BI Norwegian Business School
Master Thesis

Sports Sentiment Effect at Oslo Stock Exchange

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Abstract

This thesis has investigated the Oslo Stock Exchange's reaction to results of the seven most popular sports in Norway. Investors are said to be rational and stock prices should reflect all available information and thereby follow the efficient market hypothesis. To test our hypothesis, a simple OLS regression was used on both raw returns and normalized returns. We found that sports results did not have an impact on Oslo Stock Exchange and its stock returns, during our sample period from 1983-2016. This conclusion did not change after taking expectations into account, nor when we removed all weekend events.

1. Introduction

Our thesis is founded on behavioral biases and its impact on asset prices. Moreover, we are investigating the effect of investor mood and sentiment on asset prices. There are two principal approaches when conducting this research, which either link returns to a single event or to a continuous variable that impacts mood. Examples of the former could be to study the impact of the results of football matches or sports results and the latter could be the impact of sunshine.

For our thesis, we have chosen an event approach. Edmans et al. (2007) state that the main advantage of conducting an event approach is how it clearly identifies a sudden change in the mood of investors through the presence of a larger signal-to-noise ratio, should it occur. On the other hand, the main disadvantage of the event approach is how the number of observations has a tendency to be significantly lower, which in turn could result in a reduced statistical power.

For us to be able to study whether investor's mood and sentiment can affect asset prices we need a mood variable that must satisfy the following three key characteristics defined by Edmans et al. (2007):

1. The given variable must drive mood in a substantial and unambiguous way, so that its effect is strong enough to show up in asset prices.

2. The variable must impact the mood of a large proportion of the population, so that it is likely to affect a sufficient amount of investors.

3. The effect needs to correlate across the majority of individuals within the country.

In order to fulfill these characteristics and still have enough data, we have chosen to use the seven most popular sports in Norway, measured over the period 2014-2015. These sports were cross-country, biathlon, handball, alpine skiing, football, ski jumping and Nordic combined, as can be seen from figure 1. We will use the results from World Championships, European Championships and the Olympic Games. Edmans et al. (2007) did a similar research on several sports, using a cross-section study with 39 countries. They found a significant loss effect but did not find any win effect. There have been several other studies on the topic, which we will briefly describe further in our literature review. Furthermore, there have been no previous studies of this kind, focused exclusively on the Norwegian stock market and Oslo Stock Exchange. However, it is important to note that Edmans et al. (2007) used Norway as one of their 39 countries, but not exclusively. We will

use the OSEBX, which is adjusted for dividends, while Edmans used total return indices for each country collected from DataStream. We will use data from 1983 Q1 until 2016 Q2.

The stock prices should reflect all available information and thereby follow the efficient market hypothesis. If we can find evidence that the stock market reacts to investor's mood through sports results, then the stock market is not efficient. If the market reactions the day after a sporting event is large enough, investors can profit by trading on this observed trend.

In this master thesis, we choose to use Edmans et al. (2007) as a recipe for our methodology. Since the stock market is known for its calendar effects, such as the Monday effect and holiday effect, we initially conduct an OLS regression, which takes this into account. Furthermore, we will use the residuals from this regression to test whether a win or loss has an impact. Since some events might occur during high volatility periods, we also normalize the stock returns using a GARCH (1,1) model, and conduct an OLS regression on these residuals as well.

To verify the robustness of our findings we will conduct two robustness checks. One where we take Norwegians' expectations into account, and one where we remove all weekend events.

We find no statistically significant effect on sports results impact on stock returns, neither after a win nor after a loss. This result is also supported by our robustness checks. We therefore conclude that Oslo Stock Exchange is efficient and its investors are rational.

This thesis is organized as follows: Chapter 2 provides an overview of the articles that we find most relevant for this topic and its findings; Chapter 3 consists of relevant theory; Development of the hypothesis will be given in Chapter 4; Chapter 5 explains the methodology used and our results as well as the robustness checks; Chapter 6 provides proposed possible explanations for our findings and Chapter 7 concludes this thesis.

2. Literature review

There are several published articles on the subject of investor sentiment and the stock market. We divide this chapter into three sections. In the first section, we

review the existing literature on the topic of mood proxies, stock returns and risk taking. In the second section, we review the topic of sports and its effect on mood. In the final section, we review the existing literature on sports events and stock returns.

2.1 Mood Proxies, Stock Returns and Risk Taking

Research has shown that the decision-making of a person is influenced by their current state of mood (Schwarz, 1990). Moreover, factors that induce a positive mood would lead people to make more optimistic judgments than if they were in a neutral mood. Similarly, factors that induce a negative mood would lead people to make more pessimistic judgments than if they were in a neutral mood. Furthermore, Lowenstein et al. (2001) claim that the influence of mood on the decision-making process is especially pronounced when the decision involves risk and uncertainty.

Additionally, so called irrelevant temporary states of mood at the time of decision-making have been shown to influence decisions involving the long-term risks and benefits.

Dowling and Lucey (2008) state that recent behavioral finance studies investigate the possibility of equity investors misattributing their mood source and allowing irrelevant feelings to affect their equity investment decisions.

Schwarz and Clore (1983) refer to mood misattribution as the influence of irrelevant mood states on decision-making. They conducted a phone survey where they set out to research whether fluctuations in the weather had any influence on the assessment of people's life situation. They noticed that sunny weather lead to people reporting greater life satisfaction than when the weather was rainy and overcast.

Dowling and Lucey (2008) state further that the research of misattributed mood focuses on the relationship between equity prices and variables founded on different proxies for mood, for example biorhythms and weather. These variables are hypothesized as evident in equilibrium stock prices.

Malcolm Baker and Jeffrey Wurgler published their article "Investor Sentiment and the Cross-Section of Stock Returns" in the Journal of Finance in 2006. They set out to study how investor sentiment affects the cross-section of stock returns, i.e. why stock A earns higher / lower return than stock B. Baker and Wurgler

(2006) used monthly stock returns between 1963 and 2001 to test how the cross-section of subsequent stock returns varies with beginning-of-period sentiment. Baker and Wurgler found that *"when sentiment is estimated to be high, stocks that are attractive to optimists and speculators and at the same time unattractive to arbitrageurs - younger stocks, small stocks, unprofitable stocks, non-dividend-paying stocks, high volatility stocks, extreme growth stocks, and distressed stocks - tend to earn relatively low subsequent returns"*.

Mark J. Kamstra, Lisa A. Kramer and Maurice D. Levi published an article in 2000 called "Losing Sleep at the Market: The Daylight Saving Anomaly" in American Economic Review. The authors researched whether the sleep desynchronosis, the change in sleep pattern as a result of the clock shifting at the beginning and end of daylight savings time, lead to different financial market effects the following Monday than on other weekends. They found the daylight saving effect to be both statistically and economically significant in several international financial markets. In the United States the daylight saving effect implied a one-day loss of $31 billion on the NYSE, AMEX and NASDAQ exchanges.

Kamstra et. al published another article in 2003 called "Winter Blues: A Sad Stock Market Cycle" in The American Economic Review. They set out to find whether they could support the argument that daylight had a profound effect on people's mood, and in turn whether people's mood could relate to risk aversion. They found evidence that support the existence of seasonal affective disorder on stock market returns in the Northern Hemisphere.

2.2 Sports as a Proxy for Mood

During past decades, researchers have found clear proof that sports have a remarkable effect on human behavior and mood. They find clear indications that sporting events and results affect health and psychological conditions (Kloner et al. 2009). The following section consists of a literature review of articles on these subjects.

Knoll, Schramm and Schallhorn (2013) conducted a research where the goal was to test whether the outcomes of games at the FIFA World Cups could affect

viewers' estimations regarding their own self-confidence and the current economic situation of their home country. The results showed that the mood of television viewers was influenced by the outcome of the game. Viewers were in a significantly better mood after watching their favored team win compared with before the game. In addition, their mood decreased after watching their favorite team lose, although non-significantly.

Jones et al. (2012) set out to explore English and Spanish fans' emotional responses to team success and failure and resulting changes in social interaction and spending during the 2010 FIFA World Cup. They found that both English and Spanish fans displayed significant change in emotional state after the success and failure of their respective teams during the competition. The positive emotional state of winning the tournament persisted with the Spanish fans for four days. The Spanish fans reported spending more time socializing and spending more money than usual compared with the baseline. While the negative emotional state associated with exiting the tournament at an early stage did not have any effect on the English fans compared with usual behavior.

Berthier and Boulay (2003) hypothesized that with an exceptional positive sporting event the total effect of emotional and mental stress, immense fervor and the collective euphoria observed at the time of victory could be a decrease in cardiovascular mortality. They studied data from days surrounding the FIFA World Cup final in France 1998. They observed a significant decrease in mortality from myocardial infarction in French men on the day of the final July 12th.

