:08	-10.83	-10.37	0.47	21.68	-9.38
6	2014:01	-10.71	-1.02	9.69	24.70	-0.87
7	2008:12	-10.35	3.25	13.60	-23.70	-0.21
8	2004:02	-8.83	-1.36	7.47	61.03	2.88
9	2004:03	-8.18	-10.71	-2.53	64.17	-6.02
10	2017:08	-8.05	-5.32	2.73	27.46	-0.12
11	2005:03	-7.16	-3.02	4.13	85.01	-3.71
12	2010:01	-6.80	5.45	12.25	-11.22	3.18
13	2015:10	-6.16	2.18	8.34	24.61	5.88
14	2009:01	-4.96	-6.44	-1.48	-34.35	-7.72
15	2015:05	-4.70	3.72	8.41	30.92	2.11

Panel D: 12-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2009:04	-24.97	2.12	27.10	-27.52	15.44
2	2014:04	-16.44	-0.16	16.28	10.80	7.49
3	2012:01	-14.16	1.24	15.40	16.38	0.27
4	2012:08	-12.23	70.82	13.05	-0.93	6.06
5	2008:12	-10.11	2.40	12.51	-23.70	4.54
6	2014:01	-9.96	-1.08	8.88	24.70	5.81
7	2011:08	-9.36	-9.08	0.28	21.68	4.29
8	2008:11	-7.91	-2.15	5.76	-22.51	0.61
9	2016:01	-7.41	-3.85	3.56	21.30	4.74
10	2008:08	-7.35	-2.07	5.28	34.10	-2.11
11	2009:01	-7.15	-4.59	2.56	-34.35	-1.43
12	2008:01	-7.06	-6.83	0.23	44.67	-10.47
13	2004:03	-6.22	-9.71	-3.49	64.17	-5.92
14	2017:05	-5.96	-2.87	3.08	35.23	4.34
15	2017:08	-5.35	-3.31	2.04	27.46	-0.67

Note: This table presents the 15 most extreme monthly losses, between 2004:01 and 2017:12

Table A.8: 15 most extreme losses – Norway

Panel A: 3-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2013:01	-48.62	10.75	59.38	8.57	4.85
2	2017:01	-24.12	0.30	24.42	25.65	1.38
3	2016:12	-17.11	13.34	30.44	25.32	4.99
4	2008:04	-16.83	1.44	18.27	28.28	12.09
5	2009:05	-15.85	9.08	24.93	-15.56	11.05
6	2014:02	-13.15	1.52	14.67	30.53	3.81
7	2004:09	-13.05	8.34	21.40	53.08	8.48
8	2012:01	-12.29	12.64	24.93	9.99	2.55
9	2016:10	-12.28	4.19	16.47	10.55	2.78
10	2004:01	-11.37	14.52	25.89	49.83	7.64
11	2004:12	-10.84	4.91	15.75	57.89	9.37
12	2015:04	-10.84	2.26	13.10	29.72	4.03
13	2008:07	-9.54	-8.70	0.84	25.61	-6.69
14	2017:09	-8.65	2.73	11.38	31.99	5.64
15	2011:01	-8.60	-1.90	6.70	59.62	-0.64

Panel B: 6-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2013:01	-30.05	12.21	42.26	8.57	4.85
2	2008:04	-26.39	2.26	28.66	28.28	12.09
3	2016:12	-23.22	9.47	32.69	25.32	4.99
4	2017:01	-21.54	2.28	23.83	25.65	1.38
5	2009:05	-21.12	7.17	28.29	-15.56	11.05
6	2016:10	-20.53	2.80	23.33	10.55	2.78
7	2012:01	-14.49	9.51	23.01	9.99	2.55
8	2009:03	-11.74	-2.56	9.18	-28.42	3.63
9	2004:09	-11.56	7.36	18.92	-28.42	3.63
10	2014:12	-11.11	7.14	18.26	53.08	8.48
11	2016:03	-10.22	8.12	18.34	7.85	1.93
12	2004:12	-8.88	2.27	11.16	57.89	9.37
13	2009:04	-8.80	5.44	14.24	-22.96	9.70
14	2015:10	-8.57	1.98	10.55	21.51	5.23
15	2014:02	-8.48	1.83	10.31	30.53	3.81

Panel C: 9-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2013:01	-48.04	8.53	56.56	8.57	4.85
2	2009:05	-30.73	0.89	31.62	-15.56	11.05
3	2008:04	-20.32	4.42	24.73	-15.56	11.05
4	2016:12	-17.64	14.80	32.45	25.32	4.99
5	2012:01	-16.05	8.99	25.05	9.99	2.55
6	2009:04	-14.21	3.09	17.31	-22.96	9.70
7	2016:03	-12.34	8.13	20.47	7.85	1.93
8	2014:12	-11.63	9.60	21.23	53.08	8.48
9	2004:12	-9.87	2.89	12.76	57.89	9.37
10	2011:01	-9.58	0.00	9.58	59.62	-0.64
11	2017:12	-9.04	0.83	9.88	31.28	2.44
12	2009:11	-8.86	-0.93	7.93	-9.56	3.99
13	2006:06	-8.45	3.82	4.62	86.06	-0.97
14	2008:03	-8.43	-5.17	3.26	25.28	-3.12
15	2014:02	-8.30	3.90	12.20	30.53	3.81

Panel D: 12-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2013:01	-53.36	6.98	60.34	8.57	4.85
2	2016:12	-36.00	9.50	45.50	25.32	4.99
3	2009:05	-26.06	1.53	27.58	-15.56	11.05
4	2017:01	-20.08	0.07	20.15	25.65	1.38
5	2008:04	-18.77	5.13	23.90	-15.56	11.05
6	2011:01	-16.58	-1.38	15.20	59.62	-0.64
7	2009:04	-14.19	3.43	17.62	-22.96	9.70
8	2014:02	-11.79	3.66	15.45	30.53	3.81
9	2016:03	-11.77	6.00	17.77	7.85	1.93
10	2017:12	-11.03	1.99	13.02	31.28	2.44
11	2015:04	-10.19	0.86	11.06	29.72	4.03
12	2005:11	-9.13	0.70	9.84	77.80	3.63
13	2004:09	-9.09	3.87	12.97	-28.42	3.63
14	2004:12	-8.83	2.14	10.98	57.89	9.37
15	2008:03	-8.81	-5.83	2.98	25.28	-3.12

Note: This table presents the 15 most extreme monthly losses, between 2004:01 and 2017:12

Table A.9: 15 most extreme losses – Sweden

Panel A: 3-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2009:04	-15.52	14.25	29.77	-27.20	14.85
2	2009:03	-10.48	0.82	11.30	-39.59	3.99
3	2012:01	-10.26	3.93	14.19	22.24	3.37
4	2015:11	-8.01	6.65	14.66	46.22	5.03
5	2010:01	-7.86	2.45	10.31	16.28	1.50
6	2004:01	-6.80	18.,04	24.83	47.08	7.87
7	2009:02	-5.44	-7.24	-1.80	-47.92	-1.76
8	2005:09	-5.19	4.01	9.20	43.57	5.82
9	2011:10	-5.02	2.25	7.27	21.87	6.95
10	2009:01	-4.91	-0.74	4.16	-43.51	-5.32
11	2017:02	-4.25	-0.35	3.91	20.17	1.95
12	2011:05	-3.81	-3.66	0.15	53.71	0.20
13	2012:12	-3.43	2.07	5.50	8.64	1.91
14	2008:02	-3.19	0.60	3.80	1.83	3.07
15	2011:12	-3.16	1.67	4.83	20.49	3.14

Panel B: 6-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2009:04	-24.98	6.68	31.66	-27.20	14.85
2	2012:01	-13.21	2.00	15.20	22.24	3.37
3	2009:03	-11.70	0.32	12.02	-39.59	3.99
4	2006:01	-10.46	9.43	19.89	48.34	3.97
5	2014:07	-8.39	-1.09	7.31	47.87	0.63
6	2015:11	-7.83	6.57	14.39	46.22	5.03
7	2010:01	-7.36	1.41	8.78	16.28	1.50
8	2004:09	-5.42	6.51	11.92	51.89	2.25
9	2012:12	-5.18	1.14	6.32	8.64	1.91
10	2005:09	-5.06	3.53	8.60	43.57	5.82
11	2004:01	-4.50	14.64	19.14	47.08	7.87
12	2009:02	-4.46	-6.02	-1.55	-47.92	-1.76
13	2016:03	-4.38	2.64	7.01	31.77	1.62
14	2009:01	-4.25	0.81	5.06	-43.51	-5.32
15	2007:01	-4.07	3.06	7.14	57.21	2.66

