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The Olympic Games
- Investor Mood and its Effect on the Stock Market

Abstract: In this paper, we study the Olympic Games and the outcome of the events from a behavioral perspective. As a proxy for investors' mood, a gold medal is used in order to show the impact on investors' trading behavior caused by a positive sport event. The dataset consists of 242 gold medals from eight Olympic Games between the years 1998 to 2014. For the individual tests on events where more than one gold medal won on the same day or gold medals won two days in a row, we cannot find significant support that gold medals affect investors' mood and thus their trading behavior on the stock market. However, on a weak statistical significance level, after adjusting for extreme outliers, the results when including all gold medal events indicate that gold medals have a positive impact on investors' mood, with a lagging effect of two days.

Keywords: Behavioral finance, investor sentiment, mega sport events, the Olympic Games, non-parametric test

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I: Introduction

The previous research of finance can in its simplest form be divided into two large research areas. On the one hand, there is research made on the neo-classical perspective, studying the rational investors in an efficient market. On the other hand, a growing part of literature, both previous and current, are focusing on behavioral finance, studying irrational investors trading on the market. As explained by Schiller (2003), the field of behavioral finance is more of a complement to the neo-classical finance, than a mutual exclusive alternative. Within the area of behavioral finance, theories have been developed trying to explain reactions on the market not fully explained by rational investors. An example of such research, showing irrational reactions of investors acting on the market, is Schumway and Hirschleifer (2003), who show how sunny weather can have an impact on investment decisions and asset pricing.

Another area of which behavioral finance recently has been applied to is sports. Due to the importance of sport events throughout the history, it is reasonable to think that other human factors, such as emotions and mood, may be affected from outcomes of such sport events. Edmans et al (2007) for example, connected this sport sentiment to the stock market by looking at the change in investors' mood after a soccer game. This behavioral finance aspect of mega sport events inspired us to elaborate more about sports and its potential impact on investors' asset pricing behavior.

One sport event that has gained an increasing attention in media in recent years is the Olympic Games. The latest Summer Games held in London 2012, for example, had an estimated viewer base of more than 4.8 billion people and over 200 countries broadcasting the events around the world.[1] Another example that has had a lot of attention is the most recent Winter Game held in Sochi, Russia in 2014. The main focus in Sochi was, besides the sport events, the economical impact that the Olympic Games can induce on a country hosting it. For instance, the total cost of just hosting the games in Sochi was estimated to over $50 billion.[2] However, it is not just the actual cost of arranging and hosting the Olympic Games that can give rise to economic impacts, it could also benefit a country the time after. This is for example shown by Rose and Spiegel (2011), who study the future economic effect on trade the time after the Olympic Games

[1] IOC Marketing: Media Guide, London 2012, s. 15
[2] http://www.businessweek.com/articles/2014-01-02/the-2014-winter-olympics-in-sochi-cost-51-billion, Accessed: 2014-04-03, 15:00

are held for the countries involved in the bidding process to become the host of the mega sport event. If such large amounts of people are watching the Olympic Games in so many different countries, it is hard not to think about the potential impact the Olympic Games can have, both on a country as a whole, but also on its citizens. One might even think that it is plausible that this large global event also could have an indirect impact on the stock market in general, and more specifically, the mood of investor's trading on the market. Having the work of Edmans et al (2007) in mind, our primary objective with this thesis is to find out if the outcome of an Olympic event, in terms of winning a gold medal, can have an impact on investors' trading behavior.

II: Previous Literature

Neo-classical View vs. Behavioral Finance

According to Fama (1963), in an efficient market, where rational investors strive to make rational decisions, any new information should be incorporated into the stock prices so that the prices reflect any known information. This theory is widely known as the Efficient Market Hypothesis (henceforth EMH). However, during the 1980's, more of the literature tried to explain the anomalies arising in the market, which were not fully explained by the EMH. One of the founders, of what later became known as behavioral finance, was Robert Schiller. In Schiller (2003), he emphasizes that behavioral finance is not something that is mutually exclusive and will replace the EMH, but rather an extension of the theory to be able to explain why the market is not always completely efficient.

Investor Sentiment on the Stock Market

One area within behavioral finance that recently has been studied more extensively is investor sentiment and its impact on the stock market. An increasing number of papers investigate how investors' mood can affect the investment decisions and hence the trading patterns on the stock market. Consistent with recent literature is the paper presented by Hirshleifer and Shumway (2003), who, as briefly mention above, study the effect of morning sunshine on market indexes. They collect data from days with morning sunshine and analyze the effect on the stock market. The question regarding sunny weather having an impact on mood has in previous literature and various physiological papers already been proven. However, what had not been studied was if this positive mood effect from sunshine in turn affects the stock market. The conclusion from the

paper suggests that morning sunshine actually has a large significant positive effect on the daily stock returns. Another research made by Kamstra et al (2000) investigates the effect of Daylight Saving Time (henceforth DST) and its impact on the stock market. The effect stems from the de-synchronization in the sleep cycle. One might think that if you gain an extra hour of sleep (as is the case during fall) compared to losing an hour (in the spring) the results would be the opposite, in other words, that the impact on the stock market is positive when gaining an hour of sleep. However, as is the case with jet lag, whether you travel east to west or west to east, one's sleep cycle is still in imbalance and the problem solving and information processing ability is in turn affected. As a result, the authors find that the change in time has a large negative impact on the stock market. According to Kamstra et al (2000), the DST-effect was around 300-500% of the weekday effect. Converting the DST-effect into dollars, the NYSE, AMEX and NASDAQ exchanges experience an implied one-day loss of $31 billion, regardless if you gained an extra hour of sleep or lost an hour of sleep. Even though this is just a small fraction of the total market trade, it is still a significantly large effect to result in an impact on the stock market.

A research closely related to behavioral finance is Bower (1992), who explores the field of psychology. Bower (1992) argues that there is a difference between an emotional state of mind and mood. While emotions are characterized as more distinct and short lasted, and connected to strong feelings, that can easily be attributed to a specific event, mood, on the other hand, such as happy, sad, anxious etc., is more subtle and longer lasting which is not as easily identified if attention is not drawn to it. The theory according to Bower (1992) implies that the emotion, the days following the event, transforms into a longer-lasting mood. In line with the findings of Bower (1992) is the research made by Bollen et al (2011), who studied the collective mood from the public to see if any effect on the stock market would appear. They did so by tracking certain key words in the twitter feeds as proxy variables for public mood during a period of time. When comparing the mood flow captured from the twitter data with the Dow Jones Industrial Average (DJIA), they distinguished a co-movement for the stock returns with the public mood swings. They also found that stock prices showed a lagged effect and registered a movement in accordance to the mood swings 3-4 days after the mood had been registered.

Furthermore, Baker and Wurgler (2007) investigated investor mood and its effect on the stock market by creating an investor sentiment index using a number of different variables as proxies for investor sentiment, for example; trading volume, closed-end fund discount and the

number and first-day returns on IPOs. With the index created, the authors were actually able to measure and track sentiment in the market. They also found evidence supporting that the index followed historical events such as bubbles and crashes reasonably well. Baker and Wurgler (2007) were also able to show that sentiment could affect the market as a whole, although the effect was larger on individual stock returns, particularly high speculative stocks. They define high speculative stocks as "*[s]tocks of low capitalization, younger, unprofitable, high-volatility, non-dividend paying, growth companies or stocks of firms in financial distress are likely to be disproportionately sensitive to broad waves of investor sentiment."* Today, studies about investor mood and behavioral finance go beyond the academic research, and are increasingly being conducted by companies in their day-to-day work. For instance, in line with the index created by Baker and Wurgler (2007), Johnson and Watson (2011) have shown that a Purchasing Manager can act as a forward-looking sentiment indicator and thus have a certain predictive power on stock returns.

Sport Events and Investors' Mood

The effect on the stock market resulting from changes in investor's mood has also been studied with the help of mega sport events. This is due to the fact that these events are watched by a large part of the population, thus having a tendency to affect a large amount of people's mood. One research that studies the effects from large sport events is Edmans et al (2007), which looks at the largest international soccer tournaments. They investigate whether there is an effect from a change in investors' mood in the winning and losing country after a match. They find that there is a significantly negative effect on the stock market in the losing country, but they do not see a corresponding positive effect on the stock market in the winning country. Moreover, as Baker and Wurgler (2007) also point out, Edmans et al (2007) discovers that the sentiment effect on soccer match results is greater on small cap stocks. However, there have also been studies supporting the theory that investors' mood do not affect the stock market. An example of such research was conducted by Gerlach (2011), who performed a similar research as the one made by Edmans et al (2007). The author finds somewhat contrasting result compared to Edmans et al (2007). Gerlach (2011) basically replicates the data used by Edmans et al (2007), but instead of using the World Market Index from Datastream, he employs another benchmark index. Gerlach creates a matching country index, which is generated by using the largest country (measured by

its Gross Domestic Product), which does not compete on day *t*, closest to the country competing in the soccer tournament on day *t*. He uses the neutral country's stock market index (it is considered neutral since the country does not play a soccer game on that specific day, which otherwise could have affected its index), instead of Datastream's World Market Index, to see if any abnormal return can be observed. By using a matching country index instead of Datastream's World Market Index, Gerlach (2011) argues that the problem with regional differences in the stock markets can be overcome, something that the World Market Index does not always identifies. Another problem identified by Gerlach (2011) is that the composition of the World Market Index makes the index biased towards the developed countries, since about 80% of the index's market value is based on Western Europe, Japan, the United States and Canada. Gerlach (2011) concludes that the matching countries experience a similar loss or gain on the stock market as the countries whose national team lost or won, which thus supports the theory that the outcome of a soccer game, and therefore investors mood, do not have any impact on the stock market. However, Gerlach (2011) states that this conclusion is only true if the matching countries are not affected by their bordering country's national teams' performance. Otherwise, the matching country index would not be valid.