2.3 Sports Events and Stock Returns

In recent decades authors have been more interested than ever before on the topic of sports events and its impact on stock returns. This increased interest has resulted in several published articles on the subject. This section consists of a review containing some of these articles, and their findings will be summarized at the end.

In 2003, J.K. Ashton, B. Gerrard and R. Hudson published an article called "Economic impact of national sporting success: evidence from the London stock exchange" in the Applied Economics Letters. They attempted to assess whether

the performance of the England national football team had an effect on subsequent daily changes in the FTSE 100 index, which represent the price of shares of the 100 largest companies traded on the London stock exchange. The data that were collected was daily data from FTSE from the period from January 6, 1984 to July 3, 2002. Also included were England's national football team's results from the same period. Ashton et al. (2003) found a statistically significant relationship between the performance of the national football team and the price of traded shares on the London stock exchange. They concluded that good (bad) performances by the national team lead to good (bad) market returns.

In response to Ashton et al. Christian Klein, Bernhard Zwergel and J. Henning Fock published an article in Applied Economics in 2009 titled "Reconsidering the impact of national soccer results on the FTSE 100" where they questioned certain elements and pointed out pitfalls in the original article. By replicating the study they discovered several minor mistakes, which in turn had severe result implications. Klein et al. concluded that their research could not significantly prove a relationship between the national football team's performance and market returns.

Furthermore, Ashton et al. themselves responded in a second article in 2011 with their publication "Do national soccer results really impact on the stock market?" in Applied Economics. While admitting to several flaws in their previous data gathering they still firmly believed in a significant relationship between soccer results and stock market returns. The paper expanded the research data from 2002 to 2009, included trimming of the data set to exclude outliers and adjusted for the majority of flaws that Klein et al. highlighted in their publication. Ashton et al. concluded that they still found a statistically significant relationship between soccer results and market returns, although only in the case where a bad performance lead to bad market returns.

In the same year as Ashton et al. published their first article about UK´s national soccer team and the effects on London stock exchange, G. Boyle and B. Walter published an article in Applied Financial Economics titled "Reflected glory and failure: international sporting success and the stock market". They set out to study whether the performance of New Zealand's national rugby team had any effect on

stock market returns in New Zealand. They theorized that since the national rugby team, or All Blacks, is of high importance for the New Zealanders it would lead to a strong psychological and emotional "relationship" that could have an impact on stock returns. Boyle and Walter (2003) did not find any relationship between All Blacks' results and market stock returns.

Edmans, Garcia and Norli published an article in 2007 titled "Sports sentiment and stock returns" in the Journal of Finance. The article investigated the stock market reaction to sudden changes in investor mood. By using international soccer, basketball, cricket and rugby results as a primary mood variable Edmans et al. were able to find a significant market decline after soccer losses. Moreover, the discovered loss effect was stronger in small stocks as well as after matches that were more important. They found no evidence of a similar positive effect after wins for any of the aforementioned sports.

Chang et al. (2012) undertook a fairly similar approach as Edmans et al. (2007), by doing a firm-level analysis of the relation between National Football League results and the returns on Nasdaq firms headquartered geographically near the NFL teams. The writers were able to locate each firm with a NFL team by comparing the zip codes of the firms and the NFL teams. After dividing firms into correct geographical area, the writers used a somewhat similar OLS regression as Edmans et al. (2007) with a data sample ranging from December 14, 1972 through December 31, 2004. Chang et al. (2012) found a loss effect after a defeat, and an even higher loss effect if the loss was not expected, but no support for a win effect. However, as the transaction costs would nearly remove all possible gains, this effect was too low to be profitable. The writers also found that small and more volatile firms had a stronger negative effect on the NFL teams' losses. By using almost identical methodology, Chang et al. (2012) found the same main characteristics as Edmans et al. (2007) found in their research paper.

Based on our selected articles, there has been a statistically significant loss effect after the relevant sports teams have lost, and even lower market returns after the teams have suffered a surprise defeat. However, G. Boyle and B. Walter (2003) did not find any effect at all.

3. Theory

3.1 Efficient Market Hypothesis

In 1953, Maurice Kendall wrote the paper "The analysis of Economic Time Series, Part 1: Prices", and found that stock prices had no predictable pattern and that a stock was as likely to go up, as it was to go down regardless of past performance. This was one of the first papers on the topic, and the essence of his paper was that stock prices should follow a random walk. Furthermore, that price changes should be random and unpredictable (Kendall, 1953).

This was the start of a well-known hypothesis called the efficient market hypothesis (EMH). Eugene Fama developed this hypothesis further during the 1960's. The hypothesis implies that it is impossible for an investor to consistently "beat the market" because the stock market efficiency will cause the share price to include all available relevant information at all times and thus, to be traded at its fair price. Fama argues that it would be impossible to outperform the market through expert selection and timing, and noted that the only way an investor could achieve higher results would be by investing in riskier investments. EMH says that a stock price reflect all available information.

It is common to distinguish among three versions of the EMH, depending on the meaning of "all available information":

1. The weak-form hypothesis asserts that stock prices already reflect all information contained in market trading data such as the history of past prices, trading volume, or short interest. This form of EMH state that technical analyses of stock prices are useless, since stock prices already has this information reflected in its price.

2. The semi-strong form hypothesis states that stock prices reflect all public information about firm's prospects such as annual reports, quality of management, patents held, earning forecasts etc. If investors do have this kind of information it is not of any value, as it would already be reflected in stock prices.

3. The strong-form hypothesis states that stock prices reflect all information relevant to the firm, even information that is only available to corporate insiders.

(E. Fama, 1970) (Bodie, Kane and Marcus, 2009).

3.2 Anomalies

Over the years, researchers have attempted to uncover anomalies in this hypothesis. Anomalies are defined according to Bodie, Kane and Marcus (2009) as patterns of returns that seem to contradict the efficient market hypothesis. There have been studies on many calendar anomalies over the years such as the day-of-the-week effect, year-end effect and the January effect. Already in 1942, Sidney B. Wachtel wrote about the January effect. He found that in eleven out of fifteen years from 1924 until 1939 there was an increase in the stock market of 5-10%, while in the four years without increase the highest decrease was 4%. Further studies on this topic resulted in a new research paper by Rozeff and Kinney (1976). Based on their study of the equally weighted index on the New York Stock Exchange they found seasonal patterns. January averaged a market increase of 3,48% while the rest of the months had an average increase of 0,42%. Furthermore, we distinguish between fundamental anomalies and technical anomalies. Fundamental anomalies are the value-effect, small-cap effect and the low-volatility anomaly and so on. Meanwhile, the momentum effect is defined as a technical anomaly. Anomalies in the stock market lead to abnormal returns.

3.3 Abnormal return

An abnormal return is estimated as the difference between the stock's actual return and its normal return. Normal return, or expected return, can be estimated by using several methodologies. In our case, the most relevant method is to estimate normal returns using an asset-pricing model such as the CAPM or one of its multifactor generalizations such as the Fama-French three-factor model (Bodie, Kane and Marcus 2009).

Abnormal return = Actual return – Normal return

Abnormal return is normal when looking at events such as IPO's (initial public offerings), dividend announcements, M&A's (merger and acquisitions), or other extraordinary announcements. Abnormal returns are also found when

psychological events occur such as sports results or terrorist attacks. As an example, the airline industry suffered an average decline of around 3-4% in their stocks after the horrific terrorist attacks in Brussels in 2016. In this case, a negative psychological effect on the willingness to use airplanes as transportation occurred, and most likely was the reason for the decline.

Very often, the stock price does not reflect such an event to take place, and therefore violates the EMH. Moreover, this psychological aspect is what we are going to study in this thesis by focusing on sports results. If we find abnormal return after these events, then the Oslo Stock Exchange is not efficient.

3.4 Mood

Mood is defined as a temporary state of mind or feeling. This feeling is often confused with emotions. While emotions have an acute effect (seconds or minutes), mood lasts over a longer period, usually for hours or days. Mood may be indirectly caused by a particular object, and is non-intentional. Mood tends to bias cognitive strategies and processing over a longer term. Moreover, mood will affect how external and internal events is appraised. If you are in a good mood, you will act or react positively, and if you are in a bad mood, you will act or react negatively. (Sears and Jacko, 2009, 55-56).

In our thesis, we attempt to find whether the results in the most popular sports in Norway have a mood effect on investors on the Oslo Stock Exchange.

4. Hypothesis development

As stated earlier Edmans et al. did a similar research in 2007, primarily on football, but also on other major sports in the world. They did not find any win effect (that sports results led to a positive market reaction), although they documented a loss effect (that sports results led to a negative market reaction). On average, the loss effect was smaller for other sports than football.