Panel C: 9-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2009:04	-27.30	6.09	33.40	-27.20	14.85
2	2006:01	-11.21	8.81	20.02	48.34	3.97
3	2009:03	-9.82	2.50	12.32	-39.59	3.99
4	2012:01	-9.15	3.45	12.60	22.24	3.37
5	2014:07	-8.63	-2.48	6.14	47.87	0.63
6	2015:11	-8.36	6.49	14.85	46.22	5.03
7	2009:08	-7.19	0.44	7.63	-5.77	5.25
8	2016:03	-6.55	2.04	8.59	31.77	1.62
9	2008:01	-6.42	-6.37	0.05	2.73	-6.90
10	2010:01	-5.83	0.49	6.32	16.28	1.50
11	2007:01	-5.73	1.91	7.64	57.21	2.66
12	2012:12	-5.68	0.55	6.23	8.64	1.91
13	2005:09	-5.63	3.25	8.88	43.57	5.82
14	2016:04	-5.52	-1.13	4.39	32.45	-1.10
15	2004:03	-4.73	-4.00	-0.74	48.62	-4.44

Panel D: 12-3

Rank	Month	Zero-cost	Winners	Losers	Mkt-2Y	Mkt
1	2009:04	-25.94	7.57	33.50	-27.20	14.85
2	2006:01	-11.98	7.72	19.70	48.34	3.97
3	2009:03	-10.58	3.42	14.00	-39.59	3.99
4	2014:07	-8.40	-2.13	6.28	47.87	0.63
5	2015:11	-8.38	5.24	13.61	46.22	5.03
6	2005:09	-7.56	1.24	8.80	43.57	5.82
7	2009:08	-6.67	1.64	8.31	-5.77	5.25
8	2005:03	-5.89	1.19	7.07	64.11	-0.23
9	2008:01	-5.86	-6.08	-0.22	2.73	-6.90
10	2016:03	-5.60	2.36	7.96	31.77	1.62
11	2010:01	-5.25	2.16	7.41	16.28	1.50
12	2012:01	-4.93	6.70	11.63	22.24	3.37
13	2011:12	-4.68	1.36	6.04	20.49	3.14
14	2007:01	-4.49	2.00	6.48	57.21	2.66
15	2008:03	-4.34	-1.91	2.43	1.23	0.16

Note: This table presents the 15 most extreme monthly losses, between 2004:01 and 2017:12

Table A.10: Option-like payoff – Denmark

Coefficient	Variable	Estimated coefficients (t-statistics)			
		(1)	(2)	(3)	(4)
Panel A: 3-3 Strategy					
$\hat{\alpha}_0$	1	1.14**	2.08***	2.04***	1.91***
		(1.98)	(3.10)	(3.09)	(3.22)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.03**	-0.01	
			(-2.57)	(-0.45)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.21*	-0.24**	-0.21*	-0.20*
		(-1.79)	(-1.99)	(-1.79)	(-1.75)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.18	0.44	0.50
			(-1.03)	(1.43)	(1.92)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-1.13**	-1.27***
				(-2.43)	(-3.54)
R^2_{adj}		0.0204	0.0517	0.0813	0.0861
Panel B: 6-3 Strategy					
$\hat{\alpha}_0$	1	1.52**	2.35***	2.28***	2.57***
		(2.34)	(3.17)	(3.24)	(4.05)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.03**	0.02	
			(-2.04)	(0.93)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.40***	-0.36***	-0.32**	-0.34***
		(-2.99)	(-2.75)	(-2.51)	(-2.74)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.67***	0.40	0.25
			(-3.60)	(1.24)	(0.89)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-2.01***	-1.70***
				(-4.02)	(-4.45)
R^2_{adj}		0.0488	0.1401	0.2180	0.2187
Panel C: 9-3 Strategy					
$\hat{\alpha}_0$	1	1.76**	2.66***	2.58***	3.05***
		(2.57)	(3.46)	(3.63)	(4.75)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.03**	0.03	
			(-2.15)	(1.53)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.42***	-0.37***	-0.31**	-0.35***
		(-2.96)	(-2.71)	(-2.45)	(-2.77)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.77***	0.63*	0.39**
			(-3.92)	(1.95)	(1.36)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-2.60***	-2.11***
				(-5.19)	(-5.45)
R^2_{adj}		0.0476	0.01542	0.2774	0.2709
Panel D: 12-3 Strategy					
$\hat{\alpha}_0$	1	1.83**	2.60***	2.51***	3.16***
		(2.57)	(3.16)	(3.32)	(4.58)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.02*	0.04*	
			(-1.70)	(1.96)	

$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.35**	-0.33**	-0.26*	-0.31**
		(-2.46)	(-2.21)	(-1.91)	(-2.29)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.64***	0.89**	0.54*
			(-3.07)	(2.54)	(1.78)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-2.83***	-2.16***
				(-5.28)	(-5.19)
R^2_{adj}		0.0315	0.0970	0.2328	0.2184

Note: The monthly time-series regressions run from 2004:01 to 2017:12. Momentum return is the dependent variable. $\tilde{r}_{m,t}$ is the market return excess of the risk-free rate and $I_{B,t-1}$ is an ex-ante bear market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is less than zero. $I_{U,t}$ is a up-market indicator that equals one if the contemporaneous market return is positive. $\hat{\alpha}_0$ is denoted in percent.

Table A.11: Option-like payoff – Finland

Coefficient	Variable	Estimated coefficients (t-statistics)			
		(1)	(2)	(3)	(4)
Panel A: 3-3					
$\hat{\alpha}_0$	1	0.84**	1.05**	1.05**	0.99**
		(2.13)	(2.35)	(2.34)	(2.42)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.01	-0.00	
			(-0.96)	(-0.31)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.09	0.01	0.01	0.01
		(-1.16)	(0.13)	(0.13)	(0.14)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.33**	-0.18	-0.14
			(-1.99)	(-0.66)	(-0.58)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-0.27	-0.34
				(-0.71)	(-1.16)
R^2_{adj}		0.0023	0.0246	0.0215	0.0273
Panel B: 6-3					
$\hat{\alpha}_0$	1	0.80*	0.85*	0.85*	0.94**
		(1.86)	(1.73)	(1.73)	(2.08)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.00	0.01	
			(-0.22)	(0.46)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.07	0.03	0.03	0.03
		(-0.85)	(0.30)	(0.30)	(0.28)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.33*	-0.09	-0.15
			(-1.84)	(-0.32)	(-0.56)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-0.42	-0.31
				(-1.03)	(-0.95)
R^2_{adj}		-0.0017	0.0087	0.0091	0.0142
Panel C: 9-3					
$\hat{\alpha}_0$	1	1.05**	1.19**	1.19**	1.32***

		(2.32)	(2.32)	(2.34)	(2.81)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.01	0.01	
			(-0.56)	(0.64)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.12	0.02	0.02	0.02
		(-1.38)	(0.21)	(0.21)	(0.18)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.47**	-0.05	-0.13
			(-2.50)	(-0.16)	(-0.47)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-0.75*	-0.58*
				(-1.76)	(-1.74)
R^2_{adj}		0.0058	0.0375	0.0507	0.0544
Panel D: 12-3					
$\hat{\alpha}_0$	1	1.03**	1.12**	1.12**	1.32***
		(2.24)	(2.15)	(2.17)	(2.79)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.00	0.01	
			(-0.33)	(1.02)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.10	0.07	0.07	0.07
		(-1.11)	(0.21)	(0.72)	(0.67)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.57***	-0.07	-0.20
			(-3.00)	(-0.23)	(-0.73)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-0.89**	-0.62*
				(-2.08)	(-1.84)
R^2_{adj}		0.0015	0.0482	0.0687	0.0684

Note: The monthly time-series regressions run from 2004:01 to 2017:12. Momentum return is the dependent variable. $\tilde{r}_{m,t}$ is the market return excess of the risk-free rate and $I_{B,t-1}$ is an ex-ante bear market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is less than zero. $I_{U,t}$ is a up-market indicator that equals one if the contemporaneous market return is positive. $\hat{\alpha}_0$ is denoted in percent.

Table A.12: Option-like payoff – Norway

Coefficient	Variable	Estimated coefficients (t-statistics)			
		(1)	(2)	(3)	(4)
Panel A: 3-3					
$\hat{\alpha}_0$	1	2.04***	2.65***	2.65***	2.60***
		(3.64)	(3.70)	(3.69)	(3.71)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.02	-0.01	
			(-0.90)	(-0.34)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.42**	-0.33**	-0.33**	-0.33**
		(-3.22)	(-2.22)	(-2.21)	(-2.21)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.40	-0.31	-0.20
			(-1.27)	(-0.55)	(-0.44)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-0.20	-0.50
				(-0.19)	(-0.85)