The Olympic Games

Another example of a mega sport event is the Olympic Games. Previous research on the Olympic Games has mostly been within the neo-classical area of finance. For instance, Dick and Wang (2010) performed an event study methodology to examine the announcement effect on the stock market when the International Olympic Committee (henceforth the IOC) announces which country that wins the bidding process and thus successfully becomes the hosting country of the Olympic Games. The authors find indications that the stock market experiences a significant positive effect when the country hosting the Summer Olympic Games is announced. Another research studying the effects from The Olympic Games is the paper from Rose and Spiegel (2011). This research focuses on the trade effect that a mega event, such as the Olympic Games, generates. They conclude that trade increases permanently with almost 20% for countries that hosts the Olympic Games. What is even more interesting with their findings is that countries not winning the bidding process, also experience a similar increase in exports. Hence, the authors argue that the effect on trade is not due to the fact that a country actually wins the bidding

process arranged by the IOC, but rather it is the participation in the bidding process that sends a signal to other countries that have a positive impact on the trade. However, there has not yet been any research looking at the effect of the Olympic Games on investors' mood, which makes it an interesting topic for a research.

III: Contribution

There have been an increasing number of literatures discussing the topic of sport sentiment within the area of behavior finance. Consequently, and due to the fact there have not been any previous studies of the Olympic Games from a behavioral finance perspective, it would be interesting to study the impact on the stock market resulting from the Olympic Games. Consequently, this study will see if it is possible to find effects resulting from a positive event, since previous literature has only found significant results from negative outcomes in sport events.

Studying the Olympic Games and Defining our Variable

Before defining our hypotheses, that will test if there are any abnormal returns resulting from the Olympic Games, we need to find a variable that can be used to detect these abnormal returns. In our thesis, to be able to distinguish a potential effect on the stock market from investor sentiment, we intend to use Olympic gold medals as our proxy for investors' mood. This variable is chosen in accordance with the three key characteristics that Edmans et al (2007) employ for determining a good mood variable. These requirements are as follows:

1. *"[f]irst the given variable must drive mood in a substantial and unambiguous way, so that its effect is powerful enough to show up in asset prices.*

2. *Second, the variable must impact the mood of a large proportion of the population, so that it is likely to affect enough investors.*

3. *Third, the effect must be correlated across the majority of individuals within a country."*

In our opinion, the Olympic Games, or more specifically, a gold medal as a proxy variable for investors' mood, satisfies these criteria. First of all, previous research, such as Edmans et al (2007), has shown that sport outcomes can affect people's mood and consequently their economic behavior. Secondly, the reason for choosing only gold medals (and not silver or bronze medals) as our proxy for investor mood is because expectations about the outcome of the game will affect the impact on the stock prices. The impact will differ depending on what was expected from the national team's performance prior to the Olympic Event, and to include silver medals might therefore distort the sample. For instance, if a country is not expecting to win any medals, a bronze or silver might have a positive effect on investors' mood, whereas a country expecting to win a gold medal, but only wins a silver, might result in a negative impact on investors' mood. Since the effects from winning a silver or bronze medal might contradict each other, depending on each country's expectations, it would be hard to interpret the results. However, even though a country and its population anticipate winning a gold medal, we would still expect to see a reaction when the gold medal is won, since it should be seen as a positive event.

Moreover, the second criterion is also met. Since the Olympic Games is such a wide and extensive tournament, with, for instance, over 200 countries broadcasting the Games and with an estimated viewer base during the most recent Summer Olympic Games of 4.8 billion people, the event should be able to reach and affect enough people and most importantly enough investors.[3] This is important to be able to spot changes on the stock market based on changes in an investor's mood. In line with the second key characteristic in choosing the mood variable pointed out by Edmans et al (2007), it is also vital to choose the largest and most popular sports that are viewed by a large portion of the population. As a result, we have chosen the six sports with the most viewer hours, in percentage of total viewer hours, as a proxy for being the most popular sports. The most popular sports selected for the Summer and Winter Olympic Games are, arranged in ranking order, the following:

[3] IOC Marketing: Media Guide, London 2012, s. 15

	Summer Olympics[4]	Winter Olympics[5]
1.	Volleyball *(12.90 %)*	Figure Skating *(17.28%)*
2.	Basketball *(11.43%)*	Snowboard *(12.61%)*
3.	Athletics *(10.80%)*	Nordic Combined *(10.84%)*
4.	Artistic *(5.92%)*	Alpine skiing *(7.15%)*
5.	Table Tennis *(5.85%)*	Speed Skating *(6.79%)*
6.	Football *(5.41%)*	Ice Hockey *(6.40%)*

The percentage represents the fraction of the total amount of viewer hours in the world for the specific sport to the total amount of viewer hours in the world covering the whole Olympic Games. When extracting the data that is to be used in our research, we have limited the number of sports to the six most common sports for the Summer and Winter Olympic Games respectively. Even though all sports in the Olympic Games have not been included, these six sport categories represent the majority of the viewer hours based on the total viewer hours in the world. Furthermore, the data on viewer hours was only available for the broader sport category and not for each single event within the sport, which is also why we, besides looking at the most important sport categories, also include all the branches within each sport. For example, in the sport event "Athletics" during Summer Olympics in London 2012, we included all the 47 individual branches within this category. This is also because the specific events within each sport have changed slightly during the years, so the only way to be certain that the sports were present each year was to take the broader sport category and include all the specific events. The TV-coverage broadcast data, retrieved from IOC, was consolidated by using one Summer Olympic Games (Athens 2004) and two Winter Olympic Games, (Salt Lake 2002) and (Turin 2006). The IOC then takes an average of the amount of total viewer hours to determine the popularity of each Olympic sport. We assume that this popularity for the individual Olympic sport is still high and has not changed, which is why we use the same proxies for all the Olympic Games between the years 1998-2014. Since we use the total amount of viewer hours in the world to distinguish the most popular sport category, the popularity of the selected sports might not

[4] Olympic Programme Comission Report to the 117th IOC Session
[5] Olympic Programme Comission Report to the 119th IOC Session

represent the most popular sport in each country. For example, the most popular sports in Sweden during the Winter Games in Sochi were:[6]

Winter Olympics

1. Cross-country Skiing (25.5%)
2. Ice Hockey (25.2%)
3. Biathlon (13.7%)
4. Alpine Skiing (12.5%)
5. Speed Skating (9.9%)
6. Snowboard (8.9%)

When comparing these sports with the sports selected in our paper, they differ in 2 out of 6 sports. Unfortunately one of the sports that differ from the above selected sports is in this case also the most popular sport in Sweden, where 25.5% of the total amount of viewers watched the Cross-Country Skiing event. These differences in the sports we use and sports that should have been used, if looking at the popularity of the sport in each specific country, is most likely present in several other countries as well. Despite these differences in the selected sports, the above method for choosing the most popular sport is still in favor. One reason is due to lack of reliable broadcasting data for each country winning a gold medal. If some Olympic events would be chosen, based on unreliable data, to represent the most popular sports within a country, the selection criteria would be somewhat arbitrary. Thus, to minimize any biases and to be consistent in our selection method, we base our selection of sports on the IOC's official broadcasting reports. To conclude, the above arguments for choosing the largest events within the Olympic Games makes the second requirement more than fulfilled.

As for the third criterion, since the contestants are competing for their home country, a gold medal is likely to affect the mood of all kinds of people in different parts of the country, and not just a certain region, as may be the case if they were competing for a certain team within the country. It is also assumed to affect them in the same way, i.e. that a gold medal will be seen as something positive for most people.

[6] http://www.mms.se/wp-content/uploads/_dokument/rapporter/tv-tittande/evenemang/2014/OS%20i%20Sotji%202014.pdf, Accessed: 2014-04-24, 20:00

Since most of the Olympic events are not pure games between two countries, but rather a whole competition between several countries, and the fact that we do not look at the qualification results but only the gold medal from the final round, we believe that it is possible to see positive abnormal returns from winning a gold medal. Compared to a soccer tournament, where a loss often means that the country will not play any more games, a win in such a tournament only results in the team qualifying to the next round. Therefore, the fact that there are only significant abnormal returns for losses and not for wins is understandable. However, since we are only looking at the final round that leads to a gold medal, we believe that it is just as likely to see positive abnormal returns from a win, as it is to see negative abnormal returns after a loss in a soccer tournament shown in previous research. Consequently, we are looking at wins in a quite different manner than previous authors. Moreover, as previously explained, since the Olympic Games is a larger event compared to international soccer games[7], we expect to see a different result when using the Olympic events as a base in our research.