For our master thesis, we will focus on Oslo Stock Exchange, whether sports results have any effect on this market. Is the market efficient, and are investors rational? In order for us to test this, we will use the following hypothesis:

Our null hypothesis is that sports results do not affect the stock market. This implies that Oslo Stock Exchange is efficient and investors are rational. Sports results should in general be uncorrelated with asset prices, with the exception of listed football teams' stock. Our alternative hypothesis is that there are positive

stock market reactions after positive results, and/or negative stock market reactions after negative results. This alternative hypothesis is based on a logical interpretation of psychological thinking that a win results in a good mood for investors and a loss results in a bad mood, with subsequent mood effects on the markets.

5. Data and Methodology

5.1 Data

The data we use in this master thesis is time series. We have collected the stock returns from Thompson Reuters' program DataStream. We use OSEBX, adjusted for dividends, from 3 January 1983 to 18 April 2016. The OSEBX index is an investable index and consists of the 59 most traded shares listed on Oslo Stock Exchange. The index is semiannually adjusted with changes implemented 1 December and 1 June (Oslo Stock Exchange, 2016). We use daily data, and the index is traded five days a week (Monday, Tuesday, Wednesday, Thursday and Friday). If one of these days is a holiday, and therefore no trade takes place, we will set the return on this day to zero, and will thereby not be included in the model. This is done to avoid a biased result.

We have chosen to look at the seven most popular sports in Norway 2014-2015 (Sponsor Insight, 2015). These sports were cross-country, biathlon, handball, alpine skiing, football, ski jumping and Nordic combined, as can be seen from figure 1. We will use the results from World Championships, European Championships and the Olympic Games. These results have been collected using the respective sports federation websites as well as Wikipedia.com.

Since we have included sports without a typical win or loss result, we have chosen to define a cross-country, biathlon, alpine skiing, ski jumping or Nordic combined gold medal as a win effect, and all other placements is defined as a loss effect. We believe that this is a fair assumption, as Norwegians have a history of high performance in winter sports. In the case of football and handball, a win will give a win effect and a draw/loss will give a loss effect.

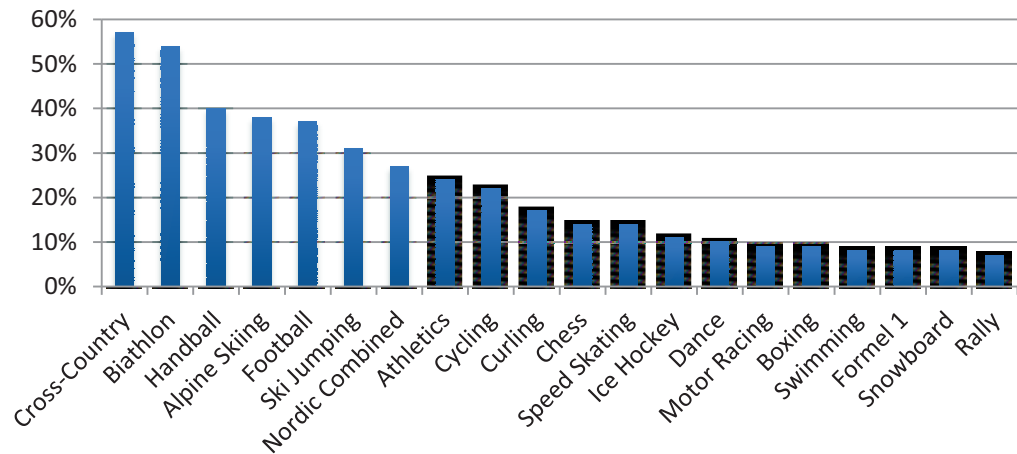## Most Watched Sports in Norway 2014Q2-2015Q1

Figure 1: Most watched sports in Norway 2014.

To measure the sports results effect on the stock returns, we have chosen to use the first trading day after the event. Moreover, this also applies when the outcome is known during the trading day. The reason for this is to ensure that we have the return for a complete day when the sports outcome is known.

During the Olympic Games and the World Championship in Nordic skiing there are several events during one day/weekend. Should at least one win occur over the course of the day/weekend we define the period to result in a win effect. Meanwhile, should all events result in losses and thus no gold medals, we define the day/weekend to result in a loss effect.

We calculate the daily percentage change of the stock returns by using the following calculations:

$$R_t = \ln(\frac{Index_t}{Index_{t-1}}),$$

where R_t is the percentage return on day t, *Index* is the daily index price for the OSEBX index on day t and *ln* is the natural logarithm.

5.2 Descriptive Statistics

Table 1 provides an overview of the number of total wins and losses over the sample period, and the number of wins and losses for each of the seven sports exclusively. Table 1 also provides the mean daily log returns and standard deviations in total, as well as for each individual sport. The basic data is presented in Panel A. In this sample there are 8100 days that are not associated with sports

events. The mean log daily return and standard deviation for these days are 4.3 and 135.2 basis points, respectively.

There are 318 days that are associated with a win, and the average log daily returns are negative 5 basis points and a standard deviation of 133.8 basis points. For the 267 days that are associated with a loss effect, the average log daily return is positive 13.1 basis points and the standard deviation is 109 basis points. Hence, the Oslo Stock Exchange has a negative effect on wins and a positive effect on losses. These observations are counter-intuitive, as a win should give a positive effect, and a loss should give a negative effect.

We observe that only ski jumping and handball give a positive win effect with a mean log daily return of 18.8 and 2.2 basis points, respectively. A loss effect can be found for the following sports: biathlon, ski jumping and Nordic combined with a mean log daily return of -4.4, -12.4 and -19.8 respectively. Thus, ski jumping is the only sport that has a positive market return on wins and a negative market return on losses. However, we have very few win effect observations for ski jumping so this effect may be "random".

Panel B is adjusted for expectations. Expectations for each sport are explained in chapter 5.5.1. There are 8216 observations that are not associated with sports events in this sample, which are 116 observations more than in Panel A. These trading days have a mean log daily return and a standard deviation of 4.5 and 135.3 basis points, respectively. These findings are fairly similar to those in Panel A. When adjusting for expectations, only ski jumping has a positive win effect, while handball has a negative win effect. Biathlon, ski jumping and Nordic combined maintain a negative loss effect, but to a lesser extent. These observations are not logical, as we have removed the events where a win/loss was expected. Thus, we should see a greater negative loss effect, as the losses are now a surprise. For now, the evidence from Table 1 suggests that sports results are not correlated with the Oslo Stock Exchange, and its returns.

Table 1
Number of Wins and Losses in the Seven Most Popular Sports in Norway
and Mean Daily Return on the First Trading Day After the Event

The table reports the number of wins and losses in the time period of Q1 1983 – Q2 2016 for the seven most popular sports in Norway, Football, Cross-Country Skiing, Biathlon, Alpine Skiing, Ski Jumping, Nordic Combined and Handball. The events that have been used are only major championships such as the World Championship (1998) and European Championship (2000) for football. For Handball events the World Championships (1986-2015), European Championships (1994-2016) and Olympic Summer Games (1988-2012) was used. World Championship (1983-2016) and Olympic Winter Games (1984-2014) is used for all the winter sports. Since some of the sports had an event in the same weekend, there will be more than 318 win events and 267 loss events when we calculate the mean and standard deviation for each sport exclusively. The mean returns are computed from the log daily returns on the Oslo Stock Exchange the first trading day after the event.

	No games			Wins			Losses		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Panel A: Basic data for the seven most popular sports in Norway									
No games	8100	0.043	1.352						
All games				318	-0.050	1.338	267	0.131	1.090
Football				3	-0.611	2.180	5	0.352	0.850
Cross-Country				74	-0.029	1.133	81	0.115	1.268
Biathlon				56	-0.121	0.919	102	-0.044	1.119
Alpine Skiing				25	-0.098	1.104	85	0.214	1.074
Ski Jumping				9	0.188	0.808	59	-0.124	1.195
Nordic Comb.				16	-0.045	1.044	42	-0.198	1.095
Handball				173	0.022	1.515	59	0.190	1.126
Panel B: Adjusted for expectation									
No games	8216	0.045	1.353						
All games				262	-0.084	1.261	207	0.105	1.104
Football				3	-0.611	2.180	5	0.035	0.850
Cross-Country				74	-0.029	1.087	66	0.070	1.377
Biathlon				56	-0.101	0.923	72	-0.082	1.221
Alpine Skiing				25	-0.098	1.104	35	0.284	0.795
Ski Jumping				9	0.188	0.808	24	-0.304	1.221
Nordic Comb.				16	-0.045	1.044	37	-0.219	1.022
Handball				107	-0.038	1.492	58	0.197	1.134

While working with this sample, we observe that nearly all events take place at the same time period every year. The winter sports events are during February and March, and handball events during December and January, with a few exceptions. Many of these events also occur between Friday afternoon and Sunday afternoon. This may introduce spurious day-of-the-week relationship between sports results and the Oslo Stock Exchange. In the next section, we will explain how we

perform our econometric method, and how to deal with these possible calendar problems.