R^2_{adj}		0.0571	0.0632	0.0573	0.0627
Panel B: 6-3					
$\hat{\alpha}_0$	1	2.18***	2.58***	2.58***	2.58***
		(3.22)	(3.54)	(3.53)	(3.63)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.03	-0.00	
			(-1.46)	(-0.01)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.39***	-0.31**	-0.31**	-0.31**
		(-2.89	(-2.03)	(-2.03)	(-2.04)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.34	0.12	-0.12
			(-1.04)	(0.21)	(-0.27)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-1.03	-1.04*
				(-0.96)	(-1.76)
R^2_{adj}		0.0453	0.0574	0.0571	0.0637
Panel C: 9-3					
$\hat{\alpha}_0$	1	2.23***	2.79***	2.79***	2.86***
		(3.16)	(3.73)	(3.76)	(3.96)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.04**	0.02	
			(-2.01)	(0.45)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.35**	-0.20	-0.20	-0.21
		(-2.49)	(-1.30)	(-1.32)	(-1.34)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.63*	0.28	0.11
			(-1.91	(0.48)	(0.25)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-2.05*	-1.64***
				(-1.89)	(-2.74)
R^2_{adj}		0.0327	0.0780	0.0934	0.0982
Panel D: 12-3					
$\hat{\alpha}_0$	1	2.35***	2.76***	2.76***	2.92***
		(3.07)	(3.34)	(3.38)	(3.66)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.03	0.04	
			(-1.33)	(0.93)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.36	-0.26	-0.26	-0.27
		(-2.39)	(-1.53)	(-1.55)	(-0.58)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.43	0.64	0.26
			(-1.18)	(1.00)	(0.52)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-2.41**	-1.48**
				(-2.02)	(-2.23)
R^2_{adj}		0.0296	0.0416	0.0607	0.0614

Note: The monthly time-series regressions run from 2004:01 to 2017:12. Momentum return is the dependent variable. $\tilde{r}_{m,t}$ is the market return excess of the risk-free rate and $I_{B,t-1}$ is an ex-ante bear market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is less than zero. $I_{U,t}$ is a up-market indicator that equals one if the contemporaneous market return is positive. $\hat{\alpha}_0$ is denoted in percent.

Table A.13: Option-like payoff – Sweden

Coefficient	Variable	Estimated coefficients (t-statistics)			
		(1)	(2)	(3)	(4)
Panel A: 3-3					
$\hat{\alpha}_0$	1	1.24***	1.39***	1.39***	1.30***
		(4.21)	(4.46)	(4.45)	(4.35)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.01	-0.01	
			(-1.52)	(-0.96)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.22***	-0.13	-0.12	-0.12
		(-3.05)	(-1.59)	(-1.59)	(-1.53)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.37**	-0.32	-0.19
			(-2.25)	(-1.13)	(-0.79)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-0.10	-0.36
				(-0.25)	(-1.19)
R^2_{adj}		0.0509	0.0930	0.0874	0.0878
Panel B: 6-3					
$\hat{\alpha}_0$	1	1.45***	1.78***	1.78***	1.72***
		(4.10)	(4.88)	(4.94)	(4.98)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.03***	-0.01	
			(-2.67)	(-0.59)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.28***	-0.15	-0.15	-0.15
		(-3.22)	(-1.58)	(-1.60)	(-1.57)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.52***	0.03	0.11
			(-2.71)	(0.08)	(0.38)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-1.00**	-1.19***
				(-2.16)	(-3.41)
R^2_{adj}		0.0572	0.1470	0.1671	0.1706
Panel C: 9-3					
$\hat{\alpha}_0$	1	1.62***	1.85***	1.85***	1.88***
		(4.34)	(4.82)	(4.91)	(5.22)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.02*	0.00	
			(-1.93)	(0.27)	
$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.31***	-0.14	-0.14	-0.14
		(-3.38)	(-1.42)	(-1.45)	(-1.47)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.69***	0.02	-0.02
			(-3.37)	(0.06)	(0.06)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-1.29***	-1.20***
				(-2.64)	(-3.29)
R^2_{adj}		0.0631	0.1538	0.1858	0.1908
Panel D: 12-3					
$\hat{\alpha}_0$	1	1.67***	1.88***	1.88***	1.92***
		(4.56)	(4.97)	(5.08)	(5.44)
$\hat{\alpha}_B$	$I_{B,t-1}$		-0.02*	0.01	
			(-1.81)	(0.43)	

$\hat{\beta}_0$	$\tilde{r}_{m,t}$	-0.29***	-0.13	-0.14	-0.14
		(-3.32)	(-1.38)	(-1.41)	(-1.44)
$\hat{\beta}_B$	$I_{B,t-1}\tilde{r}_{m,t}$		-0.66***	0.06	-0.01
			(-3.32)	(0.17)	(-0.02)
$\hat{\beta}_{B,U}$	$I_{B,t-1}I_{U,t}\tilde{r}_{m,t}$			-1.31***	-1.17***
				(-2.74)	(-3.29)
R^2_{adj}		0.0608	0.1466	0.1819	0.1862

Note: The monthly time-series regressions run from 2004:01 to 2017:12. Momentum return is the dependent variable. $\tilde{r}_{m,t}$ is the market return excess of the risk-free rate and $I_{B,t-1}$ is an ex-ante bear market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is less than zero. $I_{U,t}$ is a up-market indicator that equals one if the contemporaneous market return is positive. $\hat{\alpha}_0$ is denoted in percent.

Table A.14: Source of optionality – Denmark

Coef	Bear market			Coef	Bull market		
	Loser	Winner	Z-C		Loser	Winner	Z-C
Panel A: 3-3 Strategy							
$\hat{\alpha}_0$	-0.39	1.65***	2.04***	$\hat{\alpha}_0$	0.64	-0.55	-1.19
	(-0.55)	(3.28)	(3.09)		(0.60)	(-0.72)	(-1.14)
$\hat{\alpha}_B$	0.46***	0.25***	-0.21*	$\hat{\alpha}_L$	0.50***	0.25***	-0.25**
	(3.66)	(2.73)	(-1.79)		(4.06)	2.92)	(-2.07)
$\hat{\beta}_0$	-0.02	-0.02*	-0.01	$\hat{\beta}_0$	0.02	0.02*	0.04***
	(-0.89)	(-1.83)	(-0.45)		(-1.29)	(1.77)	(2.63)
$\hat{\beta}_B$	0.41	0.84***	0.44	$\hat{\beta}_L$	0.99**	1.06***	0.07
	(1.26)	(3.64)	(1.43)		(2.51)	(3.82)	(0.18)
$\hat{\beta}_{B,U}$	1.03**	-0.11	-1.13**	$\hat{\beta}_{L,U}$	0.04	-0.42	-0.45
	(2.08)	(-0.30)	(-2.43)		(0.06)	(-0.95)	(-0.76)
Panel B: 6-3 Strategy							
$\hat{\alpha}_0$	-0.60	1.68***	2.28***	$\hat{\alpha}_0$	0.76	0.05**	-0.71
	(-0.81)	(3.54)	(3.24)		(0.63)	(0.09)	(-0.59)
$\hat{\alpha}_B$	0.48***	0.16*	-0.32**	$\hat{\alpha}_L$	0.55***	0.12	-0.43***
	(3.58)	(1.89)	(-2.51)		(4.02)	(1.59)	(-3.16)
$\hat{\beta}_0$	-0.02	-0.01	0.02	$\hat{\beta}_0$	-0.03	0.01	0.04**
	(-1.21)	(-0.51)	(0.93)		(-1.39)	(1.32)	(2.11)
$\hat{\beta}_B$	0.33	0.73***	0.40	$\hat{\beta}_L$	1.01**	0.98***	-0.03
	(0.97)	(3.36)	(1.24)		(2.30)	(4.16)	(-0.06)
$\hat{\beta}_{B,U}$	1.46**	-0.54	-2.01***	$\hat{\beta}_{L,U}$	0.06	-0.27	-0.33
	(2.77)	(-1.60)	(-4.02)		(0.09)	(-0.71)	(-0.48)
Panel C: 9-3 Strategy							
$\hat{\alpha}_0$	-0.83	1.75***	2.58***	$\hat{\alpha}_0$	0.50	-0.20	-0.70
	(-1.12)	(3.90	(3.63)		(0.41)	(-0.33)	(-0.56)

$\hat{\alpha}_B$	0.48***	0.17**	-0.31**	$\hat{\alpha}_L$	0.57***	0.11	-0.45***
	(3.61)	(2.08)	(-2.45)		(4.07)	(1.61)	(-3.18)
$\hat{\beta}_0$	-0.03*	-0.01	0.03	$\hat{\beta}_0$	-0.03	0.02**	0.05**
	(-1.73)	(-0.42)	(1.53)		(-1.42)	(2.02)	(2.38)
$\hat{\beta}_B$	0.12	0.76***	0.63*	$\hat{\beta}_L$	0.88**	0.98***	0.10
	(0.35)	(3.67)	(1.95)		(1.97)	(4.37)	(0.21)
$\hat{\beta}_{B,U}$	1.87***	-0.74**	-2.60***	$\hat{\beta}_{L,U}$	0.17	-0.38	-0.55
	(3.56)	(-2.33)	(-5.19)		(0.25)	(-1.08)	(-0.76)
Panel D: 12-3 Strategy							
$\hat{\alpha}_0$	-0.64	1.86***	2.51***	$\hat{\alpha}_0$	-4.58***	-0.79	3.79***
	(-0.85)	(3.91)	(3.32)		(-3.67)	(-1.03)	(2.70)
$\hat{\alpha}_B$	0.42***	0.17*	-0.26*	$\hat{\alpha}_L$	0.33***	0.09	-0.24*
	(3.15)	(1.95)	(-1.91)		(2.62)	(1.14)	(-1.71)
$\hat{\beta}_0$	-0.04*	0.00	0.04*	$\hat{\beta}_0$	0.03**	0.02**	-0.02
	(-1.96)	(0.01)	(1.96)		(2.17)	(2.19)	(0.73)
$\hat{\beta}_B$	0.08	0.96***	0.89**	$\hat{\beta}_L$	0.94***	0.83***	0.11
	(0.22)	(4.37)	(2.54)		(5.63)	(8.01)	(-0.61)
$\hat{\beta}_{B,U}$	1.79***	-1.04***	-2.83***	$\hat{\beta}_{L,U}$	1.93***	0.23	-1.70***
	(3.35)	(-3.08)	(-5.28)		(7.15)	(1.37)	(-5.60)

