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The US Holiday Effect

Evidence from Nordic markets on the impact of US investors

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Abstract: This paper investigates four Nordic stock indices on US holidays, days when the New York Stock Exchange is closed due to holiday. We provide evidence for a US holiday effect that on average cause large positive returns and low volumes. The returns are particularly strong after positive close of the NYSE the previous day and highly significant for the Swedish and Finnish market. Our results persist after controlling for other anomalies such as the day of the week effect and the turn of the month. We conclude that the effect exist and provide a qualitative explanation for the effect based on a higher share of trading being conducted by noise traders that drive abnormal returns. The small number of US holidays makes it a less feasible trading strategy and from 1990 one would have gained 244.4% (5.5% compound annual rate) by investing in the OMXS30 index on close the day before US holiday and liquidating on close at US holiday and by holding the risk free rate on other days. However we think the effect is important to consider in the timing of investments and since it is indicative for differences between institutional investors and noise traders.

Keywords: *US holiday, calendar anomaly, abnormal return, volume, noise traders*
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I Introduction

Since it was first published in 1970, Eugene F. Fama's theory on market efficiency, the Efficient Market Hypothesis (EMH), has become a pillar in modern finance. The EMH states that all available information should be reflected in the market prices at all times. Thus, according to the theory, recurring return patterns should not appear, as arbitrageurs would incorporate the information and monetize from it, thereby removing the patterns Research on return patterns is thorough and patterns have been identified as: (i) certain characteristics leading to additions to asset pricing models, for example high-minus-low and small-minus-big according to Fama and French (1992) and momentum by Carhart (1997); and (ii) calendar anomalies which might be explained by illiquidity, tax planning and mood variations.

> *"The markets are moved by animal spirits and not by reason."*
>
> \- John Maynard Keynes, 1936[1]

There are plenty of empirical studies within the finance literature that identifies different return anomalies that are persistent within several stock markets. Numerous studies have been conducted on calendar anomalies including the day of the week effect (Gibbons and Hess, 1981), the turn of the month effect (Cadsby, 1992) and the January effect (Wachtel, 1942 and Thaler, 1987).

This paper is inspired by the research published in 2013 by Jorge Casado, Luis Muga and Rafael Santamaria on the abnormally high returns on European indices during US Holidays that are trading days in Europe. We aim to see if their results are replicable on the Nordic markets. We further aim to causally explain the reasons for the effect. This study has not included Iceland due to the index's small size and to the recent relisting of the index.

Our results provide evidence for significant positive abnormal returns in Sweden and Finland on trading days coinciding with US Holidays and the results persist even after controlling for other known calendar anomalies. We also find non-significant, smaller abnormal returns for Norway and Denmark. Volume decreases significantly for all four indices on US holidays and we also find mall decreases in estimated volatility. We explain our results to be an effect of an increasing share of trading being conducted by noise traders[2] as a consequence of the withdrawal of institutional investors from the US as well as less information flow from the US and a lack of reference prices from the world's largest stock market. The theories on Noise

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[1] Animal spirits are described by Keynes as human emotions that motivate people to take, in general, positive action.

[2] Noise traders are defined as an investor making investment decisions without, or with insufficient, use of fundamental data. The noise trader is irrational, has poor timing and overreact which causes price deviations from fundamental values. Research on Noise traders has been performed by Black (1985) and De Long et.al (1990) and can be found in Section III Previous Research.

trading are closely linked to theories from other economic areas concerning irrational behavior and similarly for the financial markets noise traders are not fully rational decision-makers.

> *"Most of the time common stocks are subject to irrational and excessive price fluctuations in both directions as the consequence of the ingrained tendency of most people to speculate or gamble, to give way to hope, fear and greed."*
>
> - Benjamin Graham, 1976

We have structured this paper so that Section II contains our four hypotheses. Section III contains previous research. Section IV describes the methodology we have used when testing the effect and Section V presents our data. In Section VI we report our results that we discuss qualitatively in Section VII and in Section VIII we provide suggestions for future research.

II Hypotheses

This paper studies the Nordic indices behavior on US holidays, days when the NYSE is closed while the Nordic markets are open, and we hypothesize that the Nordic markets have abnormal characteristics during these days. We anticipate that the mean return on these days will be higher than the average daily return observed on the respective index and that the volume will be lower than the average daily volume. The effect has been observed with significance in other European indices such as DAX30, FTSE-100, EUROSTOXX50, IBEX35 and we do not see any reason why the effect should not be present in the Nordic markets as well. We believe that the effect arises due to a change in the investor composition, where the reduced number of institutional investors on US holidays increases the share of noise traders leading prices to diverge from their fundamental values. In accordance with De Long et al. (1990) a simplification is made, dividing the investor base into two categories: noise traders and sophisticated investors. In accordance with Fama (1965) and Black (1986) noise traders are irrational and may drive prices away from fundamental values and according to De Long et al. (1990) noise traders are in general positive. Sophisticated investors on the other hand are well informed and are generally contrarian to noise traders and move prices back towards their fundamental values. In this paper we have alternated the investor base to consist of noise traders and institutional, rather than sophisticated investors, in part since the definition of a sophisticated investor is rather vague and in part since a great deal of the sophisticated investors are institutional.

Hence our main question of interest in this paper is whether a greater share of noise trading provides excess returns on the market and we lay a theoretical foundation for testing this with our way of thinking[3] *and hypotheses stated below.*

[3] Our way of thinking is based on the four assumptions (i-iv), found in Table 1, and the simplistic assumption that noise traders account for 30% of trading on any given day. The numbers provided in this section are not based on any quantitative findings other than the observed volume drop during US Holidays for OMXS30 of 35%, which equals the drop in volume in t=US Holiday stated above. We believe the impact is there even if our base assumption on 30% noise traders is either too high or too low.

Table 1

Way of thinking around noise trading

i	Noise traders have domestic focus due to their simplistic nature	
ii	Aggregated trading volume from noise traders is constant over time	
iii	Trading by insititutionals and noise traders are collectively exhaustive	
iv	American insitutional investors are passive on US holidays	
V_t	=	Trading volume for day t (currency)
$V_{N,t}$	=	Trading volume from noise traders (currency)
$V_{I,t}$	=	Trading volume for insititutional investors (currency)
V_t	=	$V_{N,t} + V_{I,t}$
t	=	**Common day**
V_t	=	$0.70 \times V_{I,t}$ $0.30 \times V_{N,t}$
Where $V_{I,t}$ is composed of 50% US investors		
t	=	**US holiday***
V_t	=	$0.54 \times V_{I,t}$ $0.46 \times V_{N,t}$
* Implies absent US investors		

Hypothesis 1: *Average returns during US holidays are higher than average for a "normal" day*

We will try to test our hypothesis that returns and volumes during US holidays are deviating from the mean values and that this depends on irrational investors by looking at a set of sub hypotheses starting with the return deviation.

Hypothesis 2: *Average volumes during US holidays are lower than daily average volumes*

Our second hypothesis is that volume during US holidays is significantly lower than it is on a normal day due to less investor's and less capital being active as US investors withdraw.

Hypothesis 3: *Volatility during US holidays is not largely different from volatility during "normal" trading days, however due to less new information in the market on these days the volatility should, ceteris paribus, be slightly lower.*

The third hypothesis will be tested by using a simplified measure in which we take the highest index value less the lowest index value per day and divide this value with the day's closing value of the index as described in Section IV Method. The measure is suboptimal in capturing the intraday volatility, however given our dataset it is the best way to estimate daily volatility.

Hypothesis 4: *We believe that whether returns on NYSE in t-1 was positive or negative is reflected in the daily return of each respective index in day t and that the daily US holiday return in day t is larger given a positive close on NYSE in t-1compared to the average daily return on US holidays for each respective index.*

Our fourth hypothesis is that the positive return effect is partly explained by the performance of the NYSE benchmark the day earlier, that is, a positive close on NYSE the previous day intensifies the effect. Since we look at the "blue-chip" indices for the Nordic countries we have used S&P 500 as a proxy for the NYSE the day before. The information related to the close of S&P 500 t-1 would be one of the general types of information that switches the noise trader's mindset in a more positive direction.

III Previous Research

The review of previous research is divided into two parts starting with a theoretical research part followed by a part on empirical research on market anomalies.

Theoretical research

This study's theoretical framework will be based on the efficient market hypothesis (EMH) and a deeper delving into noise trading and its impact on the financial markets.

The Efficient Market Hypothesis - The theory on market efficiency is closely linked to the random-walk model and the Martingale model where the best prediction of next period's return equals the current period's observed return. Described in 1970 by Eugene Fama, a professor at the University of Chicago's Booth School of Business, the EMH is one of today's base frameworks in finance. Efficient markets implies that market prices are correct and reflect all available information, meaning there should be no arbitrage opportunities, that is, no "free lunches" and that it should not be possible to outperform the market in the long run (Fama, 1991). Information is normally divided into three sub categories; past prices, public information and private information, hence the theory exists in three forms to reflect the different information categories. The strong-form efficiency implies that market prices fully reflect information from all three sources thereby removing potential abnormal profits from insider trading as well as fundamental and technical analysis. The strong-form is conditioned on no costs associated with obtaining information and no transaction costs (Grossman and Stiglitz, 1980), which are not fully realistic assumptions. The semi-strong form efficiency implies that current prices reflect past prices and publicly available information thereby removing any potential abnormal returns from fundamental and technical analysis. The weak-form efficiency implies that current market prices reflect all information on past prices thereby removing abnormal profits from technical analysis and making deviations from the efficient market hypothesis negligible.