5.3 Econometric Methods

For this part of our thesis we use a fairly similar model and procedure as Edmans et al. (2007) used in their article in the Journal of Finance (pp. 1975/1976). We also use an earlier thesis from Erasmus University Rotterdam, written by Astika (2010) as an inspirational source.

Since we are working with time series in our thesis, the first thing we have to control is that our data is a dataset with a constant mean, constant variance and constant auto-covariance for each given lag. Hence, that it is stationary. We control for these momentums by using Augmented Dickey-Fuller test. The hypothesis for this test is:

H_0: series contains a unit root

H_1: series is stationary (Brooks 2008).

Furthermore, we test the hypothesis explained in chapter 4, "Hypothesis development":

H_0: Sports results do not affect the stock market

H_1: there are positive stock market reactions after positive results, and/or negative stock market reactions after negative results.

In order to estimate wins and losses impact on stock returns while controlling for calendar effects such as the Monday effect, we first estimate the following Ordinary Least Square (OLS) regression:

$$R_t = \gamma_0 + \gamma_{1i}R_{t-1} + \gamma_{2i}D_{it} + \gamma_{3i}Q_t + \epsilon_t \quad (1)$$

Where R_t is the daily return, R_{t-1} is the previous day return, $D_{it} = (D_{1t}, D_{2t}, D_{3t}, D_{4t})$ are dummy variables for Monday through Thursday, and $Q_t = (Q_{1t}, Q_{2t}, Q_{3t}, Q_{4t}, Q_{5t})$ are dummy variables for days where the previous 1 through 5 days are non-weekend holidays. The lagged daily return R_{t-1} is included to account for first-order serial correlation. This model is fairly similar to

Edmans et al. (2007), although we have removed the world market index from our model, since we are only looking at one country.

We let $\hat{\epsilon}_t$ denote the residuals from regression (1). Moreover, we use the following regression model in order to estimate the effect of the outcome of the different sports results:

$$\hat{\epsilon}_t = \beta_0 + \beta_W W_t + \beta_L L_t + u_t \ (2),$$

where $W_t = (W_{1t}, W_{2t},....,)$ are dummy variables for wins in different sports and $L_t = (L_{1t}, L_{2t},....,)$ are loss dummies for the same set of sports. (Edmans et al. 2007. 1976)

If the samples fall during periods of high volatility, the magnitude of our standard errors would be biased downwards. In this case we use a GARCH (1,1) developed by Bollerslev (1986) and Taylor (1986). The GARCH model allows the conditional variance to be dependent upon previous own lags. The GARCH model is used since it can substitute the ARCH model with unlimited order. (Brooks 2008, 392)

After modeling stock returns using equation (1), we model the volatility of the error term from this regression as the GARCH (1,1) process

$$\sigma_t^2 = \lambda_0 + \lambda_1 \epsilon_{t-1}^2 + \lambda_2 \sigma_{t-1}^2,$$

where σ_t^2 is the index return volatility on day t. We then use the time series σ_t^2 to form the new time series of normalized stock index returns

$$R_t^0 = a + b\left(\frac{1}{\hat{\sigma}_t}\right) R_t,$$

where a and b are chosen so that the mean of R_t^0 is equal to zero and the standard deviation is equal to one. By normalizing all index returns, we eliminate the volatility in addition to the time-series variation adjustment of the GARCH model. The normalized returns, R_t^0, are then used in the model specification (1), from which we obtain a second set of normalized residuals, which we denote by $\tilde{\epsilon}_t$. (Edmans et al. 2007, 1976)

5.4 The Win and Loss Effect

Table 2 reports the most important findings of this master thesis. Unlike Edmans et al. (2007) we do not find any effect of sports results impact on Oslo Stock

Exchange. For our 318 wins the OLS coefficient on the win dummy is 6.5 basis points and not statistically significant. The 267 loss events results in a non-statistically OLS coefficient on the loss dummy, of 10.4 basis points.

Table 2
Abnormal Daily Stock Market Performance after Sports Results

This analysis is based upon 575 wins and losses during the period of 1983-2016. We have used 8685 trading days from the Oslo Stock Exchange and the table reports the values of β_W and β_L from the following equation ordinary least squares:

$$\hat{\epsilon}_t = \beta_0 + \beta_W W_t + \beta_L L_t + u_t$$

Where W_t is one if the event on the previous day was won and zero otherwise, and L_t is one if the event on the previous day was a loss or a draw and zero otherwise. In Panel A $\hat{\epsilon}_t$ is the "raw residuals" ϵ_t defined by the regression:

$$R_t = \gamma_0 + \gamma_{1i} R_{t-1} + \gamma_{2i} D_{it} + \gamma_{3i} Q_t + \epsilon_t$$

Where R_t is the daily return, R_{t-1} is the previous day return, $D_{it} = (D_{1t}, D_{2t}, D_{3t}, D_{4t})$ are dummy variables for Monday through Thursday, and $Q_t = (Q_{1t}, Q_{2t}, Q_{3t}, Q_{4t}, Q_{5t})$ are dummy variables for days for the previous 1 through 5 days are non-weekend holidays. The lagged daily return R_{t-1} is included to account for first-order serial correlation. Panel B is the abnormal normalized returns, which is calculated after using a GARCH (1,1) model.

	Wins			Losses		
	Number of games	β_W	t-Values	Number of games	β_L	t-Values
Panel A: Abnormal Raw Returns						
All games	318	-0.065	-0.84	267	0.104	1.24
Football	3	-0.678	-0.88	5	-0.035	-0.06
Cross-Country	74	-0.045	-0.29	81	0.098	0.66
Biathlon	56	-0.139	-0.77	102	-0.071	-0.53
Alpine Skiing	25	-0.107	-0.40	85	0.195	1.34
Ski Jumping	9	0.212	0.47	59	-0.124	-0.71
Nordic Combined	16	-0.056	-0.17	42	-0.207	-1.00
Handball	173	0.012	0.11	59	0.172	0.98
Panel B: Abnormal Normalized Returns						
All games	318	-0.081	-1.05	267	0.087	1.04
Football	3	-0.657	-0.85	5	-0.084	-0.14
Cross-Country	74	-0.054	-0.35	81	0.083	0.55
Biathlon	56	-0.168	-0.93	102	-0.088	-0.66
Alpine Skiing	25	-0.142	-0.53	85	0.168	1.15
Ski Jumping	9	0.179	0.40	59	-0.152	-0.87
Nordic Combined	16	-0.075	-0.22	42	-0.219	-1.06
Handball	173	0.001	0.01	59	0.162	0.93

These results do not make any psychological sense; a win will lead to a negative market reaction and a loss leads to a positive market reaction.

When we calculate the means and standard deviations for each sport we get a fairly similar result. Ski jumping and handball gives a positive market reaction after a win, with a coefficient of 21.2 and 1.2 basis points, respectively. However, none of these effects are statistically significant. When studying each individual sport after a loss, football, biathlon, ski jumping and Nordic combined all have negative coefficients, -3.5, -7.1, -12.4 and -20.7 basis points, respectively. Although, none of them are statistically significant. Indeed, none of our sports are statistically significant.

Panel B reports the abnormal normalized returns for the OLS coefficient on the win and loss dummies after a GARCH (1,1) has been used to normalize the returns. Since these returns are adjusted for high volatility periods, it is fair to assume that these are the most reliable returns. The win dummy gets an even higher negative return after this normalization (-8.1 basis points). The loss dummy is moving in the "right" direction (8.7 basis points), although not enough to prevent a negative result from leading to a positive market reaction. In fact, all sports react positively on the loss dummy, since all are moving towards a negative market reaction after the normalization. However, the same sports as in the "raw residual"-case are negative, and statistically insignificant. While we observe a trend in the loss dummy after normalization, there is no clear trend in the OLS coefficients of the win dummy.

Based on these findings we can conclude, for now, that Oslo Stock Exchange is not affected by the results of the seven most popular sports in Norway.

5.5 *Robustness Check*

To conclude whether the Oslo Stock Exchange is efficient, we need to perform robustness checks. We conduct a robustness check for expectation, as well as a robustness check where we remove all weekend events. By conducting these tests, we expect to conclude that Norwegian sports results do not have any effect on the stock returns on Oslo Stock Exchange. Thus, the market would be efficient.

