RETURN PATTERNS PROXIMAL TO CENTRAL BANK RATE DECISION ANNOUNCEMENTS

OMX 30 excess return and monetary policy announcements

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ABSTRACT

In this study, it is determined that excess returns on the OMX 30 are confirmed to rise in anticipation of monetary policy decisions made by the central banks of Sweden and The United States of America. Those findings were manifested at a greater magnitude on the first day prior to the announcements and on a statistically significant level one day prior to monetary policy decisions from the Federal Open Market Committee. Moreover, excess returns beyond the average rate were found to be substantially higher on the first and third day prior monetary policy decisions from the Swedish Central bank (Riksbanken) albeit not on a statistically significant level. The results drawn from the data in the study were reinforced by findings in similar tests conducted during times of global recession.

My special thanks go to my supervisor Lu Zhao for careful guidance, patience and support.
INTRODUCTION

Investment is a game of risk. Regardless of where investment is made, be it in prudent and secure government bonds or volatile equities, there is always some risk involved. Still, it appears as if the rewards are pro rated in terms of the risk an individual takes (Chong, 2004).

However ever since, Ball and Brown (1968) found that stocks move in the direction of the earnings surprise, subsequent studies show that market anomalies occur proximally with earnings reports, rate decisions etc. (Bondt and Thaler, 1984; Bernard and Thomas, 1989). The reaction of investors to the phenomena is unprecedented. Transitionally, potential explanations have been the controversy of many studies. Former event drift skeptics and believers of the efficient market hypothesis Fama (1970, 1993, 1998) has admitted that the market can be partly predictable in some circumstances. Nevertheless, that predictability is predicated by higher requited risk compensation. The argument is that while the market seems to fall short in terms of predictability, such faults are brought forth by the fact that most risk models do not compensate properly for risk under some circumstances. Social behaviorists however, (Shiller, 1984; Barberis, Shleifer, and Vishny 1998) argue that the market participants are not rational and that overreaction to the event is simply a manifestation of lack of reason.

The unpredictability of the market reaction prior to the Federal Open Market Committee (FOMC) was only augmented by the FOMC during the times when it kept its economic decisions under the rose. Investors would have to infer the ebb and flow of stocks from the movements on the OMX30 in the days subsequent to the FOMC meeting. However, since the FOMC changed its mode of announcement in 1994, there has been an increase in daily excess returns in the days preceding the FOMC decision meetings. This is regarded as the pre-FOMC announcement drift. (Lucca and Moench, 2012).

The study aims to statistically prove that the taking of position by investors prior to FOMC or Riksbanken meetings facilitates the creation of an environment wherein risk is systematized and investors can buy or sell equities safely by riding the pre/post announcement drift.
Significance of the Study

The significance of this study is anchored on the significance of the difference in excess return rates in the OMX30 during the 1 and 3 day periods preceding FOMC or Riksbanken announcements. This would mean that investors can buy or sell equities in an environment that wherein risk is absent by riding the pre-announcement drift. While it can be argued that risk will inevitably be present in trading stocks due to the volatile nature of transactions, it can be said that a t-test result affirming the alternative hypothesis will create an environment wherein return is systematized and predictable.

Risk is a primary issue in investments. Reduction of risk in a particular investment instrument usually results in more investors placing their money. This applies to investment portfolios (Tuttle and Maginn, 1983) wherein risk is substantially reduced by balancing blue chip equities with government bonds to stabilize stock volatility. If risk in investing in equity can be predicted or at the very least, systematized, such an achievement would be a breakthrough in financial management. There would be a way to ensure success in the financial industry.

Investment portfolios find a market in those seeking a middle ground between the security of government bonds and the volatility of stocks. This is because everyone wants to win in investments. People who do not have the necessary competence to be able to manage their affairs as stockholders of various globalized firms stand to lose quite a bit of money. The most apparent solution is to get someone to manage stocks for them. This is the service provided by many insurance companies and financial institutions which offer investment portfolios (Rose and Hudgins 1998).

The financial industry is all about buying risk. People buy negotiable instruments, trade stocks and extend loans all at a risk. Much of the risk can be attributed to the human element in finance. If people who veer away from risk can be ensured success through a systematic mode of investment, the economic landscape will be transformed. Whilst before, people win and lose in the stock market, systematized risk would allow people to keep winning by being responsive to the ebb and flow of stock value. This leads us to the main objective of this study (Holmes, 2002).

While there has been a fair amount of studies about the effect of monetary policies on equity return, none have studied equity return on the dates prior/succeeding Riksbanken rate decisions. Neither has equity return on the Swedish market on the dates prior/succeeding FOMC announcements been subjected to intensive and scholarly scrutiny.
Problem Statement

Given the premise that the daily excess return from the OMX30 is significantly higher in the days preceding the Federal Open Market Committee (FOMC) and Swedish Central Bank (Riksbanken) meetings, can such a timeframe be exploited for generating risk-free return. This study aims to use comparative statistical analysis to answer this question.