Note: This table presents results from the following regressions, run from 2004:01 to 2017:12: $\tilde{r}_{i,t} = (\hat{\alpha}_0 + \hat{\alpha}_B I_{B,t-1}) + [\hat{\beta}_0 + I_{B,t-1}(\hat{\beta}_B + I_{U,t})]\, \tilde{r}_{m,t} + \tilde{u}_t$ to test for optionality in bear markets and $\tilde{r}_{i,t} = (\hat{\alpha}_0 + \hat{\alpha}_L I_{L,t-1}) + [\hat{\beta}_0 + I_{L,t-1}(\hat{\beta}_L + I_{U,t})]\, \tilde{r}_{m,t} + \tilde{u}_t$ to test for optionality in bull markets. $\tilde{r}_{m,t}$ is the market return excess of the risk-free rate and $I_{B,t-1}$ is an ex-ante bear market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is less than zero. $I_{U,t}$ is a up-market indicator that equals one if the contemporaneous market return is positive. $I_{L,t-1}$ is a bull market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is greater than zero and defined as 1- $I_{B,t-1}$. $\hat{\alpha}_0$ is in percent and the zero-cost portfolio is denoted Z-C.

Table A.15: Source of optionality – Finland

Coef	Bear market			coef	Bull market		
	Loser	Winner	Z-C		Loser	Winner	Z-C
Panel A: 3-3 Strategy							
$\hat{\alpha}_0$	-0.69*	0.35	1.05**	$\hat{\alpha}_0$	0.31	0.48	0.17
	(-1.72)	(1.33)	(2.34)		(0.43)	(1.04)	(0.22)
$\hat{\alpha}_B$	0.00	-0.00	-0.00	$\hat{\alpha}_L$	-0.01	0.00	0.01
	(0.19)	(-0.22)	(-0.31)		(-1.06)	(0.04)	(0.99)
$\hat{\beta}_0$	0.64***	0.65***	0.01	$\hat{\beta}_0$	0.98***	0.67***	-0.31**
	(7.84)	(12.19)	(0.13)		(7.91)	(8.24)	(-2.29)
$\hat{\beta}_B$	0.11	-0.07	-0.17	$\hat{\beta}_L$	-0.35*	0.03	0.37*
	(0.45)	(-0.42)	(-0.66)		(-1.70)	(0.22)	(1.67)
$\hat{\beta}_{B,U}$	0.42	0.15	-0.27	$\hat{\beta}_{L,U}$	0.00	-0.09	-0.08

	(1.24)	(0.64)	(-0.71)		(0.01)	(-0.52)	(-0.31)
Panel B: 6-3 Strategy							
$\hat{\alpha}_0$	-0.50	0.35	0.85*	$\hat{\alpha}_0$	0.16	0.79	0.63
	(-1.15)	(1.27)	(1.73)		(0.21)	(1.60)	(0.72)
$\hat{\alpha}_B$	0.46	0.01	0.00	$\hat{\alpha}_L$	-0.01	0.00	0.01
	(0.41)	(1.46)	(0.46)		(6.71)	(0.00)	(0.78)
$\hat{\beta}_0$	0.61***	0.65***	0.03	$\hat{\beta}_0$	0.88***	0.59***	-0.30**
	(7.05)	(11.51)	(0.30)		(6.71)	(6.89)	(-2.01)
$\hat{\beta}_B$	0.21	0.12	-0.09	$\hat{\beta}_L$	-0.34	0.19	0.53**
	(0.83)	(0.73)	(-0.32)		(-1.58)	(1.34)	(2.15)
$\hat{\beta}_{B,U}$	0.10	-0.32	-0.42	$\hat{\beta}_{L,U}$	0.13	-0.23	-0.36
	(0.28)	(-1.38)	(-1.03)		(0.46)	(-1.35)	(-1.17)
Panel C: 9-3 Strategy							
$\hat{\alpha}_0$	-0.78*	0.41	1.19**	$\hat{\alpha}_0$	0.17	0.78	0.61
	(-1.81)	(1.46)	(2.34)		(0.22)	(1.55)	(0.67)
$\hat{\alpha}_B$	0.00	0.01*	0.01	$\hat{\alpha}_L$	-0.01	-0.00	0.01
	(0.37)	(1.73)	(0.64)		(-0.95)	(-0.40)	(0.57)
$\hat{\beta}_0$	0.63***	0.65***	0.02	$\hat{\beta}_0$	0.97***	0.52***	-0.45***
	(7.29)	(11.49)	(0.21)		(7.36)	(5.98)	(-2.84)
$\hat{\beta}_B$	0.18	0.13	-0.05	$\hat{\beta}_L$	-0.34	0.16	0.49*
	(0.71)	(0.78)	(-0.16)		(-1.58)	(1.12)	(1.95)
$\hat{\beta}_{B,U}$	0.28	-0.47**	-0.75*	$\hat{\beta}_{L,U}$	0.00	-0.05	-0.06
	(0.78)	(-1.99)	(-1.76)		(0.01)	(-0.29)	(-0.17)
Panel D: 12-3 Strategy							
$\hat{\alpha}_0$	-0.69	0.42	1.12**	$\hat{\alpha}_0$	0.28	1.05**	0.76
	(-1.60)	(1.51)	(2.17)		(0.37)	(2.09)	(0.83)
$\hat{\alpha}_B$	-0.00	0.01*	0.01	$\hat{\alpha}_L$	-0.01	-0.01	0.00
	(-0.01)	(1.84)	(1.01)		(-0.91)	(-0.81)	(0.31)
$\hat{\beta}_0$	0.59***	0.66***	0.07	$\hat{\beta}_0$	0.99***	0.50***	-0.49***
	(6.78)	(11.64)	(0.71)		(7.51)	(5.22)	(-3.11)
$\hat{\beta}_B$	0.12	0.05	-0.07	$\hat{\beta}_L$	-0.39*	0.18	0.58**
	(0.45)	(0.27)	(-0.22)		(-1.81)	(1.32)	(2.23)
$\hat{\beta}_{B,U}$	0.52	-0.37	-0.89**	$\hat{\beta}_{L,U}$	-0.03	-0.04	-0.02
	(1.43)	(-1.59)	(-2.08)		(-0.10)	(-0.25)	(-0.05)

Note: This table presents results from the following regressions, run from 2004:01 to 2017:12: $\tilde{r}_{i,t} = (\hat{\alpha}_0 + \hat{\alpha}_B I_{B,t-1}) + [\hat{\beta}_0 + I_{B,t-1}(\hat{\beta}_B + I_{U,t})]\, \tilde{r}_{m,t} + \tilde{u}_t$ to test for optionality in bear markets and $\tilde{r}_{i,t} = (\hat{\alpha}_0 + \hat{\alpha}_L I_{L,t-1}) + [\hat{\beta}_0 + I_{L,t-1}(\hat{\beta}_L + I_{U,t})]\, \tilde{r}_{m,t} + \tilde{u}_t$ to test for optionality in bull markets. $\tilde{r}_{m,t}$ is the market return excess of the risk-free rate and $I_{B,t-1}$ is an ex-ante bear market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is less than zero. $I_{U,t}$ is a up-market indicator that equals one if the contemporaneous market return is positive. $I_{L,t-1}$ is a bull market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is greater than zero and defined as 1- $I_{B,t-1}$. $\hat{\alpha}_0$ is in percent and the zero-cost portfolio is denoted Z-C.