The criticism against the EMH has been massive, however the theory has prevailed due to evidence supporting the EMH such as random movements of market prices (Cootner, 1964), manager's inability to consequently beat the market (Fama and French, 2009) and that new information quickly incorporates into market prices. Even though anomalies have been discovered proving the EMH to be flawed to some degree, markets are not entirely inefficient due to continuous adaption after their respective discoveries according to Marquering et al. (2006). In general, markets are efficient to a large extent, but there are deviations, one of which this thesis investigates.

Noise traders – Black (1985) describes noise traders as investors without access to insider information that make decisions based on "noise" but believe this is information that would give them an edge to gain excess returns in the market. Fama (1965) explains noise traders as irrational traders, however without any real impact on the efficient market since they are met by rational investors resulting in prices reflecting fair values. Figlewski (1979) has described the process in which prices adjust to fundamental values as being relatively long due to noise trader's opinions being pegged to their own misbeliefs and not easily adjusted to reflect fundamental values, hence investors betting against noise traders might face remaining and even increasing price deviations, called noise trading risk. According to De Long et al. (1990) noise traders are on average positive and due to their price diverging effect they affect the market. In particular the market is affected when something disrupts the equilibrium in investor composition between noise traders and sophisticated investors, in this thesis we use the term institutional investors instead of sophisticated investors. They describe that as the share of noise traders increase, noise traders create price risk and make sophisticated investors reluctant to speculate against them.

Empirical research

The theory on market efficiency is important for the economic setting and for establishing an idea around the actions by economic agents and since the financial market is transparent in prices, volumes and the ability to constantly learn about the buy-side and sell-side of various assets it has been easiest to understand deviations from efficiency in this setting. The fact that prices deviate from their fundamental values on certain times of the year and due to characteristics of the different assets has been showed empirically in various markets. A large part of the criticism towards market efficiency is related to psychology and behavioral science and has led to a new field within finance called behavioral finance. Trading patterns are easily associated to behavioral finance due to psychological theories on lack of objectivity and rationality among human beings. These patterns have been expressed by herd behavior and a too relaxed attitude towards new information which favors status quo as well as overconfidence in the respective individual's own ability. Behavioral finance takes the aim to provide psychology-based explanations to the anomalies observed in the market however, the discovery of abnormal movements in the stock markets is much older than the psychology based explanations.

In the middle of World War II Sidney B. Wachtel (1942), an investment banker in New York, published a paper where he emphasized that returns on the NYSE were abnormally high during January compared to other months. His speculation, that the effect was even more significant in certain stocks, was later confirmed when Rozeff and Kinney (1976) used an equally weighted index and when Keim (1983) investigated the size anomaly together with the January effect and found that the effect is most significant for small firms. The effect may be explained by tax planning i.e. that investors sell their stocks with losses in December to reduce their taxes and then re-enter the market again in January which increases aggregate demand for stocks resulting in a subsequent rise in share prices in January.

Similarly to the studies of the January effect Thaler (1987) described the returns on various days of the week and anticipated that Mondays should provide average returns significantly higher than other days of the week since they should incorporate the returns that were not present during the weekend. However global research contradicts his theory and has shown that actual average returns are low on Mondays and high on Fridays, which might be an implication of poor information being released over the weekend to avoid too volatile movements due to overreactions. In the Swedish market Claesson (1987) found that average returns were particularly low on Tuesdays, thereby indicating a difference between Sweden and most countries that experience this effect on Mondays but with returns being large on Fridays similar to other countries. The day-of-the-week effect is harder to explain but might stem from human emotions and behavioral differences between days where people are expected to be happier on Fridays and less in the beginning of the week.

The same year as Thaler discussed the day-of-the-week effect Ariel (1987) found in his research that positive returns on the CRSP index were mostly achieved on the days around the beginning of a month. Returns were in fact only positive for the first half of a month during the period 1962-1986 with returns in the second half being around zero. A further study on this topic was conducted by Lakonishok and Smidt (1988) and they found that when narrowing the turn-of-the-month time window to the final trading day of each month and the first four in the subsequent month, that is day -1 to day +4, the lion's share of monthly returns were achieved during this short time. Kunkel and Compton (2003) found the effect significant even when accounting for other effects such as turn-of-the-year and turn-of-the-quarter and the explanation for the effect is largely linked to capital flows associated with salary payment dates in most western countries which drive returns due to an increase in aggregate demand.

Empirical research has also been conducted on times associated with other events such as the expiration day effect, the pre-holiday effect and the vacation effect. The expiration day effect stems from the idea that prices and volume might be affected by the expiration of futures and options and has been studied widely. Stoll and Whaley (1987) found a significantly higher volatility and average returns in S&P 500 on expiration days compared to other days, and these higher returns were followed by a reversal. Chen and Williams (1994) and Karolyi (1996) further found higher trading volume in the underlying assets on expiration days. The expiration day effect is not consistent across markets which might be explained by differences in legislation and size of the respective derivative markets and the Swedish market showed only higher volumes associated with expiration days but no differences in returns or volatility according to Alkebäck and Hagelin (2004). The main explanations for the expiration-day effect are that it is the result of speculative strategies around the expiration date, market manipulation as well as the effect of early unwinding by arbitrageurs.

The vacation effect and the pre-holiday effect as described by Hong and Yu (2009) and Lakonishok and Smidt (1988) respectively sound more related than they actually are. The vacation effect mainly regards lower share turnover during the summer months and has been confirmed for a large number of markets around the world and with regards to the scope of this thesis a significant vacation effect has been found in Norway and Finland. The summer months also provide lower average returns as in accordance with the disagreement model stated by Hong and Stein (2007) proposing a connection between lower volume and lower return. Abnormal returns on days prior to holidays have been observed on various markets around the globe by different researchers and might be explained by a more positive investor outlook around holidays in accordance with Dodd and Gakhovich (2011).

Most relevant for this paper is the previous research on the US holiday effect that has been conducted by Jorge Casado, Luis Muga and Rafael Santamaria in "The effect of US holidays on the European markets: when the cat's away…" (2013). The paper investigate five European indices for the period between 1991 to 2008 and find proof for the anomaly stated to "consist of the presence of significant positive returns in European stock markets on days when the NYSE takes a holiday". They find a significant effect that remains after controlling for other seasonal anomalies and the previous day's inertia from the European markets as well as the US market. The results are strong with US holidays carrying an average return of fifteen times an average trading day with below average risk and the anomaly provide gains from trading even after accounting for transaction costs. The effect is very significant when the NYSE closed positive on the day before however not significant on a day following a negative close on the NYSE.

There are two explanations provided for the effect, firstly that the US produce a large share of the financial news in the world and hence less information flows on a US holiday and secondly that a lower level of investors are active due to the withdrawal of US investors. This might increase noise trader risk due to a higher share of noise traders compared to sophisticated investors according to De Long et al. (1990). The lower information flow together with the withdrawal of US investors would lead to less investor disagreement and should result in lower volumes and lower returns in accordance with the disagreement model by Hong and Stein (2007). Due to the withdrawal of investors and the lower flow of new information on US holidays, volumes are expected to be lower than an average day which according to the disagreement model would implicate lower returns. The theory on noise trading however states that as the share of noise traders increase prices will deviate from their fundamental values and returns will be positive on average.

The effect of the previous day's closing sign would be grounded in noise traders trying to take advantage of the US news free day. This would put upwards pressure on the markets when the NYSE's previous day was positive. The effect would be neutralized on days when the NYSE previous day's was negative by traders wishing to sell as a result of the NYSE negative close.

Regarding the Nordic markets there has not been anything written on the subject of market returns during US holidays. Given the novelty of topic, Casado et al.'s study has been used an inspiration for this thesis. Our initial hypotheses, as can be seen in Section II, are thus based on the results of Casado et al. with the addition of volatility, which we expect to be slightly lower on US holidays.

IV Methodology

Introduction

To investigate the presence of the US holiday effect on the Nordic markets we first use a naïve comparison based on means of return and volume and then econometric models. As we are testing the US holiday effect we are indirectly testing the robustness of the EMH, hence no new theory is created from the results. Instead the study attempts to contribute with evidence and analysis regarding existing theories applied on the Nordic markets with the main aspiration to see if the earlier described US holiday effect is present

Given the nature of this thesis we consider secondary data the only suitable option. By using data from well-known data providers we minimize the risk of data related problems. More information regarding the collected data can be found in Section V.

Method summary

We first conduct a simple naïve comparison between average trading days in the data sample and the US holidays and then investigate the robustness of the US holiday effect using linear dummy regressions. To control our results we conduct t-test on the regression parameters. As we have simple regressions applied over a large number of years with the specific focus of investigating the US holiday effect we don't analyze the adjusted R^2 values. The adjusted R^2 values for returns are also expected to be very small given the low number of US holidays per year and due to the fact that we're regressing expected daily returns with large inherent variation. As the study focus on the entire stock market we simply study the coefficients and don't focus on alphas. We have considered alternative ways of studying the effect such as event studies or vector autoregressive models, however due to the difficulties in selecting a benchmark, the lack of guidance from previous research, and the fact that we're not trying to explain interdependence between several time series we find these methods unsatisfactory.

Structure of data

When the closing prices for the respective indices have been collected, and cleaned as discussed below in Section IV, we calculate the daily returns. We use the natural logarithm to the base of e to avoid statistical problems and to simplify comparison between positive and negative figures.

Step by step approach

To test our hypotheses we look at the return, volume and volatility of our four indices. Our step-by-step approach thus starts by explaining the three measures used as well as our naïve comparison. We then explain our robustness tests.

Naïve comparison

We use the following definitions for return, volume and volatility:

Return – The common return defined as the return from the closing price on the preceding day to the closing price on the day.

$$R_t^E = ln(index_t^E) - ln(index_{t-1}^E)$$

Where R_t^E is the daily return for each index respectively and $index_t^E$ the daily closing value of each index respectively.