5.5.1   Sports Results Based on Expectations and Stock Returns

We have previously stated, when applying sports results as a variable for mood, that the given variable must drive mood in a substantial and unambiguous way, so that its effect is strong enough to show up in asset prices.

Over the course of time the performance level of athletes can fluctuate, which in turn could lead to longer periods where Norwegian athletes are not considered to be represented within the utmost elite for a given sport or discipline. We predict that this in turn would, with high probability, have an effect on investor expectation. While for instance downhill skiing could be a popular sport in Norway, should the Norwegian athletes however over time be struggling to show any form of results, the general public would not expect gold medals at major events. Furthermore, these expectations would affect the strength of its impact asset prices. To represent this we construct constraints, which will affect the data sample by removing certain data points with loss effect and win effect as a result of expectation.

For all of cross-country skiing, ski jump, Nordic combined and alpine we expect that investors will have an expectation of gold medal for all events that calendar year if a Norwegian competitor placed within the top 5 of the World Cup final standings the previous season. If the previous season did not yield such a placement, a loss effect will not occur. Moreover, should a Norwegian competitor place within the top 5 the previous season and proceed to retire from international competition, this competitor will not count towards the initial constraint and should this individual happen to be the only competitor to place within the top 5, then a loss effect will not occur. If a Norwegian competitor is the reigning World champion or Olympic champion in the specific discipline investors would have an expectation of gold medal even though no Norwegians placed within the top 5 of the World Cup final standings the previous season. Should however the reigning champion retire, or by any chance not compete to defend his or her title, this constraint will not apply.

The dataset for handball and soccer differs from the other sports as they have several match days, which in contrast does not yield a certain outcome of gold or no gold. This could in turn lead to several match days that would be of less importance and would probably influence investor mood in a different degree.

Therefore, we remove the data points where the outcome of the match is irrelevant for the team's tournament progression.

Unfortunately, there are no international rating for neither the woman's handball nor the men's. As a result, we have chosen to use an unofficial ELO rating when calculating the expectation for woman's handball.
By using the following ELO formula we calculate the probability of a Norwegian victory.

$$P\left(Team\ H\ wins\right) = \frac{1}{10^{-(E_H - E_A)/400} + 1}$$

E_H = Elo rating Norway

E_A = Elo rating opposition

Should the probability equal 80% or more, then a win effect will not occur. Likewise, should the probability equal 20% or less, a loss effect will not occur. Another challenge is that there exists no historic ELO rating database and the most recent updated rating is from 2014, which is calculated using all games played since 2000. Thus, we run the risk of overvaluing certain teams historic performance level as the data set goes back to 1983. Therefore, we have chosen to include another constraint when calculating expectation to eliminate matches where the historic opposition's level was so low that an investor would take victory for granted, even though their current ELO rating would indicate otherwise. To reflect this effect we remove win effects if a margin of victory of 10 or more should occur. Similarly, we would remove loss effects with a margin of victory of -10 or less although there are no such cases in the data set.
As previously noted there exists no ranking for men's international handball. Furthermore, there does not even exist an unofficial ELO rating. As such, we are left with eliminating data points with large margin of victory.

Similarly to handball, championships in soccer are also run in a tournament format, and we would remove data points where the outcome of a match day would have no effect for progression but there are no such cases. Meanwhile, there exists a historic ELO rating for men's international soccer. Therefore, we apply the ELO rating constraint to soccer as with the woman's handball although without taking margin of victory into account.

We calculate the probability of a Norwegian victory. Should the probability equal 80% or more, then a win effect will not occur. Likewise, should the probability equal 20% or less, a loss effect will not occur. In neither case does this constraint have any effect on the set of data.

The data sample is reduced by 116 events after taking all these constraints into account, with handball wins and Biathlon losses as the most affected sports. The number of wins is reduced by 56 observations and the number of losses is reduced by 60 observations. However, the total reduction per sport is higher than 116 observations since some sports have an event on the same day/weekend.

Table 3
Abnormal Daily Stock Market Performance After Sports Results, Adjusted for Expectations

This analysis is based on the same method as Table 2, but after adjusting for expectations, which is explained above. After adjusting for expectations we are left with 469 win and loss events, a reduction of 116 events from our original analysis.

	Wins			Losses		
	Number of games	β_W	t-Values	Number of games	β_L	t-Values
Panel A: Abnormal Raw Returns based on expectation						
All games	262	-0.100	-1.19	207	0.079	0.84
Football	3	-0.678	-0.88	5	-0.035	-0.06
Cross-Country	74	-0.043	-0.27	66	0.048	0.29
Biathlon	56	-0.128	-0.71	72	-0.105	-0.66
Alpine Skiing	25	-0.107	-0.40	35	0.274	1.21
Ski Jumping	9	0.212	0.47	24	-0.31	-1.15
Nordic Combined	16	-0.056	-0.17	37	-0.231	-1.05
Handball	107	-0.049	-0.37	58	0.181	1.02
Panel B: Abnormal Normalized Returns based on expectation						
All games	262	-0.119	-1.42	207	0.067	0.71
Football	3	-0.657	-0.85	5	-0.084	-0.14
Cross-Country	74	-0.052	-0.34	66	0.031	0.18
Biathlon	56	-0.157	-0.87	72	-0.124	-0.78
Alpine Skiing	25	-0.143	-0.53	35	0.266	1.17
Ski Jumping	9	0.179	0.40	24	-0.345	-1.26
Nordic Combined	16	-0.075	-0.22	37	-0.239	-1.08
Handball	107	-0.063	-0.48	58	0.172	0.97

Table 3 provides the results of the same OLS regression that we used earlier in the thesis, adjusted for these expectations. In this section, we will only comment on

the normalized returns as these are adjusted for periods with high volatility. The win effect for the 262 wins is now -11.9 basis points, which is 3.8 basis points worse. Meanwhile, the loss effect for the 207 losses is reduced to 6.7 basis points, which is a reduction of 2 basis points. While the reduction of the loss effect seems logical, even though it is still positive, the change in the win effect is illogical. Furthermore, none of the win or loss coefficients for any sports are statistically significant.

There have been no change in the number of win observations in any other sports than handball. Therefore, we conclude that this illogical change in the win effect comes from the handball events. The win effect on the handball events change from 0.1 basis points to -6.3 basis points. Based on these findings, we investigate whether handball has too great of an impact on the data set, and remove all handball events. We find that the OLS coefficient for the win dummy based on normalized returns is -15.3 basis points. The result for the win dummy is now even more negative, and the loss dummy is 3 basis points, which is lower than when the handball events are included. However, none of the coefficient is statistically significant.

The change in loss effect is of much more interest. The number of observations change for all sports except football. Cross-country skiing, biathlon, ski jumping and Nordic combined experience a decreased positive coefficient or an increased negative coefficient on the loss dummy, as we expected when making these constraints. Cross-country skiing is 3.1 basis points (5.2 basis points reduction), biathlon is -12.4 basis points (3.6 basis points reduction), ski jumping is -34.5 basis points (19.3 basis points reduction) and Nordic combined is -23.9 basis points (2 basis points reduction).

The coefficient for the loss dummy for alpine skiing and handball become even more positive after adjusting for expectation with a change of 9.8 and 1 basis points respectively.

Even after adjusting for expectations, the Oslo Stock Exchange is efficient, and we can see no clear trend that positive sports results lead to positive stock returns, and visa versa.

5.5.2 Win and Loss effect without weekend events

Our second robustness check takes into account that several events occur during one weekend. These weekend-events are common during the Olympic Games and FIS Nordic World Ski Championships. Based on our assumptions, one weekend that consists of several events where one of the events result in a gold medal will lead to a win effect. As an example, Norway competed in seven competitions over the weekend of 17. February until 19. February during the Olympics in Torino, 2006. The result was only one gold medal, taken by Kjetil André Aamodt in alpine skiing. This assumption is therefore quite harsh and we study whether we can find that sports results affect Oslo Stock Exchange, and its market returns, by removing these events.

Table 4
Abnormal Daily Stock Market Performance After Sports Results, Without Weekend Events

This table provides an overview of the 374 win and loss events, coefficient values and t-values for the win and loss dummies. The method used in this table is the same as in Table 1, but all events during a weekend are removed. This is done because of the large number of events during one weekend, especially in Winter Olympics and FIS Nordic World Ski Championships.