Table A.16: Source of optionality – Norway

Coef	Bear market			Coef	Bull market		
	Loser	Winner	Z-C		Loser	Winner	Z-C
Panel A: 3-3 Strategy							
$\hat{\alpha}_0$	-2.06***	0.59*	2.65***	$\hat{\alpha}_0$	-0.55	0.41	0.96
	(-2.73)	(1.78)	(3.69)		(-0.30)	(0.51)	(0.56)
$\hat{\alpha}_B$	0.00	-0.01	-0.01	$\hat{\alpha}_L$	-0.01	0.01	0.02
	(0.11)	(-0.47)	(-0.34)		(-0.55)	(0.57)	(0.85)
$\hat{\beta}_0$	1.21***	0.89	-0.33**	$\hat{\beta}_0$	1.68	0.94***	-0.74***
	(7.72)	(12.73)	(-2.21)		(5.71)	(7.31)	(-2.62)
$\hat{\beta}_B$	0.29	-0.03	-0.31	$\hat{\beta}_L$	-0.38	0.03	0.42
	(0.48)	(-0.10)	(-0.55)		(-0.97)	(0.16)	(1.09)
$\hat{\beta}_{B,U}$	0.40	0.21	-0.20	$\hat{\beta}_{L,U}$	-0.17	-0.20	-0.02
	(0.37)	(0.43)	(-0.19)		(-0.38)	(-0.99)	(-0.05)
Panel B: 6-3 Strategy							
$\hat{\alpha}_0$	-1.83**	0.75**	2.58***	$\hat{\alpha}_0$	0.30	0.09	-0.20
	(-2.53)	(2.16)	(3.53)		(0.17)	(0.11)	(-0.11)
$\hat{\alpha}_B$	0.00	0.00	-0.00	$\hat{\alpha}_L$	-0.02	0.01	0.02
	(0.06)	(0.12)	(-0.01)		(-0.76)	(0.85)	(1.16)
$\hat{\beta}_0$	1.24***	0.93***	-0.31**	$\hat{\beta}_0$	1.50***	0.86***	-0.64**
	(8.22)	(12.86)	(-2.03)		(5.33)	(6.33)	(-2.26)
$\hat{\beta}_B$	-0.05	0.07	0.12	$\hat{\beta}_L$	0.12	0.12	0.24
	(-0.08)	(0.26)	(0.21)		(0.30)	(0.65)	(0.61)
$\hat{\beta}_{B,U}$	0.71	-0.31	-1.03	$\hat{\beta}_{L,U}$	-0.32	-0.10	0.21
	(0.67)	(-0.62)	(-0.96)		(-0.73)	(-0.51	(0.48)
Panel C: 9-3 Strategy							
$\hat{\alpha}_0$	-1.89***	0.89***	2.79***	$\hat{\alpha}_0$	0.76	-0.37	-1.13
	(-2.61)	(2.64)	(3.76)		(0.43)	(-0.45)	(-0.62)
$\hat{\alpha}_B$	-0.00	0.01	0.02	$\hat{\alpha}_L$	-0.02	0.02	0.04*
	(-0.10)	(0.77)	(0.45)		(-1.15)	(1.61)	(1.85)
$\hat{\beta}_0$	1.15***	0.95***	-0.20	$\hat{\beta}_0$	1.56***	0.73***	-0.83***
	(7.63)	(13.44)	(-1.32)		(5.53)	(5.50)	(-2.85)
$\hat{\beta}_B$	-0.08	0.20	0.28	$\hat{\beta}_L$	-0.34	0.29	0.63
	(-0.14)	(0.75)	(0.48)		(-0.89)	(1.60)	(1.59)
$\hat{\beta}_{B,U}$	1.12	-0.93*	-2.05*	$\hat{\beta}_{L,U}$	-0.16	-0.16	-0.00
	(1.05)	(-1.88)	(-1.89)		(-0.36)	(-0.78	(-0.01)
Panel D: 12-3 Strategy							
$\hat{\alpha}_0$	-1.88**	0.87**	2.76***	$\hat{\alpha}_0$	-0.25	-0.36	-0.10
	(-2.41)	(2.51)	(3.38)		(-0.13)	(-0.42)	(-0.05)
$\hat{\alpha}_B$	-0.02	0.01	0.04	$\hat{\alpha}_L$	-0.01	0.02	0.03
	(-0.64)	(0.74)	(0.93)		(-0.64)	(1.53)	(1.26)
$\hat{\beta}_0$	1.17***	0.90***	-0.26	$\hat{\beta}_0$	1.44***	0.74***	-0.69**
	(7.15)	(12.48)	(-1.55)		(4.69)	(5.48)	(-2.15)
$\hat{\beta}_B$	-0.39	0.25	0.64	$\hat{\beta}_L$	-0.23	0.23	0.45
	(-0.63)	(0.92)	(1.00)		(-0.54)	(1.24)	(1.04)
$\hat{\beta}_{B,U}$	1.50	-0.91*	-2.41**	$\hat{\beta}_{L,U}$	-0.11	-0.16	-0.05
	(1.31)	(-1.79)	(-2.02)		(-0.23)	(-0.76)	(-0.10)

Note: This table presents results from the following regressions, run from 2004:01 to 2017:12: $\tilde{r}_{i,t} = (\hat{\alpha}_0 + \hat{\alpha}_B I_{B,t-1}) + [\hat{\beta}_0 + I_{B,t-1}(\hat{\beta}_B + I_{U,t})]\, \tilde{r}_{m,t} + \tilde{u}_t$ to test for optionality in bear markets and $\tilde{r}_{i,t} = (\hat{\alpha}_0 + \hat{\alpha}_L I_{L,t-1}) + [\hat{\beta}_0 + I_{L,t-1}(\hat{\beta}_L + I_{U,t})]\, \tilde{r}_{m,t} + \tilde{u}_t$ to test for optionality in bull markets. $\tilde{r}_{m,t}$ is the market return excess of the risk-free rate and $I_{B,t-1}$ is an ex-ante bear market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is less than zero. $I_{U,t}$ is a up-market indicator that equals one if the contemporaneous market return is positive. $I_{L,t-1}$ is a bull market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is greater than zero and defined as 1- $I_{B,t-1}$. $\hat{\alpha}_0$ is in percent and the zero-cost portfolio is denoted Z-C.

Table A.17: Source of optionality – Sweden

Coef	Bear market			Coef	Bull market		
	Loser	Winner	Z-C		Loser	Winner	Z-C
Panel A: 3-3 Strategy							
$\hat{\alpha}_0$	-0.64**	0.75***	1.39***	$\hat{\alpha}_0$	-0.87	-0.74	0.13
	(-1.98)	(3.40)	(4.45)		(-1.10)	(-1.38)	(0.17)
$\hat{\alpha}_B$	-0.01	-0.02***	-0.01	$\hat{\alpha}_L$	0.00	0.02***	0.02*
	(-1.01)	(-2.85)	(-0.96)		(0.39)	(3.05)	(1.73)
$\hat{\beta}_0$	0.94***	0.81***	-0.12	$\hat{\beta}_0$	1.38***	0.89***	-0.50***
	(11.26)	(14.28)	(-1.59)		(9.23)	(8.72)	(-3.47)
$\hat{\beta}_B$	0.16	-0.15	-0.32	$\hat{\beta}_L$	-0.39*	0.10	0.49**
	(0.57)	(-0.77)	(-1.13)		(-1.72)	(0.63)	(2.24)
$\hat{\beta}_{B,U}$	0.50	0.40	-0.10	$\hat{\beta}_{L,U}$	-0.09	-0.32*	-0.23
	(1.21)	(1.41)	(-0.25)		(-0.33)	(-1.68)	(-0.83)
Panel B: 6-3 Strategy							
$\hat{\alpha}_0$	-0.81**	0.97***	1.78***	$\hat{\alpha}_0$	-0.30	-1.10**	-0.80
	(-2.25)	(4.41)	(4.94)		(-0.34)	(2.03)	(-0.89)
$\hat{\alpha}_B$	0.01	-0.02**	-0.01	$\hat{\alpha}_L$	0.00	0.02***	0.02**
	(0.73)	(-2.15)	(-0.59)		(0.06)	(3.68)	(2.16)
$\hat{\beta}_0$	0.96***	0.81***	-0.15	$\hat{\beta}_0$	1.40***	0.73***	-0.68***
	(10.41)	(14.16)	(-1.60)		(8.46)	(7.12)	(-3.99)
$\hat{\beta}_B$	0.01	0.03	0.03	$\hat{\beta}_L$	-0.25	0.20	0.44*
	(0.02)	(0.17)	(0.08)		(-0.98)	(1.29)	(1.75)
$\hat{\beta}_{B,U}$	0.78*	-0.22	-1.00**	$\hat{\beta}_{L,U}$	-0.37	-0.22	0.15
	(1.71)	(-0.76)	(-2.16)		(-1.17)	(-1.14)	(0.46)
Panel C: 9-3 Strategy							
$\hat{\alpha}_0$	-0.99**	0.86***	1.85***	$\hat{\alpha}_0$	-0.48	-0.59	-0.11
	(-2.59)	(3.88)	(4.91)		(-0.51)	(-1.08)	(-0.12)
$\hat{\alpha}_B$	-0.01	-0.01	0.00	$\hat{\alpha}_L$	0.00	0.02**	0.02*
	(-0.81)	(-0.92)	(0.27)		(0.01)	(2.46)	(1.41)
$\hat{\beta}_0$	0.97***	0.83***	-0.14	$\hat{\beta}_0$	1.49***	0.66***	-0.83***
	(9.86)	(14.39)	(-1.45)		(8.41)	(6.40)	(-4.65)