Volume – We use the daily turnover in each respective index's currency as a measure of volume.

Volatility - Due to the nonexistence of intraday data for the Nordic indices we use the following measure by Parkinson (1980) to compute an estimate of daily volatility:

$$Vola_t^E = \frac{(H_t^E - L_t^E)^2}{(C_t^E)^2}$$

Where $Vola_t^E$ is our estimated daily volatility on day *t* for each index respectively, H_t^E, L_t^E and C_t^E are the highest value, the lowest value and the closing value for each index respectively on day *t*.

We conduct an initial naïve comparison between the daily return and volume of the Nordic indices during US holidays compared to the total sample using simple measures of mean and standard deviation. We use t-statistics and f-statistics respectively to determine if the differences are statistically significant. We also compare the share of days with positive returns between US holidays and the total samples.

Robustness Test

After our initial comparison we set up regressions to test the effect of US holidays on the Nordic stock indices and the variables used are presented in Table 2 below.

Table 2
Definition of variables

Variable	Definition
R_t^E	Return of the Nordic index under consideration
$R_t^{S\&P500}$	Return of the US index
Vol_t^E	Volume of the Nordic index under consideration
$Vola_t^E$	Volatility of the Nordic index under consideration
$Vola_t^{S\&P500}$	Volatility of the US index
D^{Jan}	A dummy variable equal to one for January and zero otherwise
D^{Dec}	A dummy variable equal to one for December and zero otherwise
D^{Mon}	A dummy variable equal to one for Monday and zero otherwise
D^{Tue}	A dummy variable equal to one for Tuesday and zero otherwise
D^{Thu}	A dummy variable equal to one for Thursday and zero otherwise
D^{Fri}	A dummy variable equal to one for Friday and zero otherwise
D^{TOM}	A dummy variable equal to one for turn of the months and zero otherwise*
D^{UShol}	A dummy variable equal to one for US holidays and zero otherwise

* Turn of the month is defined as the t-1th to t+4st days around the turn of the month in accordance with Lakonishok, and Smidt (1988).

Return Regressions

Our initial regression studies the US holiday effect on the return of the respective indices.

(1) $R_t^E = \beta_0 + \beta_1 * D^{UShol} + \varepsilon_t$

This regression enables us to measure the differences between the sample that is assumed to have value β_0 and US holidays that are assumed to have value $\beta_0 + \beta_1$.

We extend our initial regression for a first robustness test by including the previous days return on the respective indices as well as the previous days return of the S&P 500.

(2) $R_t^E = \beta_0 + \beta_1 * D^{UShol} + \beta_2 * R_{t-1}^E + \beta_3 * R_{t-1}^{S\&P500} + \varepsilon_t$

To further test the robustness we include a set of dummies to control for other known seasonal anomalies.

(3) $R_t^E = \beta_0 + \beta_1 * D^{UShol} + \beta_2 * R_{t-1}^E + \beta_3 * R_{t-1}^{S\&P500} + \beta_4 * D^{Jan} + \beta_5 * D^{Dec} + \beta_6 * D^{Mon} + \beta_7 * D^{Tue} + \beta_8 * D^{Thu} + \beta_9 * D^{Fri} + \beta_{10} * D^{TOM} + \varepsilon_t$

Volume Regressions

We perform three regressions for volume to control for the effect of US holidays as well as robustness tests similar to the return regressions but applied to volume. The regressions are comparable to regression (1), (2) and (3) but applied on volume instead of return and does not take the previous day's US index volume into account to avoid unnecessary complexity arising from having two currencies in the same regression.

(4) $Vol_t^E = \beta_0 + \beta_1 * D^{UShol} + \varepsilon_t$

(5) $Vol_t^E = \beta_0 + \beta_1 * D^{UShol} + \beta_2 * Vol_{t-1}^E + \varepsilon_t$

(6) $Vol_t^E = \beta_0 + \beta_1 * D^{UShol} + \beta_2 * Vol_{t-1}^E + \beta_3 * D^{Jan} + \beta_4 * D^{Dec} + \beta_5 * D^{Mon} + \beta_6 * D^{Tue} + \beta_7 * D^{Thu} + \beta_8 * D^{Fri} + \beta_9 * D^{TOM} + \varepsilon_t$

Volatility Regressions

We perform the following three regressions for volatility to control for the effect of US holidays as well as robustness is still similar to the return regressions but applied to volatility. The regressions are comparable to regression (1), (2) and (3) but applied on the volatility measure instead of return.

(7) $Vola_t^E = \beta_0 + \beta_1 * D^{UShol} + \varepsilon_t$

(8) $Vola_t^E = \beta_0 + \beta_1 * D^{UShol} + \beta_2 * Vola_{t-1}^E + \beta_3 * Vola_{t-1}^{S\&P500} + \varepsilon_t$

(9) $Vola_t^E = \beta_0 + \beta_1 * D^{UShol} + \beta_2 * Vola_{t-1}^E + \beta_3 * Vola_{t-1}^{S\&P500} + \beta_4 * D^{Jan} + \beta_5 * D^{Dec} + \beta_6 * D^{Mon} + \beta_7 * D^{Tue} + \beta_8 * D^{Thu} + \beta_9 * D^{Fri} + \beta_{10} * D^{TOM} + \varepsilon_t$

Effect of previous day's closing sign on the S&P 500

To test the effect of the previous day's closing sign of the S&P 500 on the US holiday effect for the Nordic indices we perform three regressions similar to regression (1), (2) and (3) but with two dummies dependent on the S&P 500's closing sign the day before US holiday instead of the simple US holiday dummy.

(10) $R_t^E = \beta_0 + \beta_1 * D^{USpos} + \beta_2 * D^{USneg} + \varepsilon_t$

(11) $R_t^E = \beta_0 + \beta_1 * D^{USpos} + \beta_2 * D^{USneg} + \beta_3 * R_{t-1}^E + \beta_4 * R_{t-1}^{S\&P500} + \varepsilon_t$

(12) $R_t^E = \beta_0 + \beta_1 * D^{USpos} + \beta_2 * D^{USneg} + \beta_3 * R_{t-1}^E + \beta_4 * R_{t-1}^{S\&P500} + \beta_5 * D^{Jan} + \beta_6 * D^{Dec} + \beta_7 * D^{Mon} + \beta_8 * D^{Tue} + \beta_9 * D^{Thu} + \beta_{10} * D^{Fri} + \beta_{11} * D^{TOM} + \varepsilon_t$

Method for investment strategy

We also investigate whether it is possible to base an investment strategy on the US holiday effect for the Swedish market. Given the low number of yearly observations we regard this as more of an extended view at the US holiday effect rather than a freestanding investing strategy. Still, the results could be relevant for planning the timing of individual investments and as common saying goes it's enough to be right 51% of the time to be successful. With this in mind knowledge of the impact that US holidays have on the market is of importance for investors.

We compare the US holiday strategy against a buy and hold strategy of the OMXS30. The comparative buy and hold strategy is based on buying the OMXS30 on the first day of trade in 1990 and selling the holding on the last day of trade in 2012. It is important to note that our reported returns for the buy and hold strategy does not take any dividends into account, hence it's not a total return measure and is lower than the actual return achieved. The US holiday strategy is based on only entering the market at close on the days before US holidays and selling at the end of each US holiday respectively between 1990 and 2012. For the days between entering the market the risk free rate is held and we use the Swedish reference interest rate provided by the central bank of Sweden, the Riksbank. To calculate the daily return of the risk free rate we use the average of the yearly return by taking the yearly return to the power of 1/365 in accordance with the formula below:

$$Daily\ rate = (1 + yearly\ rate)^{1/365}$$

We have also tested the US holiday strategy without holding the risk free rate between the market entries. Due to the difficulties of estimating transaction costs, as they differ largely between a small investor and a larger investor among other things we assume zero transaction costs in our comparison. However we have provided Table 12 with different transaction costs as a means of transparency. For this test we have not used logarithmic returns.

V Data

Choice of time period

There is always a tradeoff between having a longer time period with a larger amount of data and a shorter time period with less but perhaps more relevant data. To investigate the US holiday effect we use data for the Swedish, Finish, Danish, Norwegian and US markets from the start of the year 1990 to the end of 2012. This 23-year period is long enough to provide us with reliable results. Since the US holiday effect has never before been studied on the Nordic indices we did not have to take consideration to any novelty aspects when choosing our time frame.

Choice of data

This study uses the OMXS30, OMXH25, OMXC20, OBX and S&P 500 indices for Sweden, Finland, Denmark, Norway and the US respectively. The OMXS30, OMXC20, OBX and S&P 500 closing prices are provided by Avanza's trading application, Infront online trader. The OMXH25 closing data is retrieved from Bloomberg since our primary data source did not have closing prices for OMXH25 further back than 2003. The Finish data is manually corrected to remove national holidays due to Bloomberg reporting the previous day's value on holidays[4]. Consecutive data on volume, defined as daily turnover in respective currency, is available until the end of 2012 for all four Nordic indices. The starting date for this data varies for the different indices; 2006-03-20 for OMXS30, 2009-10-26 for OMXC20 and OMXH25 and from 2003-08-15 for OBX. In our volatility data we have removed trading days when high and low have been equal to each other since the reported information on these dates is insufficient to generate an indication of volatility according to our selected measure. We have been able to use data on volatility for the entire sample period for S&P 500 and OMXS30 however for OMXC20 we only have data from 2002-02-04, for OMXH25 from 1998-07-01 and for OBX from 1998-05-04. These data insufficiencies needs to be remembered while considering the volume results presented later in this study.

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[4] www.timeanddate.com was used on the 16th of April 2013 to find the Finnish national holidays per year.