	Wins			Losses		
	Number of games	β_W	t-Values	Number of games	β_L	t-Values
Panel A: Abnormal Raw Returns without weekend events						
All games	196	-0.068	-0.71	178	0.189*	1.86
Football	(2)	0.471	0.50	(3)	0.001	0
Cross-Country	52	0.051	0.27	51	0.020	0.11
Biathlon	27	-0.113	-0.44	62	0.110	0.64
Alpine Skiing	(13)	-0.145	-0.39	43	0.245	1.20
Ski Jumping	(5)	0.167	0.28	23	-0.329	-1.18
Nordic Combined	(7)	-0.047	-0.09	26	-0.157	-0.60
Handball	112	-0.076	-0.60	38	0.401*	1.88
Panel B: Abnormal Normalized Returns without weekend events						
All games	196	-0.073	-0.75	178	0.187*	1.84
Football	(2)	0.499	0.53	(3)	-0.049	-0.06
Cross-Country	52	0.050	0.27	51	0.019	0.10
Biathlon	27	-0.125	-0.48	62	0.110	-0.64
Alpine Skiing	(13)	-0.162	-0.43	43	0.243	1.18
Ski Jumping	(5)	0.146	0.24	23	-0.356	-1.27
Nordic Combined	(7)	-0.051	-0.10	26	-0.162	-0.62
Handball	112	-0.079	-0.62	38	0.415*	1.90

Note: Statistically significant at 1%=***, 5%=** and 10%=*

Table 4 reports the values of the coefficient of the win and loss dummies for all sports events in total as well as for each individual sport. For the 196 win dummies the OLS coefficient on the abnormal normalized returns is -7.3 basis points and insignificant. The OLS coefficient on the loss dummy is statistically significant on the 10% level, with a value of 18.7 basis points. Meaning that a loss in a non-weekend event will lead to a positive market return on the next trading day, which goes against all psychological research. This result says that you can earn positive profits of 0.187% the day after a loss. However, possible profits are so low, that even with extremely low transaction costs, they are highly unlikely.

When studying each sport exclusively we notice that for some sports the number of observations are too low, making the findings useless. These observations are in parentheses in table 4. The most interesting finding is that the 38 loss events in handball lead to a statistically significant (10%-level) result of 41.5 basis points, meaning that handball has a great impact on the total result on the loss dummy for all games. After removing all handball events we get an insignificant (t-value of 0.85) OLS coefficient for the loss dummy of 9.7 basis points. This means that the all games loss dummy is highly affected by the handball events.

We conclude, based on our robustness checks, that the Oslo Stock Exchange is efficient and the results from the seven most popular sports in Norway do not affect its stock returns.

6. *Possible Explanations of Our Findings*

6.1 The Number of Foreign Investors

The number of foreign investors have increased greatly since 1983 until 2016. In fact, since 1999-2013 the percentage of foreign investors has increased from 31.5% to 37% (Oslo Børs, 2014). Based on our calculations from the report of key numbers from 2015 (ww.oslobors.no) the number of foreign investors has increased further to 46.2%, and the weakness of the Norwegian Kroner is expected to increase the amount of foreign investors even further. This could have great impact on our research. Foreign investors will not be emotionally affected by the results of the Norwegian athletes. Therefore, further research could set out to study whether firms with low foreign ownership are greater effected by sports results than firms with high foreign ownership.

We have chosen to run an OLS test on the OSESX-index, to test whether the number of foreign investors might have an impact on our findings. The OSESX-index includes the 10% lowest capitalized shares on Oslo Stock Exchange, and is adjusted for dividend payments. By using this index, we believe that the vast majority of foreign investors are excluded from the dataset as one can assume that foreign investors invest in larger companies.

Table 5
Abnormal Daily Stock Market Performance after Sports Results (OSESX)

This table provides an overview of the 423 wins and losses during the sample period of 1996-2016, by using the same OLS regression as in table 2 on the 5296 trading days.

	Wins			Losses		
	Number of games	β_W	t-Values	Number of games	β_L	t-Values
Panel A: Abnormal Raw Returns						
All games	254	-0.125	-1.92*	169	0.112	1.41
Football	2	0.098	0.14	3	-0.181	-0.31
Cross-Country	54	-0.235	-1.69*	40	-0.042	-0.26
Biathlon	45	-0.105	-0.69	67	0.009	0.08
Alpine Skiing	19	-0.098	-0.42	52	0.148	1.05
Ski Jumping	4	-0.541	-1.06	37	-0.274	-1.63
Nordic Combined	9	-0.077	-0.23	31	-0.387	-2.12**
Handball	151	-0.66	-0.79	48	0.300	1.56
Panel B: Abnormal Normalized Returns						
All games	254	-0.134	-2.44**	169	0.105	1.31
Football	2	0.031	0.043	3	-0.251	-0.43
Cross-Country	54	-0.231	-1.65*	40	-0.036	-0.23
Biathlon	45	-0.135	-0.88	67	0.005	0.04
Alpine Skiing	19	-0.139	-0.89	52	0.129	0.91
Ski Jumping	4	-0.605	-1.18	37	-0.299	-1.78*
Nordic Combined	9	-0.088	-0.26	31	-0.403	-2.19**
Handball	151	-0.070	-0.83	48	0.206	1.39

*=10%, **=5%, ***=1%

The OSESX-index dataset is downloaded from Datastream and ranges from 01.01.1996 until 18.04.2016. Although this dataset is smaller than the OSEBX-index, the results will be of value to our research. By conducting the same OLS regression as for the OSEBX-index earlier in our research, we ended up with a few statistically significant results on the normalized data. Looking at the 254 wins we get a statistically significant negative return on the 5 percent level (-1.34 basis points). Furthermore, we get a statistically significant negative return on the

10 percent level for the 54 cross-country wins (-2.31 basis points). An interesting finding is that a win by the national team results in a negative abnormal return on the OSESX-index, which one would regard as counter-intuitive. While looking at the losses we do get statistically significant negative returns on ski jumping and Nordic combined of -2.99 and -4.03 basis points respectively. This finding is consistent with Edmans et al. (2007). The negative return on ski jumping and Nordic combined is of much greater degree when using the OSESX-index rather than the OSEBX-index. This might prove that the number of foreign investors do have an impact on the OSEBX-index. However, we do not get the same pattern when looking at other sports, which might indicate that this pattern is random.

Table 6
Abnormal Daily Stock Market Performance After Sports Results, Adjusted for Expectations (OSESX)

This analysis is based on the same method as Table 2, but after adjusting for expectations. After adjusting for expectations we are left with 340 win and loss events, a reduction of 83 events from our analysis in Table 5.

	Wins			Losses		
	Number of games	β_W	t-Values	Number of games	β_L	t-Values
Panel A: Abnormal Raw Returns						
All games	204	-0.123	-1.70*	136	0.116	1.31
Football	2	0.098	0.14	3	-0.181	-0.30
Cross-Country	54	-0.237	-1.71*	36	-0.056	-0.32
Biathlon	45	-0.105	-0.69	50	-0.027	-0.19
Alpine Skiing	19	-0.010	-0.42	26	0.260	1.30
Ski Jumping	4	-0.540	-1.06	14	-0.337	-1.24
Nordic Combined	9	-0.077	-0.22	26	-0.433	-2.17**
Handball	91	-0.074	-0.69	47	0.240	1.62
Panel B: Abnormal Normalized Returns						
All games	204	-1.374	-1.89*	136	0.113	1.27
Football	2	0.031	0.04	3	-0.251	-0.43
Cross-Country	54	-0.232	-1.66*	36	-0.048	-0.28
Biathlon	45	-0.136	-0.89	50	-0.036	-0.25
Alpine Skiing	19	-0.139	-0.59	26	0.260	1.29
Ski Jumping	4	-0.604	-1.18	14	-0.337	-1.24
Nordic Combined	9	-0.088	-0.26	26	-0.443	-2.21**
Handball	91	-0.087	-0.80	47	0.218	1.46

*=10%, **=5%, ***=1%

We also analyzed the same dataset using expectations (Table 6).

Our findings were not surprisingly quite similar to the findings from Table 5. The abnormal returns have moved in the logical direction, which is a more positive negative return when the results are positive and a more negative abnormal returns when the sport result was negative (with the exception of alpine skiing and handball).

Based on this dataset we are not able to conclude whether the number of foreign investors have an impact on our research question. The reason for this is the dataset which ranges on a different timeframe as the OSESX-index was created as late as in 1996. Based solely on the analysis of the OSESX-index however, we can conclude that Norwegians are affected by the results of ski jumping and Nordic combined as a negative result gives a statistically significant negative return.

6.2 Norwegians and Their High Expectations

Norwegians are said, at least by themselves, to be born "with skis on their feet". As a result, Norwegians tend to have high expectations of their winter athletes. The Olympic Games in Torino, 2006 is still considered a sporting disaster by the general Norwegian public, resulting in only two gold medals. With the number of gold medals ranging from 9-13 in all winter Olympics since 1992, Torino was one big disappointment. However, this sub-performance did not actually affect the Oslo Stock Exchange. Is this evidence that the Norwegians do not care about the results? Could their high expectation result in a positive mood when they win, but their high expectations make this win-effect disappear?