Due to the lack of evidence of any impact from positive sport events in previous studies, the results from this thesis can give valuable information to the increasing research within the area of behavior finance.

IV: Hypothesis

Being inspired by the work of Edmans et al (2007), and since no other research has focused on the Olympic Games in the same manner as we do, it made us interested in finding out if previous findings within behavioral finance also could be applied on an event such as the Olympic Games.

Defining our Hypotheses

After having chosen the Olympic gold medals as the appropriate variable to use as a proxy for investors' mood and after having selected the sports for which these gold medals should in theory significantly impact the investors the most, the next step is to define our hypotheses.

For the first hypothesis 1(a), we want to see if a gold medal event day has any impact on the stock market, regardless if one or more gold medals are won on that event day. In other words:

[7] http://www.fifa.com/mm/document/affederation/tv/01/47/32/73/2010fifaworldcupsouthafricatvaudiencereport.pdf, Accessed: 2014-04-26, 14:00

Hypothesis 1(a): There is no significant impact on investors' mood (positive or negative), and thus not on the stock market, based on the event day when a country wins a gold medal from an Olympic event:

$$H_{0,A}: AR_{\text{Gold Medal}} = 0$$
$$H_{0,A}: CAR_{\text{Gold Medal}} = 0$$

$$H_{1.A}: AR_{\text{Gold Medal}} \neq 0$$
$$H_{1,A}: CAR_{\text{Gold Medal}} \neq 0$$

Since we argue that a gold medal event is seen as a positive event, one might expect that winning more than one gold medal on the same day should result in an even stronger mood reaction. This leads us to our second test, where we instead are going to test if there is any impact from winning more than one gold medal on the same event day, which is stated as follow:

Hypothesis 1 (b): There is no significant impact on investors' mood (positive or negative), and thus on the stock market, based on a country winning more than one gold medal on the same day from the Olympic events:

$$H_{0,B}: AR_{\text{Gold Medal}} = 0$$
$$H_{0,B}: CAR_{\text{Gold Medal}} = 0$$

$$H_{1.B}: AR_{\text{Gold Medal}} \neq 0$$
$$H_{1,B}: CAR_{\text{Gold Medal}} \neq 0$$

The above hypotheses will both test if a gold medal event day will affect the market index in country *i* and if several gold medals won on the same day will have an even larger impact on the market index in country *i.* These tests are performed in a way that isolate a gold medal event and thus only focus on the event when a gold medal is won by country *i* and no other gold medal is won on another day within the same event window as the previous gold medal event. Since the Olympic Games duration is limited to usually two-three weeks, countries may win gold medals on more than one day. The situation can arise when a country wins gold medals in the days

following each other. In line with the hypothesis 1(b), one might think that winning gold medals in the days following each other also could result in a strong mood reaction. As a result, we define our third unique event as two gold medal event days taking place two days in a row.

Hypothesis 1 (c): There is no significant impact on investors' mood (positive or negative), and thus on the stock market, based on a country having two gold medal event days in a row:

$$H_{0,C}: AR_{\text{Gold Medals in a row}} = 0$$
$$H_{0,C}: CAR_{\text{Gold Medals in a row}} = 0$$

$$H_{1,C}: AR_{\text{Gold Medals in a row}} \neq 0$$
$$H_{1,C}: CAR_{\text{Gold Medals in a row}} \neq 0$$

The reason why we in all the above stated hypotheses include both the abnormal return and the cumulative abnormal return, is due to the fact that we will test both the event day and the following two days. We will study the abnormal return (henceforth AR) for the event day, that is, AR(0,0), and cumulative abnormal return (henceforth CAR) for the following two days, that is, CAR(0,1) and CAR(0,2).

We have argued that, if there is an effect on investors' mood that will result in a changed trading pattern for investors, the effect is expected to be positive due to the fact that winning a gold medal is seen as something positive. Hence, we could argue in favor of using a one-tailed test to see if our one-sided hypothesis, that there is a positive effect, is valid. However, there could potentially be other underlying factors that affect the stock market in a negative way due to a gold medal event, such as a decrease in trading volume during and after the Olympic event. In a research made by Frieder and Subrahmanyam (2004) the authors emphasize the difficulty of estimating whether there will be a positive or negative impact from an event. They showed that some holidays and other religious feasts gave positive results, whereas other gave negative outcomes. As a result, even though we should expect a positive divergence, we have chosen the hypotheses to be non-zero, due to the uncertainties.

V: Methodology

The research will be conducted by using an event study approach. Applied on this thesis, a reason for using this approach is to be able to discover sudden changes in investors' mood more clearly, compared to if the continuous variable had been used. According to Edmans et al (2007), this gives a large signal-to-noise ratio in returns.[8] The disadvantage connected to event-studies, explained by the same authors, is that the number of signals observed have a tendency to be low. This can be seen in the section "Data", where approximately 60% of our initial data had to be dropped in order to be able to create a unique event within our stated event window.

To perform an event study, we will have to compare the realized return with the predicted normal return the country would have had if the event had not taken place, to be able to get the abnormal return. According to MacKinlay (1994) this predicted normal return could be calculated in two ways, either with the use of the constant mean model or the market model.

Constant Mean Model

As described by MacKinlay (1994) the constant mean model is defined as:

$$R_{it} = \mu_{it} + \zeta_{it}$$

$$E(\zeta_{it}) = 0 \qquad Var(\zeta_{it}) = \sigma^2_{\zeta it}$$

The R_{it} is the normal return in security *i* during period *t,* and μ_{it} is the average return for security *i* during period *t.* The ζ_{it} is defined as the disturbance term for security *i* during time period *t*, which will have an expected value of zero and a variance of $\sigma^2_{\zeta it}$. Furthermore, MacKinlay (1994) describes that when this model is applied on daily returns, a common approach is to use nominal returns.

[8] Signal-to-noise ratio measures the effect caused by an event in comparison with the noise in the data that can distort the signal from the event. An advantage with event studies is the assumption that a reaction, observable in the event window, is derived from the event itself and not from other factors.

Market Model

The difference between the constant mean model and the market model is that the latter is a statistical model, where the parameters are estimated using a regression.

$$R_{it} = \alpha_i + \beta_i R_{Rmt} + \varepsilon_{it}$$

$$E(\varepsilon_{it}) = 0 \qquad Var(\varepsilon_{it}) = \sigma^2_{\varepsilon\, it}$$

The R_{it} is the return for security *i* in period *t* and the R_{Rmt} is the return for the market portfolio in period *t*. The ε_{it} is the error term, or disturbance term as mentioned by MacKinlay (1994), for security *i* during period *t*, which has an expected average value of 0. The parameters of the model are α_i, β_i and $\sigma^2_{\varepsilon\, it}$.

As described in MacKinlay (1994), both models can be used when estimating the normal return of a security, or as in our case, the return for a country index. The constant mean model has the advantage that it is simple and not as time consuming to compute, but still has an acceptable accuracy similar to other models in many situations (see for example Brown and Warner (1980)). However, the market model is a potential improvement of the constant mean model, as stated by MacKinlay (1994). This is because the constant mean model may generate a mean return that could be misleading if the variations in the market return are high, which in turn affects the variance in the abnormal return. Thus, the real benefit of using the market model, compared to the constant mean model, depends on how high the R^2 is in the market model regression. The higher the R^2, the lower the variance in abnormal returns, which consequently gives a better measurement and increases the possibility to detect potential effects from an event. Dick and Wang (2010) use the market model in their event study when estimating the announcement effect on the stock market, which is the model we also intend to use in our thesis.

Before estimating the predicted normal return for country *i*'s index, we calculate the realized return for the index using the following return model:

$$r_{it} = \log(P_{it}) - \log(P_{it-1}) \qquad (1)$$

The r_{it} is the actual return for country *i*, the $\log(P_{it})$ is the logarithmic closing market index price in country *i* on day *t*, and $\log(P_{it-1})$ is the logarithmic closing market index price in country *i* on the day before *t*.

After the realized return has been retrieved for the countries winning a gold medal in accordance with the above stated return model (1), we need to compare the realized return with the expected return the country should have earned in absence of a gold medal event, in other words, its predicted normal return. To do that, we calculate the country's predicted normal return using the Capital Asset Pricing Model (henceforth CAPM). When calculating the expected return using CAPM, we will use historical index returns during a pre-determined period for country *i's* stock market index and run a regression on the country *i*'s excess return with the World Market Index excess return. The regression will then give us the beta for country *i* during that period, which we assume to be equal also for today's beta. To retrieve the betas, we run the following regression:

$$(R_{it} - R_{f,\,t,\,i}) = \alpha_i + \beta_i\,(R_{\text{World Market Index},\,t} - R_{f,\,t}) + e_{it}$$

Where $R_{f,\,t,\,i}$ is the risk free rate, which is the long-term government bond in country *i* on day *t* and $(R_{it} - R_{f,\,t})$ is the excess return of country *i*'s stock exchange. The retrieved beta represents the sensitivity to the World Market Index's volatility. Furthermore, the α is assumed to be zero when calculating the predicted return.[9] Another common assumption is also to assume that the country *i*'s beta is equal to one. However, this is a very strong assumption due to the fact that it is very unlikely that the betas among the countries will be the same. Although a strong assumption, when doing a robustness test on our results, we will also test this assumption to see how much our results differ and to confirm a stronger robustness of our results.