$\hat{\beta}_B$	-0.03	0.05	0.02	$\hat{\beta}_L$	-0.34	0.23	0.57**
	(-0.09)	(0.27)	(0.06)		(-1.27)	(1.45)	(2.11)
$\hat{\beta}_{B,U}$	0.88*	-0.40	-1.29***	$\hat{\beta}_{L,U}$	-0.34	-0.11	0.22
	(1.79)	(-1.40)	(-2.64)		(-1.01)	(-0.58)	(0.66)
Panel D: 12.-3 Strategy							
$\hat{\alpha}_0$	-0.95**	0.93**	1.88***	$\hat{\alpha}_0$	-0.25	-0.18	-0.07
	(-2.48)	(4.16)	(5.08)		(-0.27)	(-0.34)	(-0.08)
$\hat{\alpha}_B$	-0.01	-0.01	0.01	$\hat{\alpha}_L$	-0.00	0.01**	0.02
	(-0.84)	(-0.73)	(0.43)		(-0.26)	(2.12)	(1.52)
$\hat{\beta}_0$	0.99***	0.86***	-0.14	$\hat{\beta}_0$	1.43***	0.63***	-0.80***
	(9.98)	(14.77)	(-1.41)		(7.99)	(6.10)	(-4.57)
$\hat{\beta}_B$	-0.12	-0.06	0.06	$\hat{\beta}_L$	-0.31	0.32**	0.64**
	(-0.34)	(-0.31)	(0.17)		(-1.15)	(2.07)	(2.39)
$\hat{\beta}_{B,U}$	1.02**	-0.30	-1.31***	$\hat{\beta}_{L,U}$	-0.25	-0.19	0.06
	(2.05)	(-1.03)	(-2.74)		(-0.73)	(-0.97)	(0.17)

Note: This table presents results from the following regressions, run from 2004:01 to 2017:12: $\tilde{r}_{i,t} = (\hat{\alpha}_0 + \hat{\alpha}_B I_{B,t-1}) + [\hat{\beta}_0 + I_{B,t-1}(\hat{\beta}_B + I_{U,t})]\, \tilde{r}_{m,t} + \tilde{u}_t$ to test for optionality in bear markets and $\tilde{r}_{i,t} = (\hat{\alpha}_0 + \hat{\alpha}_L I_{L,t-1}) + [\hat{\beta}_0 + I_{L,t-1}(\hat{\beta}_L + I_{U,t})]\, \tilde{r}_{m,t} + \tilde{u}_t$ to test for optionality in bull markets. $\tilde{r}_{m,t}$ is the market return excess of the risk-free rate and $I_{B,t-1}$ is an ex-ante bear market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is less than zero. $I_{U,t}$ is a up-market indicator that equals one if the contemporaneous market return is positive. $I_{L,t-1}$ is a bull market indicator that equals one if the past 2-year cumulative $\tilde{r}_{m,t}$ is greater than zero and defined as 1- $I_{B,t-1}$. $\hat{\alpha}_0$ is in percent and the zero-cost portfolio is denoted Z-C.