7. Conclusion

Stock markets are said to be efficient and that stock prices reflects all available information. In this thesis, we wanted to test whether irrelevant information, such as sports results, could have an impact on stock prices. We chose to study Oslo Stock Exchange's efficiency and the rationality of its investors.

We used events ranging from 1983 to 2016, for the seven most popular sports in Norway. By conducting a fairly similar approach as Edmans et al. (2007) we were able to test whether a win by Norwegian athletes resulted in a positive market reaction and whether a loss resulted in a negative market reaction. We

knew that Edmans et al. (2007) found a statistically significant loss effect after the national football team lost a football match.

Based on our 575 win and loss events, we did not find any statistically significant results. We also tested our data in two other ways. We first took expectations into account, and saw whether surprising results could lead to a different outcome. This robustness check gave the same conclusion as our original method. Furthermore, we removed all weekend events, since our definition of win and loss effects could result in a scenario where Norway would win one event and lose four events over the course of one weekend. Hence, using such a gold medal as a win effect might lead to a biased result. However, after removing all weekend events we arrived at the same conclusion.

We conducted the same analysis of the OSESX-index to reduce the number of foreign investors in our dataset. Our findings were a statistically significant negative return on ski jumping and Nordic combined, which is consistent with the findings of Edmans et al. (2007).

Overall, we concluded that Oslo Stock Exchange is efficient and its investors are rational.

For further research on the topic of investor sentiment, sports results and stock returns, we would recommend further studying of whether small and local firms, with low amount of foreign investors, might give a different conclusion. Our dataset on the OSESX-index was not the same length as for the OSEBX-index and therefore difficult to compare. Since foreign investors are indifferent to the results by Norwegian athletes, the high level of foreign investors on the OSEBX index could possibly over-shadow this effect.

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Sports Sentiment Effect at Oslo Stock Exchange

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Table of Contents

Introduction

Our thesis is founded on behavioral biases and its impact on asset prices. Moreover, investigating the effect of investor mood and sentiment on asset prices. There are two principal approaches when conducting this research, which either link returns to a single event or to a continuous variable that impacts mood. Examples of the former could be to study the impact of the results of football matches and the latter could be the impact of sunshine.

Edmans et al. (2007) state that the main advantage of conducting an event approach is how it clearly identifies a sudden change in the mood of investors through the presence of a larger signal-to-noise ratio, should it occur. On the other hand, the main disadvantage of the event approach is how the number of observations have a tendency to be significantly lower, which in turn could result in a reduced statistical power.

Football, known in some parts of the world as soccer, is the world's most popular sport played by an estimated 250 million people across 200 nations.

Every four years FIFA, the governing body of football, organize the World Cup, which is the largest sports event in the world, only rivaled by the summer Olympic Games. For their national team to partake in such a tournament each country attempts to qualify through regional qualifications, which span across the 18 months leading up to the final tournament. In addition to the World Cup, other major football tournaments are the European Cup as well as the Copa America. The significant amount of broadcast viewing figures, media coverage, attendance and merchandise sales from international football clearly indicate that football is of national interest in large parts of the world. As a result we have chosen to use international football match results as a variable in an attempt to measure the effect of investor sentiment on asset prices.

The stock market should follow the efficient market hypothesis, EMH. If we can find evidence that the stock market react to investors mood through football results, then the stock market is not efficient. If the market reactions the day after a football match is large enough, investors can earn money by trading on this observed trend.

Research question and implications:

As previously noted, this paper will research whether one can find an effect of investor mood and sentiment on asset prices using football results. Previous research have proven loss effects, but no win effect. Our thesis set out to investigate whether we can find this effect on the Oslo Stock Exchange, and compares this result with a sample of selected countries in the world. The research question for our thesis is therefore:

"Does investor sport sentiment have a different effect in Norway compared with the rest of the world?"

The initial process in our thesis is to investigate whether investor sport sentiment affect the stock market returns using a fairly large sample of 30-40 countries, excluding Norway. These countries will be selected based on their football history and available data. Furthermore, we will investigate whether the results from the previous sample holds true when isolating the sample to only include data for the Norwegian national football team and the Oslo Stock Exchange.

While gathering literature on investor sentiment we came across an article by Edmans et al. (2007), which we found to have an approach fairly similar to what we had intended for our thesis. We will employ, to a large degree, the same methodology as Edmans et al. while differentiating on certain aspects of research approach:

Our dataset will be larger and range from 1973-2015. We will limit ourselves to only focus on football results. As a result our range of countries will be smaller than Edmans et al.

When investigating for investor sentiment effect on market returns at Oslo Stock Exchange we will employ a less advanced model.

Literature review:

Several articles have been written on the subject of investor sentiment and the stock market. In this first section, we will review the literature on research on investor sentiment and the stock market, and over the subsequent sections, we will look at the literature on investor sentiment caused by sport and its effect on the stock market.

Malcolm Baker and Jeffrey Wurgler published their article "Investor Sentiment and the Cross-Section of Stock Returns" in the Journal of Finance in 2006. They set out to study how investor sentiment affects the cross-section of stock returns, i.e. why stock A earns higher/lower return than stock B. Baker and Wurgler (2006) used monthly stock returns between 1963 and 2001 to test how the cross-section of subsequent stock returns varies with beginning-of-period sentiment. Baker and Wurgler found that "when sentiment is estimated to be high, stocks that are attractive to optimists and speculators and at the same time unattractive to arbitrageurs - younger stocks, small stocks, unprofitable stocks, non-dividend-paying stocks, high volatility stocks, extreme growth stocks, and distressed stocks - tend to earn relatively low subsequent returns".

J.K. Ashton, B. Gerrard and R. Hudson published an article in 2003 called "Economic impact of national sporting success: evidence from the London stock exchange" in the Applied Economics Letters. They attempted to assess whether the performance of the England national football team had an effect on subsequent daily changes in the FTSE 100 index, which represent the price of shares of the 100 largest companies traded on the London stock exchange. The data that were collected was daily data from FTSE from the period from January 6, 1984 to July 3, 2002. As well as England's national football team results from the same period. Ashton et al. (2003) found a statistically significant relationship between the performance of the national football team and the price of traded shares on the London stock exchange. They concluded that good (bad) performances by the national team lead to good (bad) market returns.

In response to Ashton et al. Christian Klein, Bernhard Zwergel and J. Henning Fock published an article in Applied Economics in 2009 titled "Reconsidering the impact of national soccer results on the FTSE 100" where they question certain

elements and point out pitfalls in the original article. By replicating the study they discovered several minor mistakes, which in turn had severe result implications. Klein et al. concluded that their research could not significantly prove a relationship between the national football team's performance and market returns.

Furthermore, Ashton et al. themselves responded in a second article in 2011 with their publication "Do national soccer results really impact on the stock market?" in Applied Economics. While admitting to several flaws in their previous data gathering they still firmly believed in a significant relationship between soccer results and stock market returns. The paper expanded the research data from 2002 to 2009, included trimming of the data set to exclude outliers and adjusted for the majority of flaws that Klein et al. highlighted in their publication. Ashton et al. concluded that they still found a statistically significant relationship between soccer results and market returns, although only in the case where a bad performance lead to bad market returns.

In the same year as Ashton et al. published their first article about UK´s national soccer team and the effects on London stock exchange, G. Boyle and B. Walter published an article in Applied Financial Economics titled "Reflected glory and failure: international sporting success and the stock market". They set out to study whether the performance of New Zealand's national rugby team had any effect on stock market returns in NZ. All Blacks is important for the New Zealanders leading to a strong psychological and emotional "relationship" that could have an impact on stock returns. Boyle and Walter (2003) did not find any relationship between All Blacks results and market stock returns.

Edmans, Garcia and Norli published an article in 2007 titled "Sports sentiment and stock returns" in the Journal of Finance. The article investigated the stock market reaction to sudden changes in investor mood. By using international soccer, basketball, cricket and rugby results as a primary mood variable Edmans et al. were able to find a significant market decline after soccer losses. Moreover, the discovered loss effect were stronger in small stocks as well as after matches that were more important. They found no evidence of a similar positive effect after wins for any of the aforementioned sports.

Elisabete Vieira published two articles in 2012 where she used the results from 2008 European Football Championship and 2010 FIFA World cup to study whether investor sentiment influence the stock price reaction to football match results.