Estimation Window for the Beta

When estimating the beta value, we choose to include all trading days from the year 1997 to 2014 except 10 trading days before and 30 trading days after the first medal event occurs. By excluding these days prior to and after the event, the estimated beta value will not be affected by the actual event. The reason why we take 30 days after the first medal event and not 10 days is

[9] This is only true if CAPM holds. This is derived from the assumption that the market is efficient.

due to the fact that the duration of the Olympic Games is around two-three weeks. By taking a month after the first medal event, we avoid the post-effect from being captured in the estimation window. This approach is a slightly different approach compared to the ordinary event study, since the estimation window for event studies is usually only before an event takes place. However, since the Olympic Games are recurring events every two year, we have to take into account the years between the Olympic Games when estimating the beta-value. This is because the days after the Olympic Games until the next Olympic Games will be the days before the event-window for the coming Olympic Game. As a result, the following calculation will be used to obtain the expected return for the stock exchange *i* on day *t*:

$$E(R_{it}|X_{it}) = R_{f,\,t} + \beta_i\,(R_{\text{World Market Index},\,t} - R_{f,\,t})$$

The $E(R_{it}|X_{it})$ is the expected return in country *i* on day *t*. When comparing the realized return with the expected return, the return above normal return, that is abnormal return, will be calculated for each unique observation in order to compute the cumulative abnormal return. The CAR will then sum up the AR and be used as a measure of the total impact a gold medal has had on the country *i*'s stock market. The CAR will also reveal the total time for which it took the market to fully incorporate the mood effect from the investors.

$$AR_{\text{Gold Medal (i)},t} = R_{it} - E(R_{it}|X_{it})$$

$$CAR = \sum AR_{\text{Gold Medal (i)},\,t}$$

In order to test our hypotheses, we need to define which statistical approach to use. One of the statistical models that we are going to use is the Student's t-test, also known as the t-test. An assumption that needs to be fulfilled to able to use the t-test is that the data is presumed to follow a normal probability distribution. When this cannot be confirmed, which is normally the case when the sample size is small, we have to use a non-parametric test instead. The statistical test we intend to use when testing our hypotheses, if the data does not fulfill the requirements of the t-test, is the Wilcoxon signed-rank test. In comparison to the Student's t-test, the statistics

generated when using Wilcoxon signed-rank test is somewhat weaker compared to the t-test, but it does not require a certain sample distribution.

VI: Data

Data on Gold Medals

We have collected the data on gold medalist countries between the years 1998 to 2014. Between the years 1998 to 2012 we have used the IOC's official reports to collect the data. Since our research is based on daily stock market returns, we needed the exact dates for when the final rounds were performed which resulted in a gold medal. However, due to the lack of a brief compilation of the days when the gold medals were won, the data has been collected from these extensive reports separately for each individual sport and its different branches within the sport. The advantage with these reports is that they are updated with the latest results and dates. For instance, the reports show the actual date when the gold medal is won even if the events are postponed to a later day. For the Olympic Games of 2014 we have used the official website for the Winter Games in Sochi.[10] The total number of gold medals that were initially retrieved amounted up to 464.

Adjusting for Gold Medal Events Occurring on a Weekend or on the Same Day

One problem affecting our sample size was the situation where an event was played on a weekend. The games that were played on a Saturday or a Sunday, were all adjusted for as if they occurred on a Monday instead, that is, the first trading day after the event.

Multiple Gold Medal Events in the Same Event Window

Since the Olympic Games are only occurring during two-three weeks, there are a lot of events taking place during this period. Consequently, many of these events happened the same day or on the days shortly after. This created a problem when the potential effect from the events had to be isolated. In line with previous research of effects derived from investors' mood, our event window for hypotheses 1(a) and 1(b) is three days, to be able to catch a possible lagged effect. As a result, any event occurring in another event's event window, would distort the true effect

[10] http://www.sochi2014.com/en, Accessed: 2014-03-26, 18:00

and thus bias the result. This is because, if for instance one event is taking place on Monday, the event window will be Monday to Wednesday. If then another event takes place during Tuesday, the event window for that event will be Tuesday to Thursday. This results in the AR for Tuesday and Wednesday being calculated twice since the same return is included in both event windows. Consequently, when looking at the aggregated effect for Tuesday and Wednesday, the AR for these two days will not be the true effect as a result of double-counting the same return. Assume that there is actually only an effect from Monday's event and not any for Tuesday's event, then it will appear as if the AR for the first and second day, for the event taking place on Tuesday (that is the AR for Tuesday and Wednesday), also is positive, even though this is just the lagging effect from Monday's event. As a result, we have to create a dummy variable that only includes the events that have no surrounding event distorting its effect. Only the events with an event window not colliding with other event windows could be kept. When the events take place on the same day, the problem with double counting the AR and the CAR is not present, since the multiple events affect the same trading days. The thing that could result is that one might expect the effect to be larger for these days, which is not a problem. However, multiple events taking place on the same day will accordingly result in less unique event days.

Table I: Gold Medal Events Colliding

This table describes the situation where events need to be dropped due to a collision in their event window. The event window contains three days and the abnormal returns are stated in letters instead of numbers. Only Event number 4 is a clean event, where CAR(4) does not include any double counted letters (i.e. return), and hence is the same as in CAR(TOT). The example is also illustrated by the ellipses, shown under the variable Gold Medals. One ellipse illustrates the length of the event window, that is, three days. As can be seen, the three first event windows collide with each other, shown by the red ellipses. However, the fourth event, shown by the green ellipse, does not collide with any other event and hence its event window is clean.

Date	TIC	Gold Medals	Event	AR	CAR(1)	CAR(2)	CAR(3)	CAR(4)	CAR(TOT)
2010-02-17	USA	G	1	a	a				a
2010-02-18	USA	G	2	b	a+b	b			a+2*(b)
2010-02-19	USA			c	a+b+c	b+c			a+2*(b+c)
2010-02-22	USA	G	3	d		b+c+d	d		2*(b+c+d)
2010-02-23	USA			e			d+e		2*(d)+e
2010-02-24	USA			f			d+e+f		2*(d)+e+f
2010-02-25	USA	G	4	g				**g**	**g**
2010-02-26	USA			h				**g+h**	**g+h**
2010-02-27	USA			i				**g+h+i**	**g+h+i**

A potential way to circumvent the problem with events taking place on days after one another and thus avoid dropping events is, if there for instance are several gold medal events for one country three days in a row (but not on the two following days after the last of these events), to combine these three events and define it as one event. Then AR(0,0) will be calculated on the first day of the third gold medal event, but including the cumulative abnormal return from the previous two gold medal event days since this event's "first day" will be the sum of all three days. However, if we were to see significant results, we would not know if the effect after our tests is due to the fact that there were three gold medals taken three days in a row or if just a single gold medal actually had an impact. As a result, we would not be able to come to the conclusion that a gold medal event in general has an impact, since it might only be these events with multiple medals won several days in a row that creates the effect. Thus, we have decided not to include these events. To be fair, this problem could also arise in our existing hypothesis 1(a), since we include event days where several events have taken place on the same day. If any significant effect were to appear, we cannot be sure if it is mainly due to the fact that there were several events on the same day, or if there was also an effect from the event days with only one gold medal event. This is the reason why we have chosen to state our second hypothesis as more than one gold medal being won on the same day to see, if both tests for hypothesis 1(a) and 1(b) become significant, if an event day with several events on the same day creates a larger impact on the stock market.

Time-zone Differences Affecting the Gold Medal Events

Since the time of the Olympic Events are given in local time, it is likely that the time zones differs depending on the time zone in the host country compared to the time-zone of the national teams' home country.

For an event to be affected by the time-zone difference, that is, that the competing country's stock exchange is still open the day before due to the differences in time-zones when the Olympic event occurs in the hosting country, the competing country has to have a time-zone difference of approximately 15 hours before the time-zone in the hosting country. This 15 hours time-difference was chosen due to the assumptions that the earliest Olympic event would be finished at 9:00 a.m. and the closing time for most stock exchanges are at latest around 6:00 p.m., which results in a 15 hour time-zone window. When restricting our search criteria as

described above, only a couple of hosting countries could have a time-zone impact on other countries. The two countries in our sample that could be affected were USA and Canada, when the events were held in Sydney in the year 2000 and Beijing in 2008. Although USA usually wins a lot of gold medals during the Olympic Games, we expect the event of a gold medal being won at 9:00 a.m. as rare and thus the bias error to be insignificant. Another reason for not adjusting the event window to take into account the day before to capture any time-zone effect is because we do not have exact data on when the specific events ended. As a result, even if the assumption that it is seldom for a gold medal event to end as early as 9:00 a.m. would be wrong, these events will still not be possible to adjust for every year due to lack of information for when the events ended.