There are six days annually when the NYSE is closed due to holiday while the Nordic markets are open. In Table 3 these days and their annual occurrence are presented. When the 4th of July occurs on a Saturday the NYSE is closed on the preceding Friday and when the day occurs in a Sunday the NYSE is closed on the following Monday. Note that Martin Luther King Day has only been a holiday since 1998.

Table 3
US holidays that are not holidays is the Nordic countries

Martin Luther King Day*	third Monday	January
President's Day	third Monday	February
Memorial Day	last Monday	May
Independence Day	fourth	July
Labor Day	first Monday	September
Thanksgiving Day	fourth Thursday	November

*Has only been a holiday since 1998.

Differences in the number of observations of US holidays between the four Nordic markets are due to national holidays occurring on the same date as the US holiday, for example, the Whit Monday[5] in Sweden occur at the same date as Memorial day in 1993 and 2004. We do not believe the differences in number of observations between our four indices will distort our results.

Our volume measure could have a positive bias due to the option expiration effect given that two of our six days occurs in the third week and one in the fourth week of their respective months. Until March 2008 the expiration day for options was the fourth Friday of each month for the OMXS30 index but from March 2008 it was moved to the third Friday of each month. For the other Nordic indices studied we have no information regarding a change in expiration dates. As shown by Alkebäck and Hagelin (2004), both the option expiration day as well as the week leading to the expiration day have shown increases in volume with the largest increase being on the expiration day itself. We believe this will not greatly influence our volume results since the majority of our US holidays occurring within the same week as an option expiration day occurs on Mondays. The expected bias is positive in contrast to our hypothesis of decreasing volume on US holidays but should be remembered as having a potential impact.

[5] In Swedish: Annandag pingst

The daily overlap between the American market and the Nordic markets is two hours as can be seen below in Table 4, hence the markets are simultaneously open for a short portion of each day. It should be noted that the Finnish stock exchange opens at 10.00 am local time, which neutralizes the time difference between Finland and the other three Nordic countries in our study. Due to differences in day light saving dates between the US and the Nordic countries the overlap is not constant throughout the year. We do not believe this will affect our results as none of the US holidays occurs during these weeks.

Table 4
Example of trading hours around US holiday, expressed in Central European Time (CET)

	t-1	t	t+1
Nordic indices	09.00-17-30	09.00-17-30	09.00-17-30
S&P500	15.30-22.00	Closed	15.30-22.00

VI Results

We first present summary statistics and then results per hypothesis. The significance levels provided are double-sided unless otherwise stated and the regression output tables (Table 8-11) contain the coefficients as well as their respective t-statistics.

Summary statistics

The summary statistics in Table 5 presents descriptive statistics for the four Nordic indices and the US index. Due to national holidays and the format of the data gathered from the trading application we get slightly different number of observations for the five indices, as discussed in Section V. As the table shows, the daily average returns are somewhat positive but not significantly different from zero. The share of positive returns seems to be slightly above 50% for all five indices.

Table 5

Summary statistics for the data sample

	Return (%)	SD (%)	Min (%)	Max (%)	N	$N+$	$\%N+$
US_{CC}	0.02	1.17	-9.47	10.96	5794	3068	52.95
DE_{CC}	0.03	1.20	-11.72	9.50	5750	2998	52.14
FI_{CC}	0.02	1.56	-8.91	9.29	5797	3008	51.89
NO_{CC}	0.02	1.54	-11.27	11.02	5773	3028	52.45
SE_{CC}	0.03	1.52	-8.20	11.02	5814	3009	51.75

The US market is measured by the S&P 500 index (US); the Danish market by the OMXC20 index (DE); the Finish market by the OMXH25 index (FI); the Norweigan market by the OBX index (NO); and the Swedish market by the OMXS30 index (SE), CC is close-to-close returns, daily returns (Return), standard deviation of daily returns (SD), min (max) is the minimum (maximum) of daily return, N is the number of observations, $N+$ is the number of observations with positive return, $\%N+$ is the percentage of observations with positive return.

As a first approximation we use a naïve approach comparing the average daily return on US holidays with the total samples as presented in Table 6. We have also included daily average return on Mondays and Thursday as four of the six US holidays occur on Mondays and one on Thursdays. The sixth US holiday that does not occur on a specific day of the week is Independence Day that occurs on the fourth of July and hence not dependent on a specific day of the week. As stated in Section V, if Independence Day occurs on a Saturday or Sunday, it is observed on the Friday or Monday respectively. We have also included standard deviation and percentage of positive returns in the table.

The results in Table 6 seem to divide the four Nordic indices into two groups, one group, comprising of Denmark and Norway, that shows a weaker US holiday effect and another group, comprised of Sweden and Finland, that shows a stronger, significant US holiday effect. It's relevant to note that, even if the results are not significant for the first group, all four indices have daily average returns on US holidays that are larger than the sample daily average returns for each index respectively.

For the first group, both Denmark and Norway experiences US holiday returns that are slightly above the sample returns. These results are not significant. Further, the percentages of positive returns are similar to that of their respective samples.

Table 6

US holiday return effect for the Nordic indices considered

	OMXC20 (%)	OMXH25 (%)	OBX (%)	OMXS30 (%)
US holiday (Return)	0.07	0.24*	0.09	0.30**
US holiday (SD)	1.06*	1.37**	1.46	1.20***
US holiday (%Ret +)	55.20	61.54	55.20	66.41
Sample (Return)	0.03	0.02	0.02	0.03
Sample (SD)	1.20	1.56	1.54	1.52
Sample (%Ret +)	52.14	51.89	52.45	51.75
Monday (Return)	0.01	-0.01	-0.05	0.06
Monday (SD)	1.34	1.65	1.75	1.70
Monday (%Ret +)	51.41	51.39	51.37	54.61
Thursday (Return)	0.02	0.06	0.08	0.03
Thursday (SD)	1.17	1.57	1.59	1.51
Thursday (%Ret +)	52.34	52.37	54.19	51.89
US holiday return multiple	2.49x	9.89x	4.00x	10.37x

Daily return (Return), standard deviation of daily returns (SD) and percentage of positive returns (%Ret +). *, **, *** denotes significance at the 10 percent, 5 percent and 1 percent levels respectively. US holiday return multiple is US holiday (Return) divided by Sample (Return) for each index respectively.

This is in stark contrast to what we see for the second group, comprising of Sweden and Finland. Both the OMXS30 and OMXH25 show average daily returns on US holidays that are clearly higher than the average daily returns of the sample period. If put in terms of a US holiday multiplier, OMXS30 has around ten times higher returns, and OMXH25 around eleven times higher returns, on US holidays compared to their respective samples. The standard deviations observed on US holidays are significantly different from the respective total samples for OMXS30 and OMXH25 as well as for OMXC20. The shares of positive returns are also clearly higher for the US holidays than for the respective samples as well as higher than the shares of positive returns for Mondays and Thursdays respectively. As shown, both indices have returns on US holidays that are significantly different from their respective means, Finland at above the ten percent level and Sweden at above the five percent level, while neither the returns on Mondays or Thursdays differs significantly from the sample means.

Table 7 below presents the summary statistics for volume on the Nordic indices. The daily mean volume appears to be significantly lower at the one percent level on US holidays than the total respective samples for all four indices.

Expressed as US holiday volume ratio we can see that the volume for the Nordic indices are around 32% lower on US holidays compared to the total sample period. We can also see that the max and min values are within a tighter spread during US holidays for all four indices.

Table 7

Daily volume for the Nordic stock indices

	OMXC20 (DKRM)	OMXH25 (EUROM)	OBX (NOKM)	OMXS30 (SEKM)
US holiday (Volume)	1520.63***	292.44***	4478.87***	8804.87***
US holiday (SD)	445.76	80.92	2513.02	4873.14
US holiday (Min)	1102.77	166.23	1540.58	801.53
US holiday (Max)	2501.02	431.91	13940.39	28634.32
US holiday (N)	18	19	52	40
Sample (Volume)	2364.20	455.87	5889.78	12830.15
Sample (SD)	1004.27	185.39	3164.05	6758.20
Sample (Min)	111.73	18.52	527.00	0.00
Sample (Max)	20096.40	2257.34	31826.64	66160.58
Sample (N)	798	801	2318	1832
US Holiday volume ratio	64.32%	64.15%	76.04%	68.63%

Daily volume (Volume) and standard deviation of daily volume (SD). *, **, *** denotes significance at the 10 percent, 5 percent and 1 percent levels respectively. US holiday volume ratio is US holiday (Volume) divided by Sample (Volume) for each index respectively.