Figures

Figure A.1: Monthly Returns – Nordic

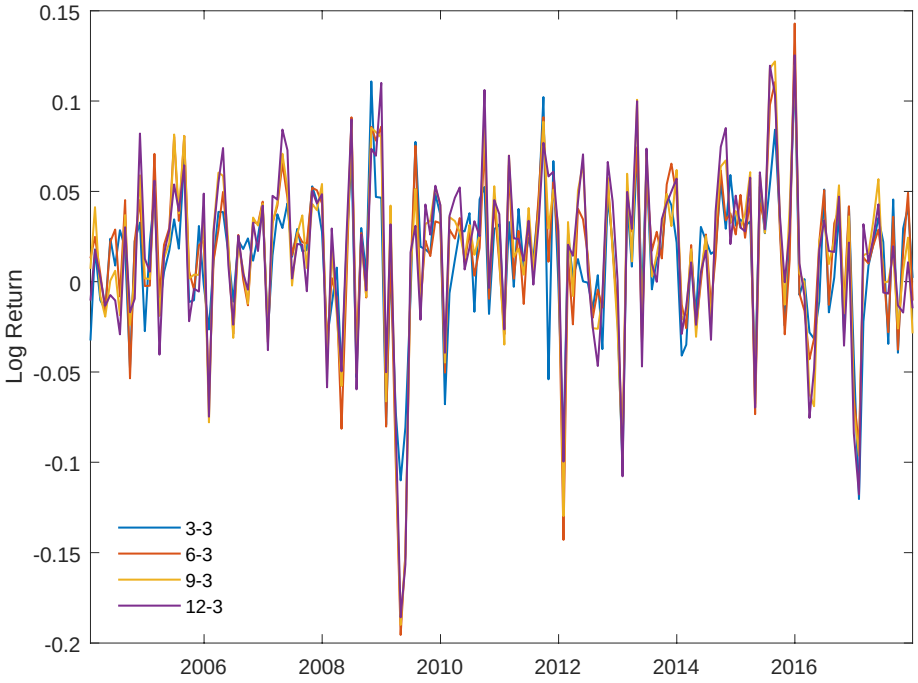


Figure A.2: Monthly returns (Scatter-plot) – Nordic

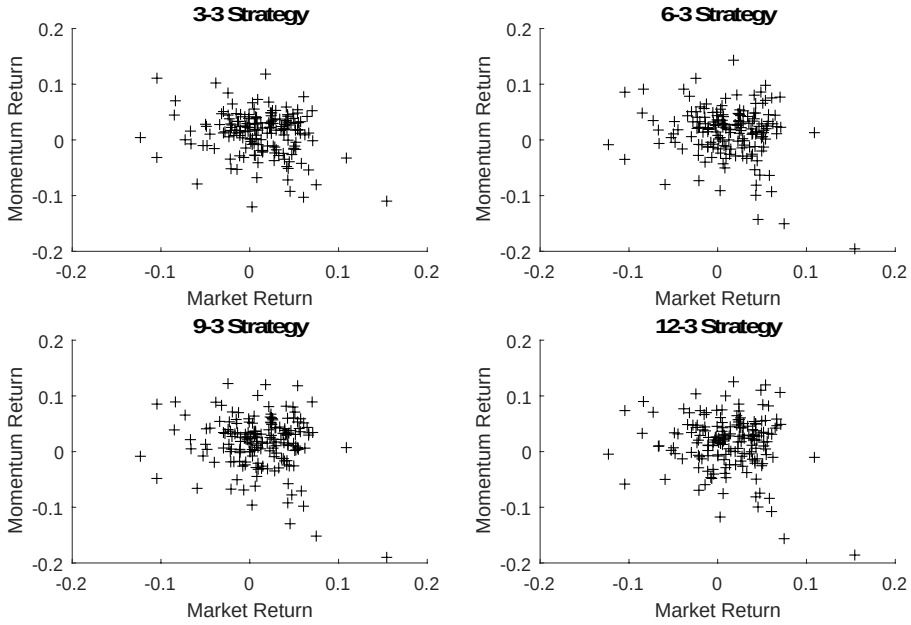


Figure A.3: Monthly returns – Individual countries

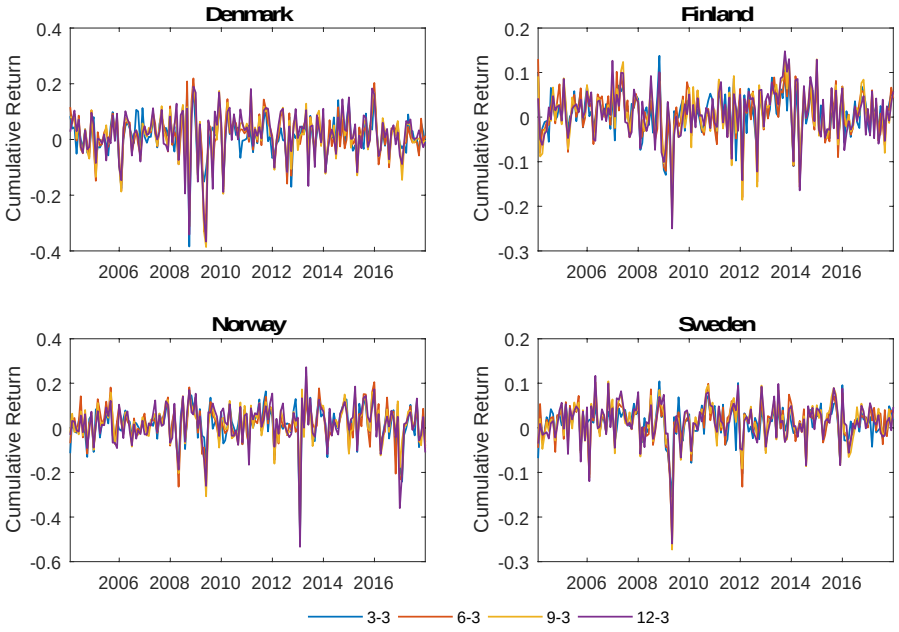


Figure A.4: Momentum deciles 1-10 - Nordic

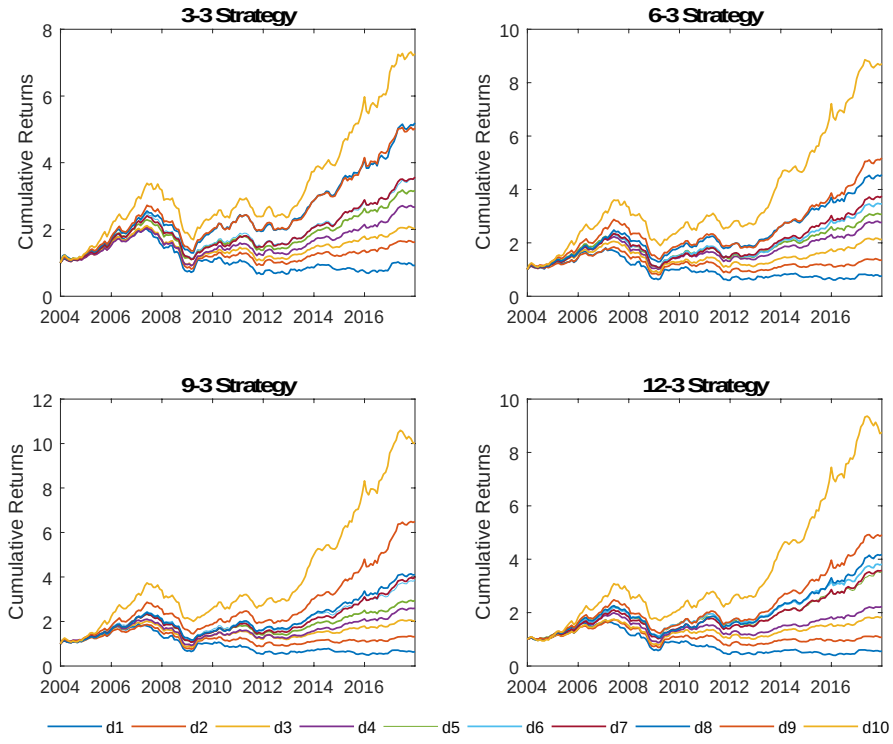


Figure A.5: Winner/Loser – Individual countries

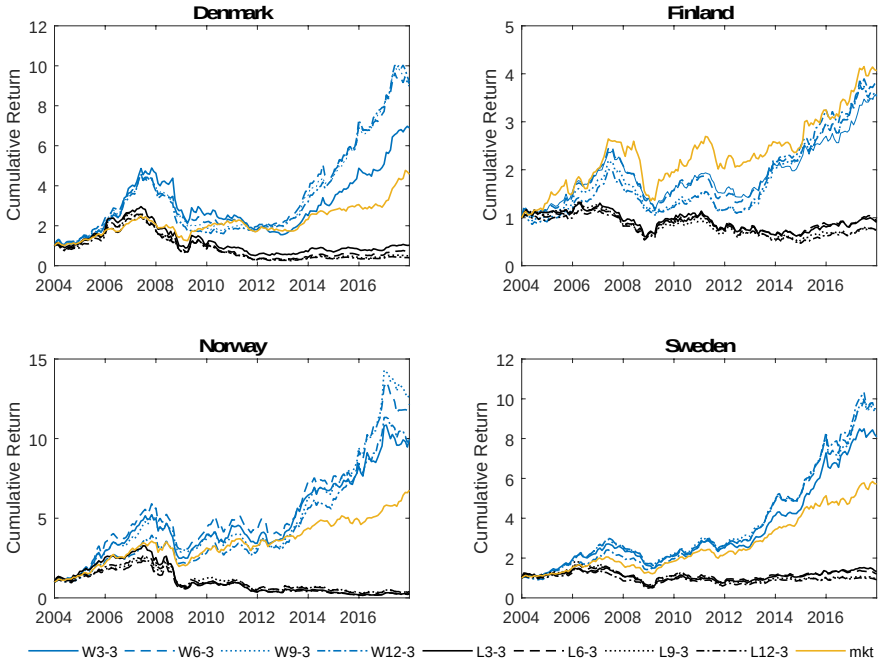


Figure A.6: WML on four strategies, each country

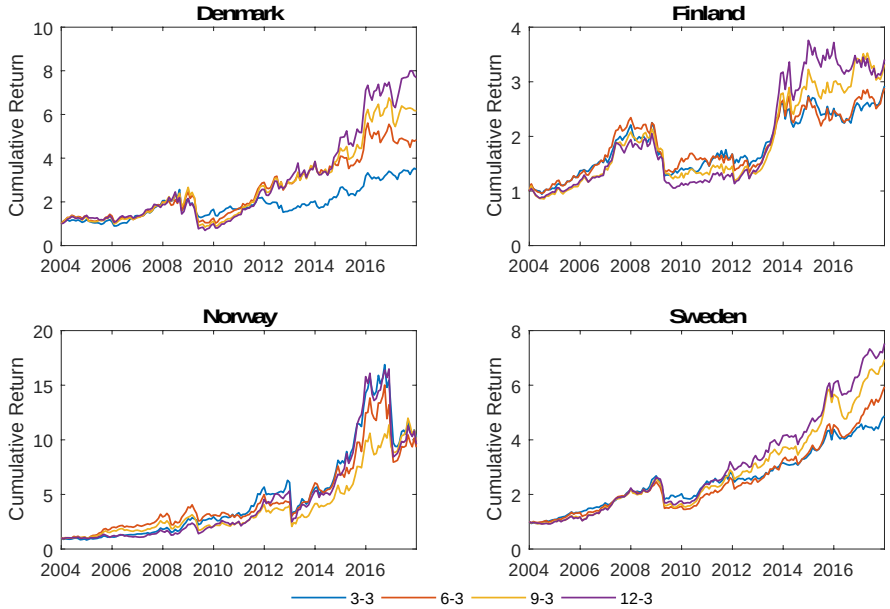
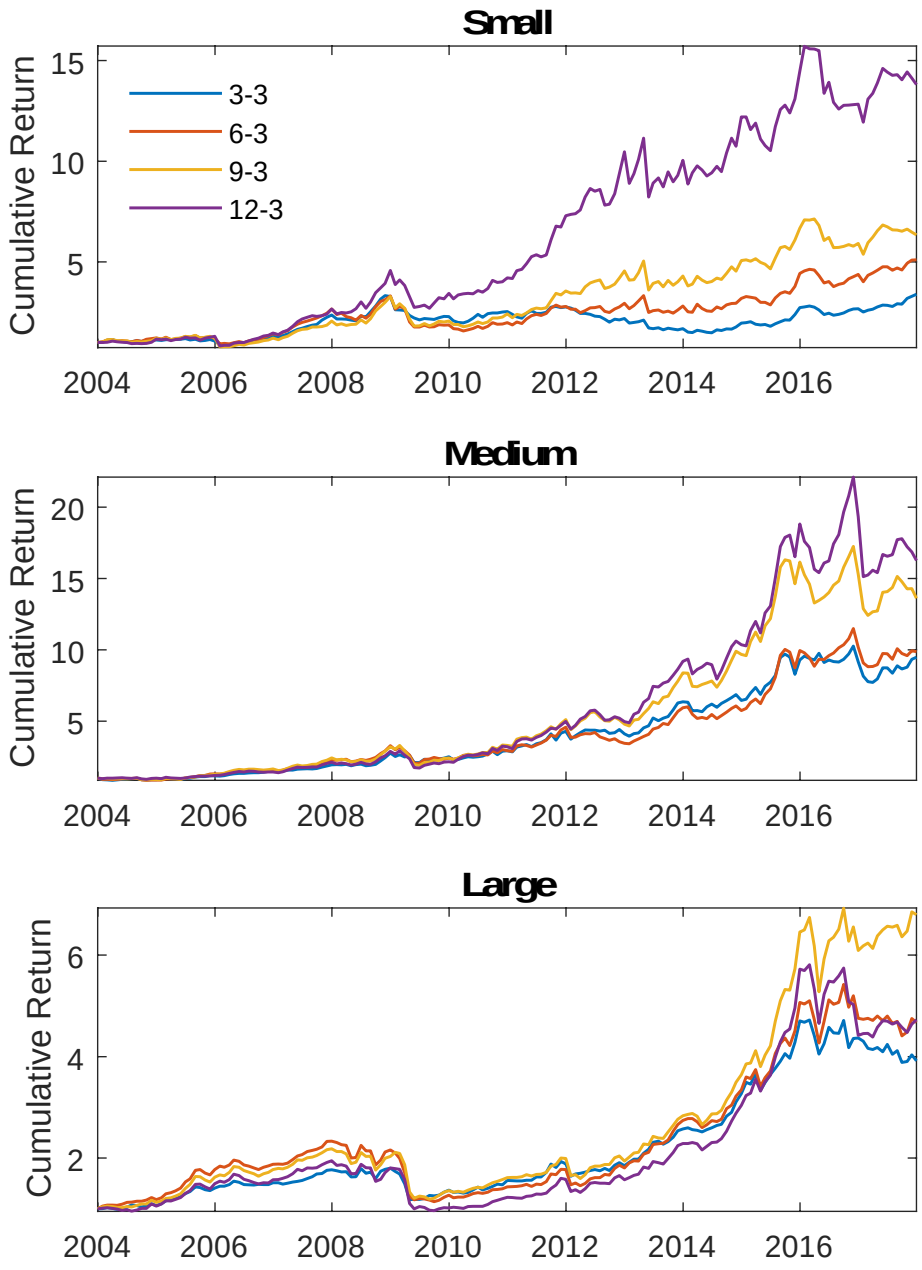


Figure A.7: Nordic zero-cost portfolios – sorted on firm size



Maximum drawdowns for different firm-size

Strategy	3-3	6-3	9-3	12-3
Small	55%	52%	46%	41%
Medium	25%	38%	42%	41%
Large	35%	51%	45%	51%

Figure A.8: Optionality for winners, losers and zero-cost – Nordic

This figure plots the zero-cost portfolios exposure to market risk in bear markets. When the contemporaneous market return is negative the point estimate for the portfolios are ($\hat{\beta}_0 + \hat{\beta}_B$) and ($\hat{\beta}_0 + \hat{\beta}_B + \hat{\beta}_{B,U}$) when the contemporaneous market return is positive. The past winner and loser portfolio are denoted W and L respectively. And the zero-cost portfolio is denoted as WML (winner minus loser).