Defining the Event Windows

When an event takes place, we expect the day of the event and the following days to be particularly important, which has to do with the natural state of emotions and the characterization of mood as previously explained by Bower (1992). This is also in line with Bollen et al (2011), who, as stated earlier, find evidence that the mood swings registered in the twitter feeds have a lagging effect on the stock market by 3-4 days. Translating the findings of Bower (1992) and Bollen et al (2011) into our thesis, it means that when a country wins a gold medal, the investor might in the same moment experience a distinct emotion, which he or she attributes to the event when the country wins the gold medal. This emotion could later on be transformed into a state of mood, which lasts for a longer period of time. Therefore, to make sure we do not miss the entire effect of winning a gold medal on investor sentiment, we extend and define our event window for the hypotheses 1(a) and 1(b) as the day of the Olympic event and the two days following the event, which should be enough to capture any potential effect from the investors' mood when calculating the CAR. A normal approach in the event studies is also to include the day before to see if any potential leakage on the market can be observable, or if the data goes back a long time which can make the actual dates for the data uncertain. In contrast to the normal approach, there is no reason for us to include the day before due to leakage or uncertainty. First of all, our data do not go back more than to 1997 and as a result hereof, the dates should be reliable. Furthermore, although expectations on a country's performance can be present beforehand, no one can foresee which country who will win a gold medal, and as a result, leakage will not be a

factor that will affect our data in a negative way. The only plausible reason for us to include the day before in our event window is due to the time-zone differences between the countries. However, as described above, few situations arise that could be affected by this time-zone difference. As a result we have not included the day before in our event window. As for the hypothesis 1(c) our event window is instead defined as when gold medals are won two days in a row and two more additional days, that is, four days including the events. The following two days, counted from the last gold medal event, are included in the event window in order to be consistent with our above stated hypotheses, and also previous literature, to make sure that the mood effect is entirely captured.

Gathering Market Indexes and Government Bonds

To be consistent in our data, we wanted to use the same index for every country included in our sample. In line with Edmans et al (2007), we therefore, where possible, retrieve data on each country's Total Market Index (henceforth "TOTMK") available on Datastream. Some countries had no trading data available for the specific index and hence had to be excluded. We obtained the trading data for the "TOTMK"-indexes from Datastream one year before the first Olympic Game in our sample, which resulted in a collection of data for daily market returns between the years 1997 and 2014.

To be able to conduct the CAPM-formula, we also need the risk-free rate for each specific country. As a proxy for the risk-free rate, we will use, where possible, the 10-year government bond. When this data was not available, we instead used the 5-year government bond as a proxy for the risk free rate.[11] The values for the government bonds are stated annually, and consequently we divided the values with 365 to get the daily return.

The retrieved indices will be regressed on the World Market Index, as shown below in section "Methodology". The World Market index will be represented by the "TOTMKWD" from Datastream as used in Edmans et al (2007), which in this perspective will be viewed upon as the market portfolio. Since no data exists for the risk-free rate on the World Market Index, we had to use a proxy for this. When doing this, we looked at the country affecting the World Market Index the most, which according to Gerlach (2011) is the United States. In lack of any better proxy, the risk-free rate in the US can be viewed upon as a World market risk free rate, even though it

[11] The 5 year government bond was only used for Brazil.

might be skewed more towards the developed part of the world compared to the emerging countries.

As explained above, not every country's data on government bonds were available on Datastream or the data available were unreliable. For example, the Russian 10-year government bond on Datastream had unusually stable returns for multiple years. As a secondary source, we instead looked at each country's Central Bank's website to see if any other historical returns could be retrieved. However, these indexes could not be downloaded and as a result were not able to be automatically connected to the dates in our existing dataset. This would not be a problem if we just copied all the data for the indexes for each day and manually inserted it in our excel sheet. But in order to be able to do that, the number of days in our existing excel sheet had to be equal to the number of days for the dataset with indices downloaded from Datastream. Due to these different index formats on the dates in Datastream and the Central Banks' index, it made it hard to synchronize with the data on the market index returns that we had retrieved from Datastream. For instance, if a holiday occurred on a Tuesday in Russia, then Datastream would replicate Monday's return index as being the index value for Tuesday, in other words, the return in percentage would be zero between Monday and Tuesday. On the Central Bank's website in Russia, on the other hand, the date for that holiday was not included in the data, but instead the return for Wednesday was displayed. This problem made it hard to connect the time series for the returns that were retrieved from Datastream and the data retrieved from the Central Bank. Since every country in average has 4509 observations for their historical market returns, that is, data on the daily market returns between the years 1997 to 2014, this would have to be computed manually to make the data consistent when importing it to Stata. However, as previously described, the Central Banks' data are stated in a different format, which made us, for example in this situation, not to include the Russian gold medal events. Due to this problem, other countries besides Russia had to be dropped as well, which can be seen in Table A in Appendix.

The Sample Remaining After Various Adjustments

We collected a total of 464 gold medal observations from 56 countries. However, as mentioned previously, some countries lacked a "TOTMK"-index, and hence these countries had to be dropped. Consequently, of the initial 56 countries, only 33 countries had data for their country's respective market index and the other 23 countries were dropped. The remaining 33 countries

had a total of 385 gold medal observations. In other words, by dropping 23 countries, we lost 79 gold medal observations, as can be seen in Table A in Appendix. Even though dropping a large amount of the countries, the number of observations did not drop dramatically. This was mainly due to the fact that the countries lacking a "TOTMK"-index were small countries that had not won a lot of gold medals. When adjusting for the countries that did not have government bonds available on Datastream to be used as a proxy for the risk-free rate, we had to exclude 14 more countries. By dropping these additional 14 countries, we lost 143 gold medal observations, as shown in Table A. The remaining 19 countries in our sample had a total of 242 gold medal observations. Accordingly, from the initial 464 gold medal observations collected, 222 gold medal observations had to be dropped due to either lack of country market index or lack of data on government bonds.

Moreover, as stated above, there are some events taking place on the same day or occurring on a weekend. As a result, of these 242 gold medal observations from the 19 countries left in our sample, the total number of unique event days that occurred on trading days, when at least one gold medal was won, amounted up to 194 observations. To clarify, the number 194 constitutes the number of unique event days where one or more gold medal was won, and hence not the total number of gold medals. The total number of gold medals is still 242 outspread on these 194 unique gold medal days.

When testing hypothesis 1(a), it is the unique event days that are crucial, independent of whether there is one or several gold medals on the same day. As just stated, this sums up to 194 event days. From these 194 unique event days, we will drop those whose event windows that collide, which is illustrated in Table I. This results in a total number of 98 unique and non-colliding event days. As for the hypothesis 1(b), even more observation had to be dropped. When adjusting for the above restrictions, we now also had to focus on the situation where more than one gold medal was won on the same day. This resulted in only 8 unique observations. When testing hypothesis 1(c), the total event window consisted of 4 days, since we wanted to be consistent with previous assumptions that there might be a lagging effect of two days after the last gold medal within the event window. After adjusting for this and the restrictions also used for non-colliding event windows, we had 9 unique events.

Beta Estimation

As mentioned above, we estimate our betas in accordance to the market model in line with MacKinley (1994).

Table II: The Betas and Correlation of the Countries

This table shows the different betas for each country in our sample and the correlation for each country's Total Market Index Return with the World Market Index Return and its respective significance level. The betas are estimated by using the market model, where each country's excess return are regressed on the World Market Index's excess return. The sample period used when estimating the betas is between 1997 and 2014. However, 10 days before the first gold medal event in an Olympic Game and 30 days after the first gold medal event are excluded from the regression in order to avoid affecting the beta estimation from any potential effect caused by an event.

Country	Beta	Correlation
Australia	0.4261762	0.4378
Belgium	0.7763626	0.6795
Brazil	0.8403155	0.6545
Canada	0.7871953	0.7396
Finland	1.228215	0.6094
France	1.028254	0.7708
Germany	1.054414	0.7569
Great Britain	0.8975403	0.7705
Hungary	0.7111413	0.5186
Italy	1.030706	0.7210
Japan	0.5524196	0.4396
South Korea	0.6771556	0.4413
Netherlands	1.025008	0.7502
Norway	0.8968819	0.6553
New Zealand	0.1514984	0.2020
Spain	0.9419529	0.7057
Sweden	1.118228	0.7066
Switzerland	0.7893118	0.7030
United States of America	1.075294	0.8296

As can be seen in Table II, some of the betas that were estimated had very different values from what could be expected of them. For instance Australia New Zealand and Japan have very low beta values. One example is New Zealand with a beta of approximately 0.1515, which is most likely not the case for this country. In this case, one reason why New Zealand's beta is too low could be due to its low correlation of only 0.2020 with the World Market Index. Then the situation could arise that the World Market Index is volatile during one period and New Zealand's Market Index might instead be stable during the same period.