Table 8

Results of the test of the US holiday effect on Nordic stock markets

	OMXC20			OMXH25			OBX			OMXS30		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
β_0	0.0264*	0.0124	-0.0219	0.0192	-0.0018	-0.0631	0.0220	0.0019	-0.0745*	0.0227	0.0104	-0.0439
	(1.65)	(0.79)	(-0.62)	(0.92)	(-0.09)	(-1.38)	(1.07)	(0.09)	(-1.70)	(1.12)	(0.52)	(-0.99)
β_1	0.0415	0.0796	0.0753	0.2190*	0.2548**	0.2562**	0.0723	0.1000	0.1372	0.2762**	0.3014***	0.2699**
	(0.43)	(0.89)	(0.80)	(1.80)	(2.27)	(2.20)	(0.55)	(0.81)	(1.07)	(2.56)	(2.96)	(2.52)
β_2		-5.4086**	-5.6278**		-7.1917***	-7.2795***		-8.9831***	-9.0279***		-12.1883***	-12.3139***
		(-2.34)	(-2.43)		(-3.68)	(-3.72)		(-3.84)	(-3.85)		(-5.82)	(-5.87)
β_3		32.9622***	32.9763***		43.0585***	43.1161***		38.8858***	38.8306***		40.8244***	40.8656***
		(15.48)	(15.44)		(16.35)	(16.32)		(13.25)	(13.18)		(14.18)	(14.17)
β_4			0.0966*			0.0895			-0.0212			0.0606
			(1.75)			(1.15)			(-0.30)			(0.85)
β_5			0.0521			0.0138			0.0623			0.0075
			(1.02)			(0.17)			(0.81)			(0.10)
β_6			-0.0089			0.0006			-0.0268			0.0480
			(-0.17)			(0.01)			(-0.40)			(0.72)
β_7			-0.0121			-0.0104			0.0563			0.0007
			(-0.25)			(-0.16)			(0.93)			(0.01)
β_8			-0.0140			0.0846			0.1084*			0.0320
			(-0.29)			(1.35)			(1.74)			(0.53)
β_9			0.0455			0.1084*			0.1372**			0.0554
			(1.00)			(1.81)			(2.39)			(0.95)
β_{10}			0.0935**			0.0766			0.0824			0.1034**
			(2.39)			(1.50)			(1.64)			(2.16)
Adj, R2	0.000	0.096	0.098	0.000	0.094	0.096	0.000	0.077	0.079	0.001	0.082	0.083

The β coefficients are multiplied by 100. R_t^E is the return of the Nordic market under consideration and D^{UShol} is a dummy variable equal to one for US holidays that are trading days for the Nordic market in consideration and zero otherwise. $R_{t-1}^{S\&P500}$ is the S&P 500 return. D^{Jan} and D^{Dec} are January and December dummies respectively. D^{Mon}, D^{Tue}, D^{Thu} and D^{Fri} are Monday, Tuesday, Thursday and Friday dummies respectively. D^{TOM} is a dummy for the turn of the month.

(1) $R_t^E = \beta_0 + \beta_1 * D^{UShol} + \varepsilon_t$

(2) $R_t^E = \beta_0 + \beta_1 * D^{UShol} + \beta_2 * R_{t-1}^E + \beta_3 * R_{t-1}^{S\&P500} + \varepsilon_t$

(3) $R_t^E = \beta_0 + \beta_1 * D^{UShol} + \beta_2 * R_{t-1}^E + \beta_3 * R_{t-1}^{S\&P500} + \beta_4 * D^{Jan} + \beta_5 * D^{Dec} + \beta_6 * D^{Mon} + \beta_7 * D^{Tue} + \beta_8 * D^{Thu} + \beta_9 * D^{Fri} + \beta_{10} * D^{TOM} + \varepsilon_t$

Results for Hypothesis One (H1) - US holidays outperform common days

The positive average daily return on US holidays for Sweden and Finland, described in the summary statistics, can also be viewed in Table 8 above. The US holiday effect has a positive coefficient for all four indices but only Sweden and Finland shows significant results at the one and ten percent levels respectively. The coefficients are also clearly stronger for Sweden and Finland than for Denmark and Norway. When performing robustness tests by first including variables for the previous day's return on respective index and the S&P 500 we continue to find the results significant for the Swedish and Finish markets as can be seen in Regression (2) in Table 8. To test if the results are due to other known seasonal anomalies we have regressed the daily return for each index on the US holiday dummy as well as a number of known seasonal anomalies. The results obtained, Regression (3) in Table 8, tell us that the inclusion of other seasonal effects does not alter our earlier findings. Sweden and Finland continue to show significance and clearly positive coefficients while Norway and Denmark does not. This is not a surprise, even though four out of the six US holidays are Mondays, US holiday returns strongly differs from the sample's Mondays as could be seen in our summary statistics.

As we add more variables, our US holiday coefficient increases in strength and significance for all four indices, due to the effect becoming cleaner, as can be seen when comparing the US holiday coefficients between Regression (1) and Regression (2) for the four indices. As we control for other known seasonal anomalies, Regression (3), the coefficients increase in strength for Norway and Finland while they decrease in strength for Sweden and Denmark. One observation that can be made in light of this is the stronger and more significant turn of the month effect in Sweden and Denmark, something that could be expected to influence the US holiday effect due to occurrence of US holidays during turns of months.

Hence we thus get mixed results for our first hypothesis. It appears that the average daily return on US holidays differs from the total sample average daily return for the respective indices significantly for two of our four indices, Sweden and Finland. For our remaining two indices, Norway and Denmark we note an insignificant smaller increase in returns. The results appear to hold even when controlling for other known seasonal anomalies.

Table 9

Results of the volume test of the US holiday effect on Nordic stock markets

	OMXC20			OMXH25			OBX			OMXS30		
	(4)	(5)	(6)	(4)	(5)	(6)	(4)	(5)	(6)	(4)	(5)	(6)
β_0	2383.66***	1638.34***	1811.26***	459.85***	227.81***	243.78***	5922.16***	1039.71***	1122.08***	13905.48***	3932.43***	3996.17***
	(66.18)	(5.96)	(6.36)	(69.30)	(9.42)	(9.36)	(88.90)	(9.08)	(7.59)	(95.08)	(9.14)	(8.39)
β_1	-863.03***	-870.19***	-806.90***	-167.41***	-144.04***	-109.77***	-1443.28***	-1785.39***	-1245.60***	-5100.61***	-4541.55***	-3385.51***
	(-7.96)	(-9.42)	(-5.81)	(-8.69)	(-8.03)	(-6.02)	(-4.10)	(-9.23)	(-6.10)	(-6.58)	(-8.31)	(-6.10)
β_2		0.32***	0.30**		0.51***	0.51***		0.83***	0.84***		0.72***	0.74***
		(2.67)	2.52		(9.02)	(9.06)		(37.70)	(36.57)		(21.64)	(21.34)
β_3			221.62**			54.71*			345.67***			576.55
			(2.46)			(1.92)			(2.63)			(1.46)
β_4			-380.18***			-60.24***			-298.7			-994.93***
			(-5.05)			(-4.74)			(-1.50)			(-4.00)
β_5			-360.19**			-93.04***			-1116.77***			-2212.85***
			(-2.41)			(-7.49)			(-9.27)			(-7.87)
β_6			-100.71			7.36			556.77***			1610.89***
			(-1.04)			(0.53)			(4.99)			(5.22)
β_7			-51.02			28.61			-5.81			47.77
			(-0.61)			(1.47)			(-0.05)			(0.17)
β_8			-184.88**			-35.50**			-456.94***			-1273.09***
			(-2.41)			(-2.18)			(-4.31)			(-4.41)
β_9			109.07*			8.88			110.50			-99.37
			(1.66)			(0.78)			(1.47)			(-0.42)
Adj, R2	0.016	0.118	0.151	0.019	0.276	0.342	0.005	0.695	0.727	0.017	0.538	0.586

Vol_t^E is the return of the Nordic market under consideration and D^{USholt} is a dummy variable equal to one for US holidays that are trading days for the Nordic market in consideration and zero otherwise. D^{Jan} and D^{Dec} are January and December dummies respectively. D^{Mon}, D^{Tue}, D^{Thu} and D^{Fri} are Monday, Tuesday, Thursday and Friday dummies respectively. D^{TOM} is a dummy for the turn of the month.

(4) $Vol_t^E = \beta_0 + \beta_1 * D^{UShol} + \varepsilon_t$

(5) $Vol_t^E = \beta_0 + \beta_1 * D^{UShol} + \beta_2 * Vol_{t-1}^E + \varepsilon_t$

(6) $Vol_t^E = \beta_0 + \beta_1 * D^{UShol} + \beta_2 * Vol_{t-1}^E + \beta_3 * D^{Jan} + \beta_4 * D^{Dec} + \beta_5 * D^{Mon} + \beta_6 * D^{Tue} + \beta_7 * D^{Thu} + \beta_8 * D^{Fri} + \beta_9 * D^{TOM} + \varepsilon_t$

Results Hypothesis Two (H2) – US holidays have lower volume than common days

There are clear negative average volumes on US holidays as can be seen in Table 9 above. The dependent variable, volume, is expressed in millions of respective local currency. The coefficients for all four indices are substantial and the results are significant at the one percent level for all four indices, which is in line with the summary statistics. The results continue to be significant after we control for the previous day's volume, as can be seen in Regression (5), and after controlling for other known seasonal effects, Regression (6).

We can hence confirm our second hypothesis uniformly, that is US holidays that are trading days for the Nordic indices appears to have lower average daily volumes than the total samples for each index respectively.