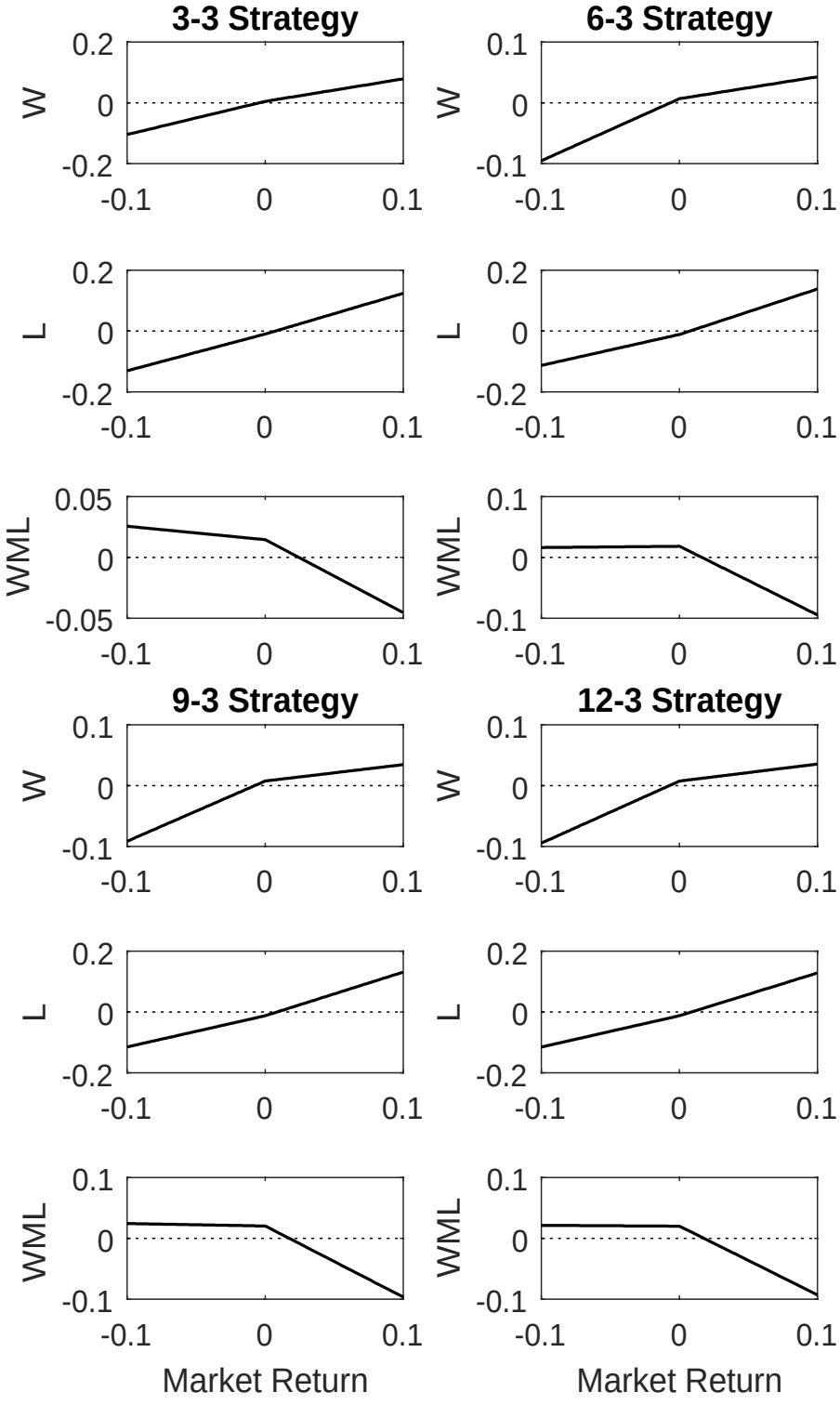
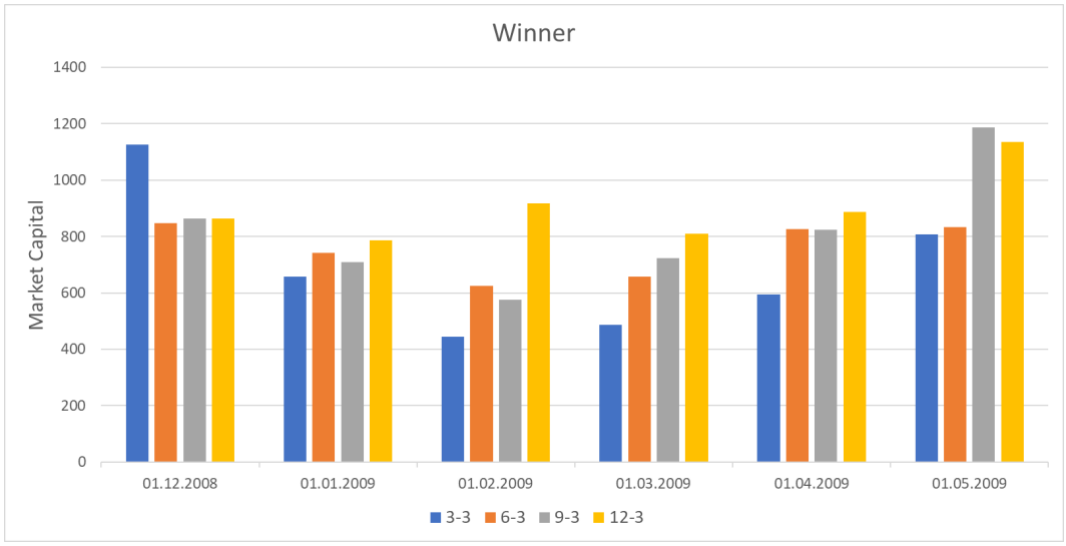


Figure A.9: Market value, past winner and loser portfolio – Nordic



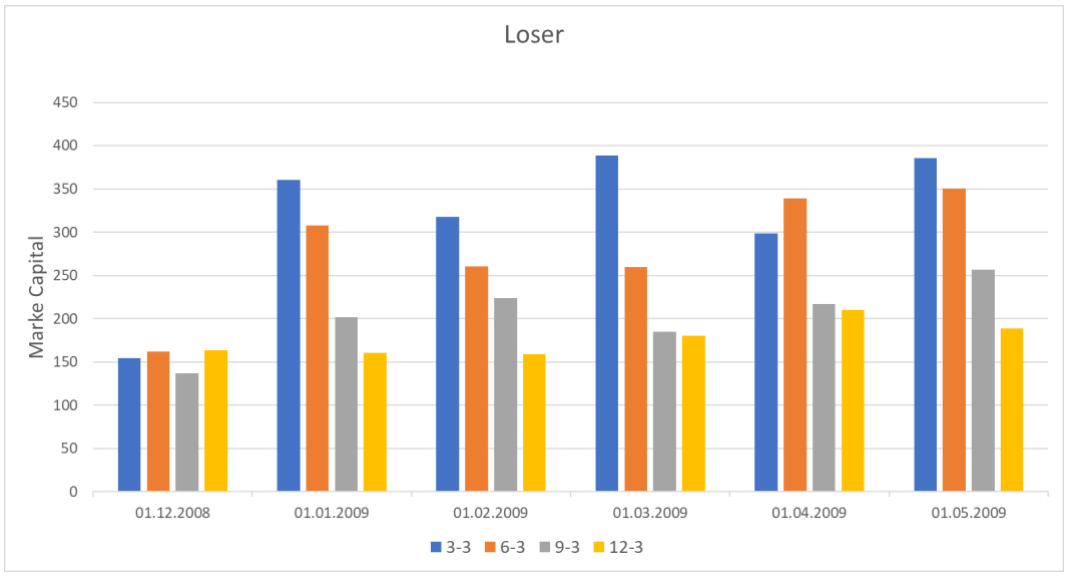


***Figure A.10**: Sectors in past winner and loser portfolio – Nordic*