The correlation problem is hard to adjust for in our thesis. In Gerlach (2011), the author created a matching country index, as described above, which matched the countries not competing in the FIFA World Cup that day with a country competing in the World Cup. Since only two countries at the time face each other in a soccer match, it is easier to find neutral countries to match with the countries competing in the tournament. However, this index cannot as easily be created for the countries in our data, since in the Olympic Games, every country competes for the same gold medal, which makes it hard to find any neutral countries to match against the competing countries. Another possible reason for the betas of Australia, New Zealand and Japan being too low could be due to the lagging effect from the World Market Index. Edmans et al (2007), for example, have a lagging dummy variable for the World Market Return to adjust for those countries that may experience a lag in their own Market Index compared to the World Market Index. However, after adjusting for this in our sample, Australia, New Zealand and Japan only experienced a marginal difference, which indicate that most of the error could derive from the low correlation with the market index for these countries. The only exception is Japan, which, according to Gerlach (2011), is one of the few countries whose market index is in the group that represents 80% of the whole World Market Index. This should make Japan's Market Index more coherent with the World Market Index. However, as can be seen in Table II, Japan only has a correlation of 0.4396, which therefore might have resulted in its too low beta, since its correlation should have been higher according to Gerlach (2011).

VII: Empirical Results

In this section we aim to present our results that are generated when testing our hypotheses. Thereafter, a discussion of our results and implications of them will be presented.

Winning a Gold Medal

When testing our hypothesis 1 (a), we ran three t-tests on; AR(0,0), CAR(0,1) and CAR(0,2). To confirm that the underlying data was normally distributed, we ran both a graphical and a numerical test. For AR(0,0) the results showed a slightly positive mean for the return of 0.0010%, however the results were not significant at an acceptable significance level.

Table III: Hypothesis 1(a) – Event: Winning a Gold Medal

This table describes the results from performing a one-sample t-test on the abnormal returns for the gold medal event day, and the cumulative abnormal returns for the two following days after the gold medal event day. The gold medal observations for hypothesis 1(a) has been isolated into unique gold medal events, which means that no other event window, prior to an event or after an event, collides with a gold medal event window. The sample period is between 1998 and 2014.

Variable	Obs	Mean	Std. Err	t-stat	Pr(|T|>|t|)	95% Conf. Interval	
AR(0,0)	98	0.0010218	0.0008619	1.1854	0.2387	-0.0006889	0.0027325
CAR(0,1)	98	0.0015468	0.0009867	1.5676	0.1202	-0.0004115	0.003505
CAR(0,2)	98	0.0020063	0.0012151	1.6511	0.1019	-0.0004054	0.0044179

The two-tailed t-test for CAR(0,1) shows a slightly higher positive mean return of 0.0015%, as seen in Table III. The results, albeit still a too high significance level to reject the null hypothesis, indicate that winning a gold medal could have a positive impact on investors' mood and in turn affect their trading behavior.

As for the CAR(0,2) the two-tailed t-test shows an even higher mean of 0.0020% at a significance level of 10.19%. Despite a somewhat stronger significance level than for CAR(0,1), it is still too weak to be able to reject the null hypothesis. However, the results, although weak, still indicate that the positive mood effect might have an even stronger effect on the returns two days after the gold medal event. These results are also in line with both the findings of Bower (1992) and Bollen et al (2011), where the authors argue that the mood effect has a lagging impact on the stock returns, and hence why we expect the CAR for the last day in the event window also to be the largest.

Due to weak significance levels for all the results we receive, we could not with certainty reject the null hypothesis in any case. As a result, one could not draw the conclusion that a gold medal will affect investors' trading behavior. However, the results are still interesting in the way that they are pointing in the direction to what we expected and compared to previous literature, our results, to some extent, indicate that there might be a small positive effect on a country's stock market from winning a gold medal.

Trimming the Data

Due to weak significance levels in our tests, we decided to trim the data for hypothesis 1(a), and perform the same test as above. The reason for only focusing on the hypothesis 1(a) is because there are enough observations left after trimming the data, compared to hypotheses 1(b) and 1(c).

When looking at a graph over the distribution of the CAR for the data used in hypothesis 1(a), it is possible to see extreme outliers in our sample. When trimming the data, we removed the extreme outliers in the 1% percentiles. As can be seen in Table IV, 96 observations remain to conduct the test for hypothesis 1(a).

Table IV: Hypothesis 1(a) – Event: Winning a Gold Medal When Trimming the Data

This table describes the results from performing a one-sample t-test on the abnormal returns for the gold medal event day, and the cumulative abnormal returns for the two following days after the gold medal event day. The data in for this test has been trimmed by removing the extreme outliers in the 1% percentiles. The gold medal observations for hypothesis 1(a) has been isolated into unique gold medal events, which means that no other event window, prior to an event or after an event, collides with a gold medal event window. The sample period is between 1998 and 2014.

Variable	Obs	Mean	Std. Err	t-stat	Pr(|T|>|t|)	95% Conf. Interval	
AR(0,0)	96	0.0010183	0.0008694	1.1713	0.2444	-0.0007076	0.0027443
CAR(0,1)	96	0.0015823	0.0009584	1.6509	0.1021	-0.0003204	0.003485
CAR(0,2)	96	0.0022176	0.0010873	2.0395	0.0442	0.000059	0.0043763

By trimming the data, we can see that the result for CAR(0,2) now is positive and the null hypothesis can be rejected at a 5% significance level, in contrast to the CAR(0,2) for the original hypothesis 1(a), which is consistent with our theory of how a gold medal event should affect the investors' mood with a lagging effect on the stock market.

Winning More Than One Gold Medal on the Same Day

There are only 8 observation left when conducting our second hypothesis test to see the possible impact on AR and CAR when several gold medals are won on the same day. This makes it hard to perform a t-test on it, since the observations are too few which usually results in the data not being normally distributed. Consequently, we needed to make sure whether the data was normally distributed or not, which we did by conducting both a graphical- and a numerical test. The tests confirmed our predictions, that is, that the sample for our 8 observations is not normally distributed. This is why we instead use the Wilcoxon signed-rank test, since it is a non-parametric test, and hence does not require the data to be normally distributed as the t-test does.

Table V: Hypothesis 1(b) – Event: Winning More Than One Gold Medal on the Same Day

This table describes the results from performing a Wilcoxon signed-rank test on the abnormal returns for the gold medal event day, and the cumulative abnormal for the two following days after the gold medal event. The gold medal observations for hypothesis 1(b) has been isolated into unique gold medal events, which means that no other event window, prior to an event or after an event, collides with a gold medal event window. The sample period is between 1998 and 2014.

Variable	Sign	Obs.	Sum ranks	Expected	Prob >|z|	z
AR(0,0)	Positive	5	28	18	0.1614	1.4
	Negative	3	8	18		
	Zero	0	0	0		
	All	8	36	36		
CAR(0,1)	Positive	3	19	18	0.8886	0.14
	Negative	5	17	18		
	Zero	0	0	0		
	All	8	36	36		
CAR(0,2)	Positive	5	25	18	0.3270	0.980
	Negative	3	11	18		
	Zero	0	0	0		
	All	8	36	36		

As seen in Table V, the signed-rank test shows that the AR(0,0) has more positive signs than negative. However, due to the low significance level of 16.14%, we cannot reject the null hypothesis. For the two following days, CAR(0,1) and CAR(0,2), the results are far from being acceptable at any normal level of significance. However, as our hypothesis 1(b) is stated, the results should have implied a stronger result on the event day when a country wins more than one gold medal, which is also indicated in this test.

Olympic Medals Two Days in a Row

As with hypothesis 1(b), the number of observations when testing the hypothesis 1(c) was very low. As predicted, both the graphical and the numerical test indicated that the underlying data was not normally distributed. As a result, we used the Wilcoxon signed-rank test to see if any significant results could be obtained.

Table VI: Hypothesis 1(c) – Event: Winning Gold Medals Two Days in a Row

This table describes the results from performing a Wilcoxon signed-rank test on the abnormal returns for the gold medal event day, which implies the last gold medal and the cumulative abnormal for the two following days after the gold medal event. The gold medal observations for hypothesis 1(c) has been isolated into unique gold medal events, which means that no other event window, prior to an event or after an event, collides with a gold medal event window. The sample period is between 1998 and 2014.

Variable	Sign	Obs.	Sum ranks	Expected	Prob >|z|	z
AR(0,0)	Positive	3	13	22.5	0.2604	-1.125
	Negative	6	32	22.5		
	Zero	0	0	0		
	All	9	45	45		
CAR(0,1)	Positive	3	12	22.5	0.2135	-1.244
	Negative	6	33	22.5		
	Zero	0	0	0		
	All	9	45	45		
CAR(0,2)	Positive	4	17	22.5	0.5147	-0.652
	Negative	5	28	22.5		
	Zero	0	0	0		
	All	9	45	45		
CAR(0,3)	Positive	3	9	22.5	0.1097	-1.599
	Negative	6	36	22.5		
	Zero	0	0	0		
	All	9	45	45		

As the previous two tests, signed-rank test for hypothesis 1(c) did not show any significant results, which can be seen in Table VI. The difference in these results compared to the results in the previous tests, however, is that it showed that a majority of the returns had negative abnormal returns. Furthermore, the significance level was even higher than previous tests, with 26.04% for AR(0,0). The results are hard to interpret due to the contradictory results, compared to the above tests. The fourth day in the event window, that is CAR(0,4), which is two days after the last gold medal event day, also implies that most of the abnormal returns are negative, but with a lower significance level of 10.97% compared to the tests for the previous days. However, the results are still insignificant at any acceptable significance level.