Table 10
Results of the volatility test of the US holiday effect on Nordic stock markets

	OMXC20			OMXH25			OBX			OMXS30		
	(7)	(8)	(9)	(7)	(8)	(9)	(7)	(8)	(9)	(7)	(8)	(9)
β_0	0.0015***	0.0008***	0.0011***	0.0010***	0.0004***	0.0005***	0.0019***	0.0007***	0.0006***	0.0013***	0.0006***	0.0006***
	(12.95)	(6.94)	(3.88)	(36.81)	(11.85)	(7.90)	(25.91)	(6.23)	(4.14)	(25.02)	(4.83)	(3.46)
β_1	-0.0005	-0.0003	-0.0005	-0.0003***	-0.0002***	-0.0002***	-0.0006**	-0.0002	-0.0004*	-0.0002	-0.0001	-0.0002
	(-1.61)	(-0.92)	(-1.32)	(-3.76)	(-2.80)	(-2.93)	(-2.10)	(-1.01)	(-1.81)	(-0.33)	(-0.38)	(0.69)
β_2		3.2411**	3.2735**		35.3733***	35.0732***		25.2161***	25.1644***		35.0420**	34.8385**
		(2.16)	(2.18)		(8.15)	(8.22)		(3.40)	(3.39)		(2.41)	(2.41)
β_3		78.8022***	78.7437***		28.1685***	28.4378***		103.4800***	103.9728***		41.9581***	42.1967***
		(7.55)	(7.57)		(6.32)	(6.40)		(5.06)	(5.08)		(3.28)	(3.30)
β_4			-0.0001			0.0002*			0.0002			0.0005**
			(-0.50)			(1.77)			(0.99)			(2.00)
β_5			-0.0007***			-0.0001			0.0004			-0.0001
			(-5.10)			(-1.04)			(0.77)			(-1.31)
β_6			0.0000			-0.0001			0.0003			0.0000
			(0.07)			(-1.13)			(1.08)			(0.21)
β_7			-0.0006***			-0.0001			-0.0002			-0.0001
			(-2.10)			(-0.81)			(-1.03)			(-0.47)
β_8			-0.0005*			0.0000			0.0001			-0.0001
			(-1.85)			(-0.07)			(0.66)			(-0.53)
β_9			-0.0003			-0.0002***			-0.0003*			-0.0003
			(-0.74)			(-3.02)			(-1.81)			(-1.51)
β_{10}			0.0000			0.0000			0.0001			0.0000
			(-0.03)			(0.74)			(0.42)			(-0.05)
Adj, R2	0.000	0.076	0.079	0.001	0.338	0.341	0.000	0.329	0.331	0.000	0.170	0.172

The β coefficients are multiplied by 100. Vola_t^E is the return of the Nordic market under consideration and D^{UShol} is a dummy variable equal to one for US holidays that are trading days for the Nordic market in consideration and zero otherwise. $\text{Vola}_{t-1}^{S\&P500}$ is the S&P 500 return. D^{Jan} and D^{Dec} are January and December dummies respectively. D^{Mon}, D^{Tue}, D^{Thu} and D^{Fri} are Monday, Tuesday, Thursday and Friday dummies respectively. D^{TOM} is a dummy for the turn of the month.

(7) $\text{Vola}_t^E = \beta_0 + \beta_1 * D^{\text{UShol}} + \varepsilon_t$

(8) $\text{Vola}_t^E = \beta_0 + \beta_1 * D^{\text{UShol}} + \beta_2 * \text{Vola}_{t-1}^E + \beta_3 * \text{Vola}_{t-1}^{S\&P500} + \varepsilon_t$

(9) $\text{Vola}_t^E = \beta_0 + \beta_1 * D^{\text{UShol}} + \beta_2 * \text{Vola}_{t-1}^E + \beta_3 * \text{Vola}_{t-1}^{S\&P500} + \beta_4 * D^{\text{Jan}} + \beta_5 * D^{\text{Dec}} + \beta_6 * D^{\text{Mon}} + \beta_7 * D^{\text{Tue}} + \beta_8 * D^{\text{Thu}} + \beta_9 * D^{\text{Fri}} + \beta_{10} * D^{\text{TOM}} + \varepsilon_t$

Results for volatility (H3) – Slightly lower volatility on US holidays

Our initial volatility regression reveals slightly lower volatility on US holidays for all four indices although the results are only significant for Finland and Norway as can be seen in Table 10 above. Regression (8) in Table 10 tells us that the results persist after controlling for the previous day's volatility for the respective indices and the US index. As we control for other known seasonal effects we continue to get the same results as seen in Regression (9) in Table 10 above.

Our hypothesis of lower volatility on US holidays is thus confirmed for Finland and Norway and rejected for Sweden and Denmark. It should be noted again that the used measure is, at best, indicative of the daily volatility but given lack of data it is the best approximation available.

Table 11

Results of the test of the US holiday effect on Nordic stock markets sorted by closing sign of S&P500

	OMXC20			OMXH25			OBX			OMXS30		
	(10)	(11)	(12)	(10)	(11)	(12)	(10)	(11)	(12)	(10)	(11)	(12)
β_0	0.0264*	0.0124	-0.0219	0.0192	-0.0017	-0.0631	0.0220	0.0019	-0.0745*	0.0227	0.0104	-0.0439
	(1.65)	(0.79)	(-0.62)	(0.92)	(-0.09)	(-.1.38)	(1.07)	(0.09)	(-1.70)	(1.12)	(0.52)	(-0.99)
β_1	0.3031**	0.0961	0.0884	0.5590***	0.3063**	0.3027**	0.4863***	0.2526	0.2827*	0.5480***	0.3250**	0.2922**
	(2.31)	(0.76)	(0.68)	(3.61)	(2.09)	(2.02)	(2.96)	(1.61)	(1.76)	(4.06)	(2.57)	(2.24)
β_2	-0.2329*	0.0622	0.0615	-0.1317	0.2017	0.2079	-0.3620*	-0.0602	-0.0165	-0.0132	0.2763*	0.2460
	(-1.80)	(0.49)	(0.48)	(-0.75)	(1.18)	(1.20)	(-1.90)	(-0.31)	(-0.09)	(-0.08)	(1.71)	(1.48)
β_3		-5.4075**	-5.6268**		-7.1974***	-7.2851***		-8.9804***	-9.0266***		-12.1892***	-12.3148***
		(-2.34)	(-2.43)		(-3.68)	(-3.72)		(-3.84)	(-3.85)		(-5.82)	(-5.87)
β_4		32.9400***	32.9587***		42.9939***	43.0578***		38.6858***	38.6407***		40.7938***	40.8366***
		(15.36)	(15.33)		(16.22)	(16.20)		(13.09)	(13.02)		(14.08)	(14.08)
β_5			0.0965*			0.0891			-0.0223			0.0605
			(1.75)			(1.14)			(-0.31)			(0.85)
β_6			0.0521			0.0138			0.0623			0.0075
			(1.02)			(0.17)			(0.82)			(0.10)
β_7			-0.0087			0.0010			-0.0255			0.0482
			(-0.17)			(0.02)			(-0.38)			(0.73)
β_8			-0.0121			-0.0104			0.0561			0.0007
			(-0.25)			(-0.16)			(0.93)			(0.01)
β_9			-0.0140			0.0844			0.1079*			0.0319
			(-0.29)			(1.35)			(1.74)			(0.53)
β_{10}			0.0455			0.1086*			0.1377**			0.0555
			(1.00)			(1.81)			(2.40)			(0.95)
β_{11}			0.0934**			0.0765			0.0819			0.1033**
			(2.39)			(1.50)			(1.63)			(2.16)
Adj, R2	0.001	0.096	0.098	0.002	0.095	0.096	0.002	0.077	0.080	0.001	0.082	0.083

The β coefficients are multiplied by 100. R_t^E is the return of the Nordic market under consideration and D^{USpos} (D^{USneg}) is a dummy variable that is equal to one for US holidays that are trading days for the Nordic market in consideration when the S&P 500 closed on a positive (negative) sign the day before and zero otherwise. $R_{t-1}^{S\&P500}$ is the S&P 500 return. D^{Jan} and D^{Dec} are January and December dummies respectively. D^{Mon}, D^{Tue}, D^{Thu} and D^{Fri} are Monday, Tuesday, Thursday and Friday dummies respectively. D^{TOM} is a dummy for the turn of the month.

(10) $R_t^E = \beta_0 + \beta_1 * D^{USpos} + \beta_2 * D^{USneg} + \varepsilon_t$

(11) $R_t^E = \beta_0 + \beta_1 * D^{USpos} + \beta_2 * D^{USneg} + \beta_3 * R_{t-1}^E + \beta_4 * R_{t-1}^{S\&P500} + \varepsilon_t$

(12) $R_t^E = \beta_0 + \beta_1 * D^{USpos} + \beta_2 * D^{USneg} + \beta_3 * R_{t-1}^E + \beta_4 * R_{t-1}^{S\&P500} + \beta_5 * D^{Jan} + \beta_6 * D^{Dec} + \beta_7 * D^{Mon} + \beta_8 * D^{Tue} + \beta_9 * D^{Thu} + \beta_{10} * D^{Fri} + \beta_{11} * D^{TOM} + \varepsilon_t$

Results Hypothesis Four (H4) – Stronger effect following a positive close on the S&P 500