Based on Euro 2008 Vieira found evidence for negative market reactions after losses. She also found negative market reactions after wins, but after adjusting for a bearish market (financial crisis) there was evidence for a positive reaction after wins. This is consistent with the findings by Ashton et al. (2003, 2011) and Edmans et al. (2007).

Based on the study of the 2010 World Cup, she did not find any relationship between football results and the stock market. This is consistent with the findings of Boyle and Walter (2003). She also set out to study whether a win or loss could lead to higher volume traded. Expectations was that a win would give a positive psychological experience, which further give a more optimistic view on the stock market. Vieira did not find any relationship between football results and volume trading.

Theory

A well-known hypothesis in the world of finance is the efficient-market hypothesis (EMH) developed by Eugene Fama during the 1960's. The hypothesis implies that it is impossible for an investor to consistently "beat the market" because the stock market efficiency will cause the share price to always include all available relevant information and to be traded at its fair price. Fama argues that it would be impossible to outperform the market through expert selection and timing, and notes that the only way an investor could achieve higher results would be by investing in riskier investments.

It is common to distinguish between three versions of EMH: weak-form efficiency, semistrong-form efficiency and strong-form efficiency; the weak-form state that stock prices already reflect all information contained in market trading data. Semistrong-form states that stock prices reflect all public information about firm's prospects such as annual reports etc. Strong-form states that stock prices reflect all information relevant to the firm, even information that is only available to corporate insiders (Bodie, Kane and Marcus, 2009).

Over the years, researchers have attempted to uncover anomalies in this hypothesis. Anomalies are defined according to Bodie, Kane and Marcus (2009) as patterns of returns that seem to contradict the efficient market hypothesis. There has been studies on many calendar anomalies over the years such as the day-of-the-week effect, year-end effect and the January effect. Already in 1942, Sidney B. Wachtel wrote about the January effect. He found that in eleven out of fifteen years from 1924 until 1939 there was an increase in the stock market of 5-10%, while in the four years without increase the highest decrease was 4%. Further studies on this topic resulted in a new research by Rozeff and Kinney (1976). Based on their study of the equally weighted index on the New York Stock Exchange they found seasonal patterns. January averaged a market increase of 3,48% while the rest of the months had an average increase of 0,42%. Furthermore, we distinguish between fundamental anomalies and technical anomalies. Fundamental anomalies is the value-effect, small-cap effect and the low-volatility anomaly and so on. While the momentum effect can be named as a technical anomaly.

Anomalies in the stock market lead to abnormal returns. An abnormal return is estimated as the difference between the stock's actual return and its normal return. Normal return, or expected return, can be estimated by using several methodologies. In our case, the most relevant method is to estimate normal returns using an asset pricing model such as the CAPM or one of its multifactor generalizations such as the Fama-French three factor model (Bodie, Kane and Marcus 2009).

Abnormal returns is common when a company announces dividend payments, IPOs, merger and acquisitions and so on. Certain research has indicated that psychological aspects could lead to abnormal returns; this aspect effect is what we aim to investigate further in our thesis. Edmans et al. (2007) find evidence that sports results affects investors mood and thereby market returns, Meanwhile, Dowling and Lucey (2005) find that weather, biorhythms and belief-based factors similarly affect investors mood.

Baker and Wurgler (2007) define investor sentiment as a belief about future cash flows and investment risks that is not justified by the facts at hand.

Investors incorporate irrational reactions and emotions while evaluating assets. As a result, investor mood could cause asset prices to deviate from the present value of future cash flows. People who are in good (bad) mood are more optimistic (pessimistic) in regards to their investment choices and judgements (Hirshleifer, 2001).

Methodology:

Our null hypothesis for our initial part of the research is that the results of football matches do not affect the stock markets. This implies that markets are efficient and investors are rational. Football results should in general be uncorrelated with asset prices, with the exception of listed football teams stock. Our alternative hypothesis is that there are positive stock market reactions after wins, and/or negative stock market reactions after losses. This alternative hypothesis is based on a logic interpretation of psychological thinking that a win results in a good mood and a loss results in a bad mood.

For this part of our thesis we plan to use the same model and procedure that Edmans et al. (2007) used in their article in Journal of Finance (pp. 1975/1976).

> "In order to estimate wins and losses impact on stock returns while controlling for calendar effects, such as the Monday effect, we first estimates the following model for each country i:

$$R_{it} = \gamma_{0i} + \gamma_{1i}R_{it-1} + \gamma_{2i}R_{mt-1} + \gamma_{3i}R_{mt} + \gamma_{4i}R_{mt+1} + \gamma_{5i}D_t + \gamma_{6i}Q_t + \epsilon_{it} \quad (1)$$

> Where R_{it} is the continuously compounded daily local currency return on a broadly based stock market index for country i on day t, R_{mt} is the continuously compounded U.S. dollar return on Datastream world market index on day t, $D_t = (D_{1t}, D_{2t}, D_{3t}, D_{4t})$ are dummy variables for Monday through Thursday, and $Q_t = (Q_{1t}, Q_{2t}, Q_{3t}, Q_{4t}, Q_{5t})$ are dummy variables for days for the previous 1 through 5 days are non-weekend holidays.

> The lagged index return, R_{it-1} is included to account for first-order serial correlation. To the extent that international stock markets are integrated,

the return on local indices will be correlated across countries. The contemporaneous return on the world market portfolio, R_{mt} is included to control for this correlation. Since some local markets may be lagging the world index while other may be leading the index, the model also includes R_{mt-1} and R_{mt+1}. We estimate the model simultaneously for all countries by interacting each independent variable with a set of country dummies. Let $\hat{\epsilon}_{it}$ denote the residuals from regression (1).

We estimate the effect of the outcome of international soccer matches using the regression model

$$\hat{\epsilon}_{it} = \beta_0 + \beta_W W_{it} + \beta_L L_{it} + u_{it} \quad (2)$$

where $W_{it} = (W_{1it}, W_{2it},....,)$ are dummy variables for wins in different game subgroups and $L_{it} = (L_{1it}, L_{2it},....,)$ are loss dummies for the same set of game subgroups. As in Hirshleifer and Shumway (2003), we estimate the above model using panel-corrected standard errors (PCSE), which assumes that the error terms u_{it} are mean zero and uncorrelated over time, but allows for heteroscedasticity and contemporaneous correlation across countries." (Edmans et al. 2007, 1975-1976)

If the samples fall during periods of high volatility the magnitude of our standard errors would be biased downwards. In this case we will have to use a GARCH (1,1). The GARCH model was developed by Bollerslev (1986) and Taylor (1986). The GARCH model allows the conditional variance to be dependent upon previous own lags. The GARCH model is used since it can substitute the ARCH model with unlimited order. (Brooks 2008, 392)

"After modeling stock returns using equation (1), we model the volatility of the error term from this regression as the GARCH (1,1) process $\sigma_{it}^2 = \lambda_{0i} + \lambda_1 \epsilon_{it-1}^2 + \lambda_{2i} \sigma_{it-1}^2$, where σ_{it}^2 is the index return volatility for country i on day t. We then use the time series σ_{it}^2 to form the new time series of normalized stock index returns $R_{it}^0 = a_i + b_i(\frac{1}{\hat{\sigma}_{it}})R_{it}$, where a_i and b_i are chosen so that the mean of R_{it}^0 is equal to zero and the standard deviation is equal to one. By normalizing all index returns, we eliminate

the heterogeneity in volatility across countries in addition to the time-series variation adjustment of the GARCH model. The normalized returns, R_{it}^0, are then used in the model specification (1), from which we obtain a second set of normalized residuals, which we denote by $\tilde{\epsilon}_{it}$." (Edmans et al. 2007, 1976)

In the second part of our research our null hypothesis is that there are no effect of investor sport sentiment in Norway. Our alternative hypothesis is that there are positive stock market reactions after wins, and/or negative stock market reactions after losses.

Since we only investigate one country when investigating the effect for the Norwegian international football teams result on the Norwegian stock exchange we have to remove the world index from the regression.

$$R_{it} = \gamma_{0i} + \gamma_{1i}R_{it-1} + \gamma_{2i}D_t + \gamma_{3i}Q_t + \epsilon_{it} \quad (3)$$

Where the variables are the same as in (1).

Data:

Our dataset will include international football results consisting of important qualifying matches as well as final tournament matches for the following tournaments: FIFA World Cup, UEFA European Championship, African Cup of Nations, AFC Asian Cup and Copa America. We choose not to include the Olympic Games as this tournament has restrictions of only a certain amount of non-youth players.
At this point in time, we have not found a complete dataset. If we are not able to obtain such a set, we will manually gather the data ourselves.

We need to collect the local market return for each individual country, as well as a world market index. These indices will be collected from Thompson Reuters program DataStream.

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