Beta Equals One

Another way to test our hypothesis 1(a), and also to see if the results are reasonable, is by assuming that the beta for the different countries is equal to one, instead of estimating the betas separately. The main reason for doing this test is to confirm that, even though including such a strong assumption, the results would not be better than the ones obtained when we estimated the betas for each individual country. Replacing all betas with one resulted in an AR(0,0) showing a mean of 0.00082%, CAR(0,1) having a mean 0.0016% and CAR(0,2) a mean of 0.0018%. As shown in Table VII, these results deviate slightly from our results we receive when estimating the betas separately, with a lower mean for all of the AR and with a weaker significance level. However, the robustness test still showed a result in line with our original results.

Table VII: Hypothesis 1(a) – Event: Winning a Gold Medal when using a beta equal to 1

This table describes the results from performing a one-sample t-test on the abnormal returns for the gold medal event day, and the cumulative abnormal returns for the two following days after the gold medal event day. The abnormal returns, and in turn the cumulative abnormal returns, has been obtained by taking the realized returns less the predicted returns, where the predicted returns has been calculated using a beta equal to one for every country. The gold medal observations for hypothesis 1(a) has been isolated into unique gold medal events, which means that no other event window, prior to an event or after an event, collides with a gold medal event window. The sample period is between 1998 and 2014.

Variable	Obs	Mean	Std. Err	t-stat	Pr(|T|>|t|)	95% Conf. Interval	
AR(0,0)	98	0.0008187	0.0008634	0.9483	0.3453	-0.0008948	0.0025323
CAR(0,1)	98	0.0015648	0.001039	1.5061	0.1353	-0.0004972	0.0036269
CAR(0,2)	98	0.0017758	0.0012777	1.3899	0.1678	-0.0007601	0.0043117

VIII: Analysis

There were no significant results for any of the original tests in the thesis, and hence the null hypotheses could not be rejected at any commonly accepted significance level. This is in line with previous literature, which has not yet shown any impact on investor sentiment from positive sport events. In other words, the significance level is still too high to be able confirm that gold medals have an impact. However, in the test for hypothesis 1(a), the results still show, to some extent, an indication of a positive mean, especially for CAR(0,2), at a significance level close to 10%. The results for hypothesis 1(b) show an even higher mean. However due to the low number of observations for the test made on hypothesis 1(b), these results become less reliable. Nevertheless, although weak indication, there might be some investor sentiment present affecting

the stock markets. This indication is even stronger when looking at the results for hypothesis 1(a) when trimming the data. In that test, CAR(0,2) show a positive mean of 0.0022 % for a three day return and the null hypothesis can be rejected at the 5% significance level. In the perspective that the returns are seen from country indexes, it could also be said to be economically significant, when looking at an annual perspective. Even though a 5% significance level is a commonly used significance level, it is not a perfect one. Thus, we cannot with a high certainty reject the null hypothesis to be sure that gold medals affect the stock market. However, the results from this test with trimmed data create a stronger support to the small indication already seen in the original results.

Previous literature has only shown significant results of investor sentiment on the stock market for negative sport event outcomes. This is to a large extent explained by the allegiance bias.[12] If a national team loses a game, the loss effect derived from the allegiance bias becomes so strong that it results in a change in investors' mood, which in turn has a negative impact on the stock market. In this event study, we use positive events as an explanatory variable to why the stock market may experience an impact. Since our main results are insignificant at any commonly used significance level, it suggests that positive events, in terms of sport outcomes, might not have the same impact as negative, which is in line with previous literature. These findings may result from the allegiance bias being present in the case of the Olympic Games as well. The positive outcome, that a gold medal represents, may thus in the presence of the bias, not affect the investors' mood that much since a positive outcome from the Olympic event would already be expected. However, since there is, to some extent, an indication of an effect from gold medal events, especially from the test with trimmed data, the allegiance bias might not be as apparent in the Olympic Games as it is in other sports. This is supported by the fact that in other sports one could follow the team for a long time and the fans can build up biased expectations for its own team. This is not as easy to follow when it comes to the Olympic Games, since one has to keep track on individual athletes rather than on national soccer teams.

Seen in a broader perspective, where allegiance bias is not applicable to the same extent in the Olympic Games, our results indicate, but cannot confirm, that there might be an effect

[12] Allegience Bias can be described as a distortion of ones own strong personal belief in something. In Edmans et al (2007), they applied this allegience bias on the fans supporting the national home team. Fans usually have a strong belief that their home team is going to win, even if the odds are against them. According to Edmans et. al (2007), this is also why the reaction is stronger when the team loses compared to when they win.

from a gold medal event, it could also be said to support the growing literature within behavioral finance and investor sentiment. The results also support our previous assumption, which is in line with previous literature, that emotions changing into mood have a lagging effect. At the time of the event, investors might experience a distinct emotion derived from the gold medal event. Initially they become happy, however, as can also be seen in our results, the entire effect has at that moment not yet been fully incorporated. Instead, the more longer-lasting mood, to which the emotions a few days later transforms into, is what actually gives the full effect and can be seen on the stock market. This process, when emotions transform into mood, is according to previous literature within the area of psychology and also supported to some extent by our results, takes about 2 days from the time the emotion arises. The lagging effect of mood has also been evident in earlier research within behavioral finance, where it is seen that the effect from investor sentiment on the stock market is largest after a few days from an event. Hence, the CAR(0,2), especially for the trimmed data, suggests that mood affecting investors' trading behavior on the market, is observable with a lagging effect.

The results for the hypothesis 1(c), however, are more difficult to interpret. We expected the result to be more in line with hypothesis 1(b), since winning more gold medals two days in a row should result in an even greater effect, at least compared to hypothesis 1(a). However, the Wilcoxon signed-rank test showed instead a negative result for all the four days in the event window where the CAR(0,3) had a significance level of 10.97%. This result is neither in line with our previous expectations before the test nor with what our results for hypotheses 1(a) and 1(b) would suggest. However, even though the last result shows a slightly stronger significance level, it is still a too weak significance for us to reject the null hypothesis. Furthermore, in the same way as for hypothesis 1(b), there are a low number of observations to run the tests on. Since the results are contradicting all of our other tests, is makes the results even more unreliable.

Another reason for all our results having a weak significance, besides allegiance bias and the small sample sizes in hypotheses 1(b) and 1(c), may have to do with gold medals not being a strong proxy variable for investors' mood. If a gold medal does not correlate well with the investors' mood, it makes the proxy less useful when estimating the impact of mood on the stock market.

IX: Implications and Conclusions

In this thesis, we have studied the effect on investor sentiment on the stock market using gold medals in the Olympic Games as a proxy variable for investors' mood. Previous literature has not tested positive sport outcomes in the same manner as this thesis has done. The aim of this thesis is to contribute with new information in an area of research that has yet to be explored.

Due to the weak significance for our results, it is hard to draw the conclusion that a gold medal with certainty affects investors' behavior to the same extent as a negative event does. If this is due to a potential allegiance bias, gold medals being a poor proxy for mood or other factors distorting our results, is hard to determine. However, what can be concluded is that we could not reject our null hypotheses for any of our original tests, which indicate that the win effect, in contrast to a loss effect, does not have the same impact on investor sentiment.

Even though the null hypothesis could not be rejected for the three original tests we performed, the results still, to some extent, indicate that there might be an effect present when a country wins a gold medal, especially for CAR(0,2) when doing the test with trimmed data for hypothesis 1(a). This suggests that, if any effect on investors' mood, CAR(0,2) should be the strongest, which our results also indicate. The positive mean generated when testing hypothesis 1(a), could also be seen as economically significant, considering that the effect relates to a cumulative three day abnormal return on a country's total market index. However, since the results for the hypothesis have a weak significance level, the economic significance becomes less important for a potential trading strategy. The question remains though, if a country's total market index is too large compared to the possible effect a gold medal event generates. The effect might be more prominent for small cap stocks that tend to be more affected by investor sentiment. The fact that previous literature has found stronger evidence for small cap stocks and due to the fact that our results, at least to some extent, show that there could be an effect on the stock market for a country winning a gold medal, makes this area interesting to explore further.

Further Research

As mentioned above, Baker and Wurgler (2007) created a sentiment index, where one of its components was trading volume. They discuss that differences in opinions could be revealed by looking at the trading volume. Hence, an interesting topic for a continued research would be to include the trading volume to see if any potential difference in the normal trading volume occurs

during the Olympic Events. In this case, by looking at the trading volume after a gold medal is won by a certain country or by looking at the trading volume during the time the event takes place, regardless of the outcome, one might see an indication of sentiment being present during or after the medal event. This can be derived from irrational investors being optimistic after a positive event, which may lead to an increased trading volume in total. However, it might also be possible to see a decreased trading volume, for example during the time a certain event takes place as a result of investors watching the event instead of working. Since trading volume can be used as a sentiment indicator on the market, it might also be useful in further research regarding investor sentiment from sport events.