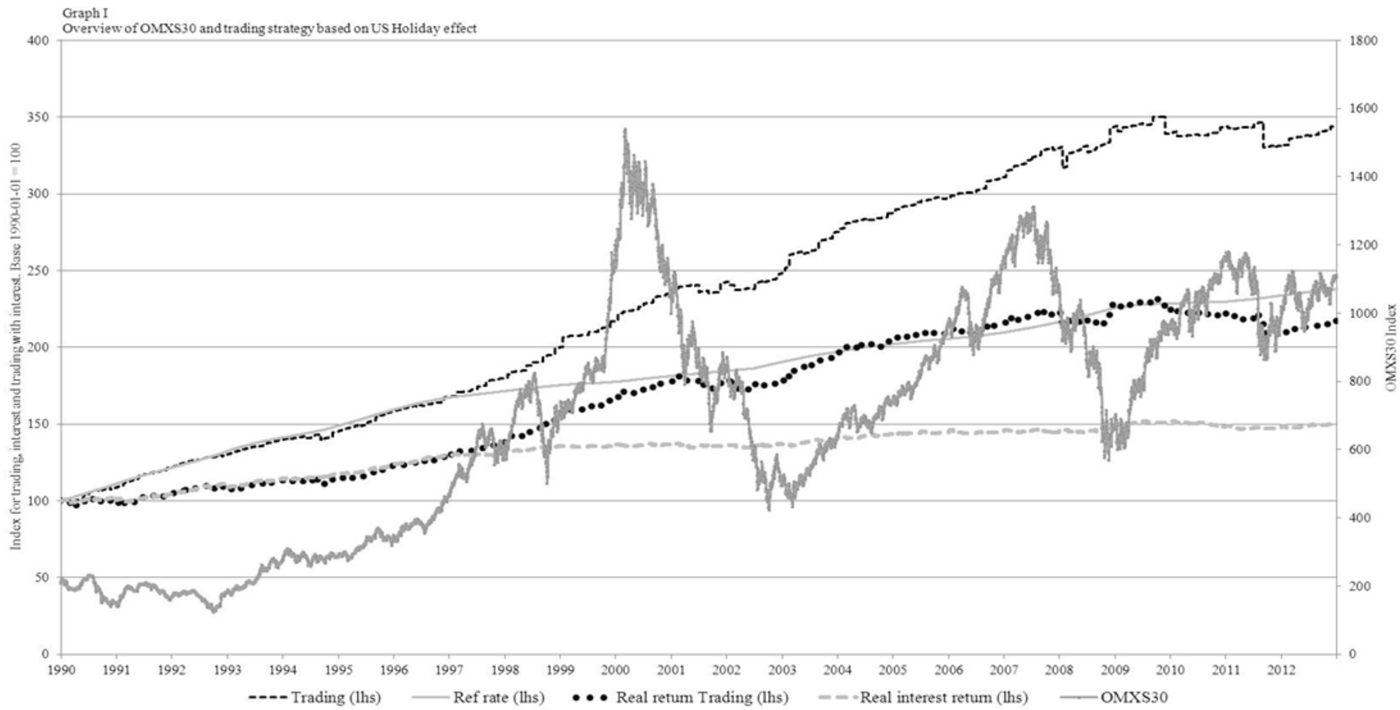
In Table 11 above, we clearly see a difference in the effect of US holidays on Nordic indices between when the S&P 500 closed with a positive or negative sign on the day before US holiday. As can be expected from our results on hypothesis one, the results are only significant for Sweden and Finland. Norway and Denmark still appears to have such a weak effect of US holidays that it is not significantly different from common days. As can be seen in Table 11 we only get significant results for Sweden and Finland for US holidays that are preceded by a positive closing sign on the S&P 500. The coefficients are also clearly stronger than the ones for the US holiday effect irrespective of previous day's closing sign as presented in Table 8. The results persist after controlling for the previous day's return on the respective indices and the S&P 500 as can be seen in Regression (11) in Table 11. The same holds true when testing for other known seasonal anomalies as presented in Regression (12) in Table 11, although the significance is weaker for both Sweden and Finland.

Our fourth hypothesis, that a positive close on the S&P 500 on the day before a US holiday intensifies the US holiday effect is thus confirmed for Sweden and Finland, and we can further see that a positive return effect on

US holidays are significant for Denmark and Norway when adding closing sign of the S&P 500 for the day before to our regression.

Trading strategy

The graph below illustrates the OMXS30 index for our investigated time period and we can see that it has gained from an index value of 206.7 to 1104.7 by the end of 2012, a return of 434.4%, not accounting for distributions to shareholders such as dividends.



Plotted on the left hand axis we can see the returns that would be achieved by trading and we have plotted four separate indices to show: (i) the gain from trading[6] on the US holiday effect and by holding the risk-free rate[7] on passive days, (ii) the gain by simply holding the risk-free rate, (iii) the real return by trading on US holidays and holding the risk-free rate on passive days and (iv) the real return from holding the risk-free rate. The strategies plotted above are stated without transaction costs.

6 Buying the OMXS30 index at close the day before US holiday and selling at close on the US holiday.

7 We have used the repo rate issued by the Swedish Riksbank as a proxy for the risk-free rate.

Table 12
Return from trading strategy

	Nominal return					Real return				
Transaction costs*	0.00%	0.01%	0.085%	0.10%	1.00%	0.00%	0.01%	0.085%	0.10%	1.00%
Trading strategy	244,43%	235,80%	177,58%	167,20%	-73,43%	117,14%	111,70%	75,00%	68,45%	-83,25%
OMXS30 Buy & Hold	434,49%	434,43%	434,03%	433,95%	429,14%	236,96%	236,90%	236,50%	236,42%	231,61%
Risk-free rate	137,83%	137,83%	137,83%	137,83%	137,83%	49,94%	49,94%	49,94%	49,94%	49,94%

*The transaction cost occurs twice per US holiday event.

The return from an active trading combined with the risk-free rate would yield a nominal return of 244.4%, whereas only trading on the US holidays and not achieving any return on the other days would yield 46.6% in return. The reason is partly that risk-free returns were significant in the beginning of the 1990's, which provided a 50% gain for the combined portfolio to mid-95 compared to the US holiday only, which were roughly unchanged at that time. Visible in the graph above is the highly positive return from trading on US holidays achieved during 1996-2000 and later in 2002-2007 but also the poor results achieved in 2000-2002 and from 2008 up until now.

The returns of the trading strategy persist even when adding low transaction costs, however when the transaction costs reach 1% the nominal and real returns are very poor. This is no surprise though since we only trade six times every year where each day accounts for two transactions and since average daily return on US holidays are approximately 0.3% it's easy to see the value distortion that occurs. Real return from trading is equal to real returns from the risk-free rate when the transaction cost is 0.145%, which is satisfactory since we have estimated transaction costs to be around 0.085% according to the internet broker Avanza's price list.[8] However we need to consider that we have left out bid-ask spreads from our estimation of the transaction costs.

The returns do not appear to be directly correlated to recessions but the dataset contain extreme days such as when the market dropped 4.8% in September 2011, 4.2% in January 2008 and 3.3% in November 2009. These days are larger than any positive return on a single US holiday in our dataset and have obviously distorted the effect in recent years.

We think that, as can be seen in Graph 1 and Graph A1, the US holiday effect on average abnormal returns on OMXS30 has decreased in recent years due to a few very negative trading days occurring on US holidays and when we clean our data from these dates we actually see a continued effect and the trading

[8] www.avanza.se on the 12th of May 2013. The brokerage fee is for the Base account and we know that our studied time period has seen a sharp decline in transaction costs due to an increasing share of internet brokers driving the prices down, we have however decided that this reported courtage is feasible since it's the highest one at Avanza as of today and hence gives us a prediction. We further consider the transaction cost to be when trading the index future, since it would be massive if one would trade every stock in the index.

strategy would hold the trend shown historically even through the financial crisis. The Graph A1, displayed in the appendix, shows average daily returns for the Swedish market and as shown, 2009 and 2011 are the years with lowest average daily return on US holidays during our sample period and even during 2008 the average daily returns were negative. The effect seem to remain but the existence of an abnormal return anomaly is no guarantee that abnormal returns will be captured every single year or at all in the future.

Overall we think the strategy has been surprisingly profitable historically given the low number of active days but the last year's performance has been poor driven by a few largely negative days. Due to a lack of intraday data we have not considered the possibility of trading with stop-losses, which probably would have reduced the negative impact during the last years, but the volatility during any given trading day would potentially have caused the stop-loss to strike on a day that finishes on the positive side. We would not regard the strategy as a money making machine largely due to the dependency on a few days per year while being exposed only to the risk-free rate at the other 98% of the year. Also, we need to remember that a significant part of the returns achieved by investors in the stock markets are distributed through dividends and share buy-backs, which one would miss out on as a trader on US holidays. Once again it should be noted that this anomaly could still be of interest for the timing of asset allocations even though a full investment strategy, relying solely on the anomaly, is not largely profitable.

VII Discussion

In our thesis we have been inspired by the novel research on US holidays effect from European markets by Casado et al. and we have been able to conclude similar findings for the Nordic countries. The reasoning behind why average returns and why percentage of days with positive returns on US holidays are higher is not completely clear and the discussion below is largely qualitatively based on our own thoughts. In an extended study it would also have been relevant to further investigate the effect of deviations from the normal investor composition and try to establish a clear understanding of the true impact of noise traders, which we feel would have been of importance for the finance commune. That being said, this thesis has provided a relatively clear causal description of the US holiday effect and we find the results significant and of economic relevance given its empirical insights into investor composition and the nature of noise trading. Hence we believe that further research on the impact of investor composition may have much in hold and is not limited to the institutional investors and noise traders, but also to the recent emergence of high-frequency trading and how the financial field is impacted by this.

The drop in volume on US holidays must be regarded as a strong effect due to the significant change of nature compared to normal days on the stock market. The impact of holidays is massive in many industries and the overall economy can face drops in GDP due to an unsatisfactory timing of Christmas, Easter or similar holidays. We find the effect on the stock market to be understandable in this regard and think that a large part of the American investors active on the Nordic, and other European, stock markets are institutional investors who probably are free from work on the public holidays and trading activity is an effect not only of the capital accessible to the investors but also of the manpower employed in trading. One needs to remember that our data samples for volume are limited to a short time period but the results still prove to be significant.

In our hypothesis section we lay the foundation for a causal interpretation of the change in the investor composition in the financial markets. We provide an idea in which noise traders are generally most active in their domestic market and particularly not in markets where the overall risk picture deviates from domestic in terms of different currency, different trading institutions and different tax systems. With this in mind it's logical to assume that the majority of international trading conducted in Sweden, or any of the other Nordic countries, on a given day is largely institutional. This implies that during the days when the amount of active institutional investors is lower the share of noise trading increases as a proportion of total trading. We know that noise trading might distort prices unless a more rational actor work in the opposite direction and it is safe to assume that this role is not filled to the normal extent on US holidays.

US holidays are the reason why the NYSE is closed down during six individual days every year and a large part of the commune of investors are not working on these days either, leading to a lower volume and less references from price changes and information from the US. Despite the volume drop making trading more risky due to increased difficulties and spreads in larger transactions there exist an increased chance to observe mispriced assets during these days for the aggressive investor. Our finding that the returns on the Nordic stock markets are larger during US holidays indicates that, ceteris paribus, there might be an overreaction in prices largely on the positive side implying that the general demand for stocks might be positively biased on average on US holidays. We deduce the results to a higher share of noise traders with an inherently positive nature and an irrational decision making process in accordance with previous research.