Edmans et al (2007), as well as Baker and Wurgler (2007), find that small speculative stocks are more exposed to investor sentiment. In Edmans et al (2007), the authors find that the loss effect after a soccer game was more evident in small cap stocks than on large cap stocks. The same method could also be applied to this research topic. Even though we are unable to detect any significant results for the original tests on the total market, an interesting aspect would be to see if it is possible to see an effect on small cap-indexes when a gold medal is won. Since smaller stocks tend to have a true fundamental value that is harder to define, one might see that small cap stocks could respond more to the gold medal event compared to large cap stocks and hence give significant results.

As explained in our thesis, we are not able to find expectations for a country's performance in the Olympic Games. As a result, we had to use a variable that to a great probability would result in a positive mood swing, regardless of the expectations, which in our case was the gold medal event. However, the lack of data on pre-expectations made us unable to look at a similar effect from an outcome of a negative event. Nonetheless, if one can find and confirm the pre-expectations for a country's performance in the Olympic Games, it might be possible to study a similar loss effect for the Olympic Games in the same manner as have been done for other sport events. This is because, if one beforehand expected a country to perform in a certain way and the outcomes from the event then differed from the expectations prior to the event, there could be both positive and negative changes in investors' mood. For instance, if one did not expect a country to finish in the top five positions, but manages to win a silver medal, this should also have a positive impact on investors' mood, even though not winning a gold medal. However, if one expected a country to win a gold medal but only won a silver medal, it

could be comparable to a loss in a match. Hence, by looking at the expectations before the events and compare these with the outcomes, it might be possible to conduct a study for negative Olympic event outcomes as well. Since there have only been significant results for negative sport event outcomes in previous literature, it would be interesting to conduct a similar test for the Olympic Games as well.

X: References

Baker, M., Wurgler, J., 2007, Investor Sentiment in the Stock Market, *The Journal of Economic Perspectives,* Vol. 21, no. 2, pp. 129-151

Bollen, J., Mao, H., Zeng, X.-J., 2011, Twitter Mood predicts the stock market, *Journal of Computational Science*, Vol. 2, no. 1, pp. 1–8.

Bower G.H, 1992, How Might Emotions Affect Learning?, *In The Handbook of Emotion and Memory: Research and Memory*, ed.: S.A. Christianson (Lawrence Erlbaum Associates, Inc., Publishers), pp- 3-31

Brown, J. S., Warner, B. J., 1980, Measuring Security Price Performance, *Journal of Financial Economics*, Vol. 8, no. 3, pp. 205-258

Dick, D. C., Wang, Q., 2010, "The Economic Impact of the Olympic Games: Evidence from Stock Markets", *Applied Economic Letters*, vol. 17, no. 9, pp. 861-864

Edmans, A., Garcia, D., Norli, O., 2007, Sports Sentiment and Stock Returns, *The Journal of Finance*, Vol. 62, no. 4, pp. 1967-1998

Fama, E. F., 1963, Mandelbrot and the Stable Paretian Hypothesis, *The Journal of Business*, vol. 36, no. 4, pp. 420-429

Gerlach, R. J., 2011, International Sports and Investor Sentiment: Do National Team Matches Really Affect Stock Market Returns?**,** *Applied Financial Economics*, Vol. 21, no. 12, pp. 863-880

Hirshleifer, D., Shumway, T., 2003, Good Day Sunshine: Stock Returns and the Weather, *The Journal of Finance*, Vol. 58, no. 3, pp. 1009-1032

International Olympic Committee, 1998, Official Report of the XVIII Olympic Winter Games, Nagano

International Olympic Committee, 2000, Official Report of the XXVII Olympic Summer Games, Sydney

International Olympic Committee, 2002, Official Report of the XIX Olympic Winter Games, Salt Lake

International Olympic Committee, 2004, Official Report of the XXVIII Olympic Summer Games, Athens

International Olympic Committee, 2006, Official Report of the XX Olympic Winter Games, Torino

International Olympic Committee, 2008, Official Report of the XXIX Olympic Summer Games, Beijing

International Olympic Committee, 2010, Official Report of the XXI Olympic Winter Games, Vancouver

International Olympic Committee, 2012, Official Report of the XXX Olympic Summer Games, London

International Olympic Committee, 2014, Official Report of the XXII Olympic Winter Games, Sochi

International Olympic Committee Marketing, 2012, Media Guide: London

Johnson, A. M., Watson, J. K., 2011, Can Changes in the Purchasing Managers' Index Foretell Stock Returns? An Additional Forward-Looking Sentiment Indicator, *Journal of Investing*, Vol. 20, no. 4, pp. 89-98

Kamstra, J. M., Kramer, A. L., Levi, D. M., 2000, Losing Sleep at the Market: The Daylight Saving Anomaly, *The American Economic Review*, Vol. 90, no. 4, pp. 1005-1011

KantarSport, 2010, FIFA World Cup South Africa: TV Audience Report. Retrieved from URL: http://www.fifa.com/mm/document/affederation/tv/01/47/32/73/2010fifaworldcupsouthafricatvaudiencereport.pdf
[Accessed 2014-04-26, 14:00]

Mediamätning i Skandinavien (MMS), 2014, OS i Sotji 2014. Retrieved from URL: http://www.mms.se/wp-content/uploads/_dokument/rapporter/tv-tittande/evenemang/2014/OS%20i%20Sotji%202014.pdf.
[Accessed 2014-04-24, 20:00]

Olympic Programme Commission Report, 117th IOC Session, 2005, Lausanne, Switzerland

Olympic Programme Commission Report, 119th IOC Session, 2007, Id-Média S.à r.l., Belmont-sur-Lausanne, Switzerland

Rose, K. A., Spiegel, M. M., 2011, The Olympic Effect, *The Economic Journal*, Vol. 121, no. 553, pp. 652-677

Sochi 2014 Olympics, 2014. Retrieved from URL: http://www.sochi2014.com/en
[Accessed 2014-03-26, 18:00]

Yaffa, J., 2014, January 01. The 2014 Winter Oympics in Sochi costs $51 Billion. *Businessweek.com.* Retrieved from URL: http://www.businessweek.com/articles/2014-01-02/the-2014-winter-olympics-in-sochi-cost-51-billion.
[Accessed 2014-04-03, 15:00]

XI: Appendix

Appendix A.

Table A: Countries in the Sample and the Gold Medal Distribution

This table shows the original amount of countries in our sample and the amount of gold medals for each country. It also shows how many countries, and consequently gold medals, that are being dropped due to either lack of Total Market Indexes, lack of Government Bonds or unreliable data for the Government Bonds.

Original amount of Countries in the dataset	Countries dropped due to lack of market index data ("TOTMK")	No. Gold Medals dropped	Countries dropped due to lack of 10 year Government Bonds data or unreliable data	No. Gold Medals dropped	Countries left in our sample	No. Total Gold Medals remaining	No. Unique Gold Medals remaining
Algeria	Algeria	2					
Argentina			Argentina	3			
Australia					Australia	4	4
Austria			Austria	17			
Bahamas	Bahamas	3					
Bahrain			Bahrain	1			
Belarus	Belarus	4					
Belgium					Belgium	1	1
Brazil					Brazil	5	5
Bulgaria			Bulgaria	1			
Cameroon	Cameroon	3					
Canada					Canada	19	17
China			China	39			
Croatia	Croatia	5					
Cuba	Cuba	6					
Czech Republic			Czech Republic	9			
Dominican Republic	Dominican Republic	2					
Estonia	Estonia	2					
Ethiopia	Ethiopia	13					
Finland					Finland	4	4
France					France	12	12
Germany					Germany	20	20
Great Britain					Great Britain	10	6
Greece			Greece	4			
Grenada	Grenada	1					

Hungary					Hungary	3	2
Italy					Italy	8	8
Jamaica	Jamaica	12					
Japan					Japan	8	7
Kazakhstan	Kazakhstan	2					
Kenya	Kenya	10					
Korea					Korea	7	7
Latvia	Latvia	1					
Lithuania	Lithuania	2					
Mexico			Mexico	1			
Morocco	Morocco	2					
Mozambique	Mozambique	1					
Netherlands					Netherlands	24	19
New Zealand					New Zealand	2	2
North Korea	North Korea	1					
Norway					Norway	15	15
Panama	Panama	1					
Poland			Poland	9			
Portugal			Portugal	1			
Romania			Romania	11			
Russia			Russia	43			
Slovenia			Slovenia	3			
Spain					Spain	2	2
Sweden					Sweden	5	3
Switzerland					Switzerland	10	10
Trinidad Tobago	Trinidad Tobago	1					
Turkey			Turkey	1			
Uganda	Uganda	1					
Ukraine	Ukraine	3					
United States					United States	83	50
Yugoslavia	Yugoslavia	1					
Sum: 56	Sum: 23	Sum: 79	Sum: 14	Sum: 143	Sum: 19	Sum: 242	Sum: 194