We have looked at an investment strategy consisting of buying the local large cap index, in Sweden the OMXS30, on close the day before US holidays and to sell it at close on the US holiday. As shown in the Section VI this strategy would achieve relatively stable results for our time period with a few exceptions during the last couple of years.

We believe that the US holiday effect exist because of the following three reasons:

i. The lower number of US investors active on the stock markets due to them being on holiday reduces the number of institutional investors active during these days, hence increases the share of trading conducted by noise traders whom are inherently less rational.
ii. The US holidays are characterized by lower news flow and the lack of reference prices from the NYSE. Fundamental investors have a rough time knowing if assets are mispriced.
iii. The US holidays reduce the number of people active on the global financial markets and thereby reduce the capital at work these days leading to lower volumes. This results in a less liquid and less volatile market compared to an average day.

To conclude we find evidence for a comparable effect in two of our four studied Nordic markets in accordance with the findings of Casado et al. (2013). The effect is substantial and we believe it to be a relevant addition to the existing literature on stock market anomalies as well as a further insight into the effects of variations in investor composition.

VIII Research topics going forward

1. Compare the findings on the different Nordic markets with the share of international (American) investors active in each market.
2. With a ground in Behavioral finance and by conducting interviews with non-American traders active in the Nordic markets; qualitatively study the reasoning behind the US Holiday anomaly.
3. Is there a reversal effect to be observed in individual stocks on the day after the US Holiday, and in particular after the US has opened?
4. The reduced US Holiday effect that has been seen in the last couple of years, is that only due to a few extreme events or might the increased share of trading conducted by high frequency traders be an explanation?

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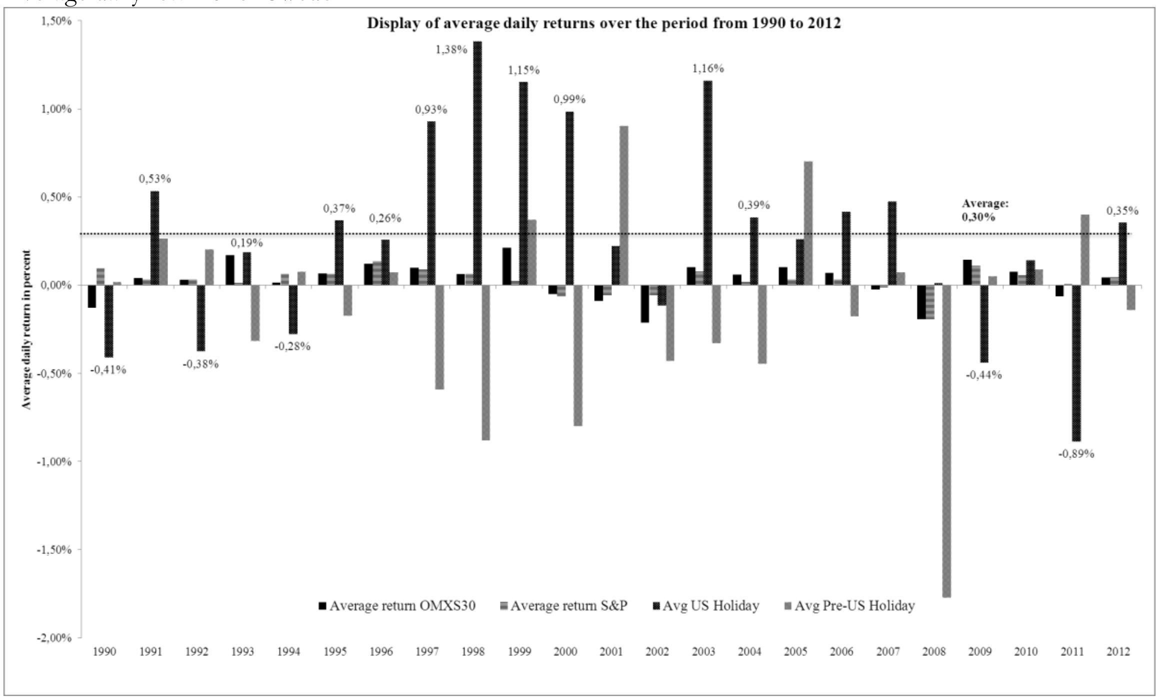
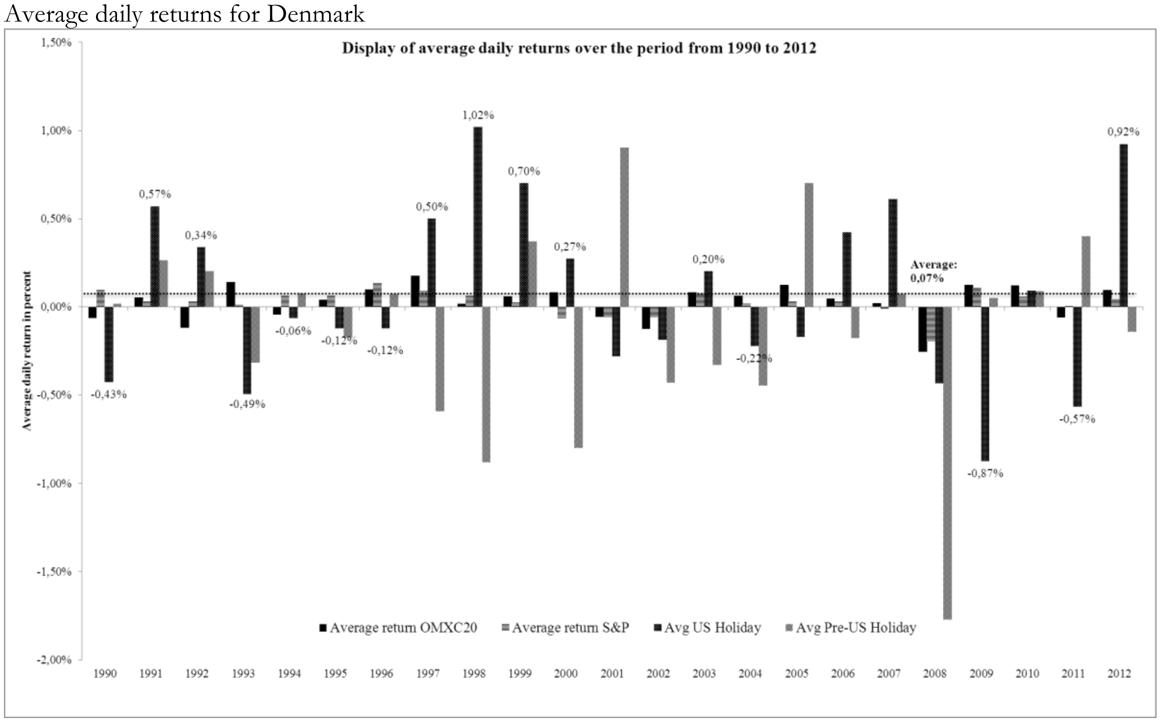
X Appendix

Historical display of average daily returns per market

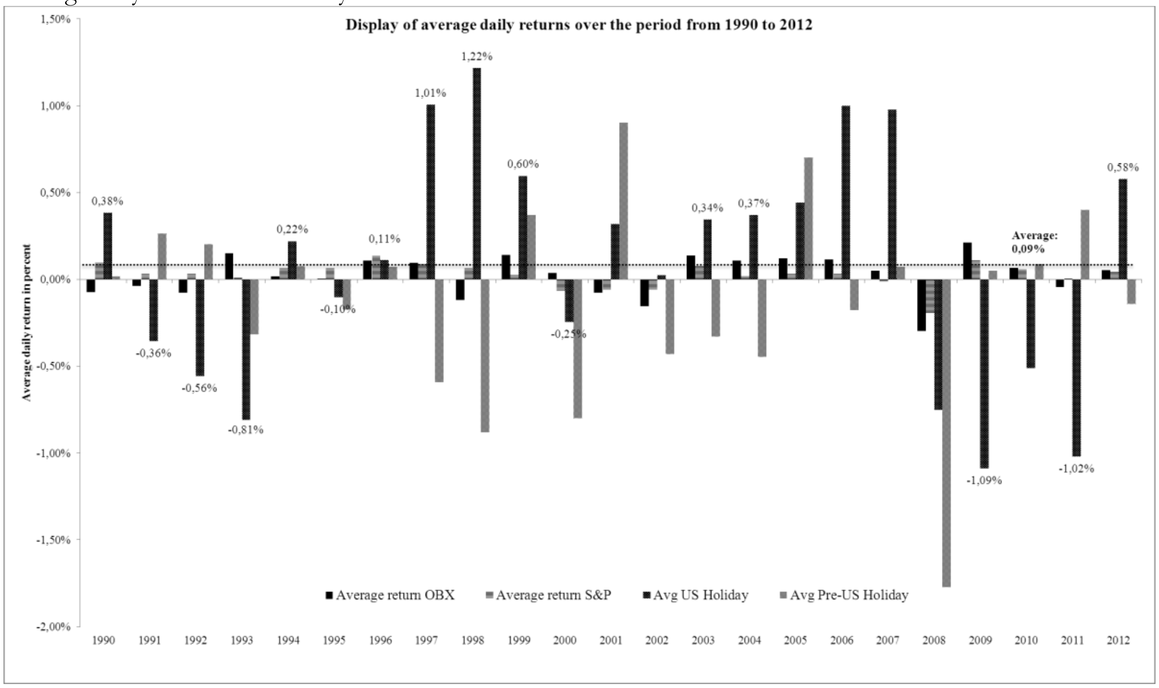
Graph A1
Average daily returns for Sweden



Graph A2
Average daily returns for Denmark



Graph A3
Average daily returns for Norway



Graph A4
Average daily returns for Finland