Scope and Delimitation

This study does not purport to coincide with any other markets around the world apart from the OMX30. Henceforth, the data yielded and the analyses thereto may not be a global indicator of daily excess return. Persons relying on the results of this study must adopt the same at their peril when applied to a different context.
BACKGROUND OF THE STUDY
THEORETICAL FRAMEWORK AND LITERATURE REVIEW

In reviewing related literature, the goal is to find prior studies which support or contradict the possibility of generating abnormal return derived from exploiting the pre/post FOMC/Riksbanken announcement drift. This part also attempts to give a background and explanation to the subject market anomaly in order to fill in gaps in previous studies. In the first part, the study will go through some more general research which have shaped economic theory and can be used as tools to expound on the topic.

Theoretical Framework

The rise in daily excess return is hardly unique to the days prior to FOMC announcement meetings. Ball and Brown (1968) were the first to find that stock price tends to drift in the direction of the earnings surprise. This finding was later confirmed by Foster, Olsen and Shevlin (1984) when their study determined that taking positions in stocks which had reported surprisingly good earnings would generate abnormal return within a 60 day span.

Those findings have been verified by a number of studies which have reinforced the phenomena of the Post Earnings Announcement Drift (PEAD). While those findings have been accepted over time, the underlying explanation is still debated. Any kind of drift before or after an event implies that there is predictability in the market. This strongly contradicts the efficient market theorem (Fama, 1970). Competing explanations have divided researchers into two schools of thought, namely those who believe there is some kind of delay in the price adjustment to new market information and those who defend the efficient market theorem by blaming risk models for not sufficiently compensating for risk. Assuming the error is indeed the calculation of risk, this gives rise to the assumption that the asset becomes riskier around earnings announcement (Fama and French 1993). Thus, it is not farfetched to believe systematic risk is higher in the pre/post FOMC announcement window. As such, the higher excess return is little more than compensation for non-diversifiable risk.

In the eighties, alternative explanations which were related to behavioural psychology gained public interest. Investors simply tend to buy what went up and sell what went down (Bondt and Thaler, 1985). Such investor behaviour is quite predictable and ultimately challenges the market efficiency theory. Barberis, Shleifer and Vishny (1998) come to the conclusion that investors tend to stand pat when it comes to single and isolated news broadcasts. Conversely, they tend to overreact on series of news broadcasts.
The implication of the delayed human behaviour was found to be successfully exploited by Jegadeesh Titman (1993). By taking positions within the short span of time prior to the drift, winners would generate a 12% yearly abnormal return.

While many studies indicate that the stock market is predictable around the time that major market events occur and that the award to risk ratio is exceptional, it should not be forgotten that the efficient market model can never be tested. What researchers are ultimately testing is a model to account for the risk. Anytime statistics which seem to be contradictory to the efficient market model are acquired, it should be determined where the imperfection occurs. Because of the joint-hypothesis while simultaneously testing the efficient market theorem and a risk-return model it is unlikely to ever find out if the market theorem holds (Fama, 1998).

In 1970 Eugene F. Fama had categorized the levels of market efficiency into three facets which could be tested in three different ways. First, the weak form determines what extent historical data predicts future patterns. Secondly the semi-strong form determines how quickly securities prices adjust to new public announcements. Finally, the strong form determines whether or not information which is not fully reflected in the price. A recurring recognizable pattern around central bank rate decision would definitely contradict the weak form. However, numerous studies suggest that the weak form does not hold true. It is more than likely that errors in time series calculation or deficient risk-models contribute to a distorted picture of the market hypothesis (Fama, 1998).

Recent studies

Other studies have shown that macroeconomic news releases cause price drifts in some way or another (Lucca and Moench, 2012). Examples of such releases are the GDP index and employment report. Studies observing the effects of these releases all attempt to identify significant independent variables in economic literature which, when proven to be relevant will facilitate the mitigation of risk in investments. Reducing risk facilitates heightened market activity as investors shy away from the safety of low yielding governments to try their luck in buying and selling stocks which can hypothetically be done in an environment wherein risk is systematized.

Without a study which aims to cohesively knit all the different variables together, much of the studies on the different sources of risk are observably sporadic and indirect. Volatility and liquidity, while considered as common sources of risk are still too minute to cause the risk aversion necessary to bring about the phenomenal demand for government bonds. This is referred to as the equity premium puzzle (Erbas and Mirakhor, 2007).

More pertinent to this study, volatility and liquidity fail to account for the spike in excess daily returns in the OMX30 in the days preceding and succeeding the FOMC
announcement. Alternative theories on political risk, restricted capacity of investors and fluctuating market participation also do not account for the rise in excess daily returns nor the demand for low risk government bonds. The gaps in literature all point to the pre FOMC announcement drift and the exploitation of potential risk free profits arising therefrom as the key to solving the equity premium puzzle (Hausman and Wongswan, 2006).

Data has proven the existence of a drift in stock price and daily excess returns even in the days subsequent to FOMC announcements. It is to be noted that this phenomenon is inexplicable as the release of information on new economic policies from the FOMC should give the market time to adjust the price directly instead of causing a drift over a 4 day period. Hypothetically speaking, this creates a window to generate abnormal return (Ball and Brown, 1968). The hypothesis is supported by the existence of upward trends in stock price for firms which have been positively affected by the FOMC announcement. Conversely, a downward trend is observable for firms which have been adversely affected.

Economic policy as released by the FOMC is directly correlated and simultaneous with rise in daily excess returns. What puzzles economists however, is the fact that the daily excess returns are generated prior to the announcement. Henceforth, it cannot be regarded as a reactionary motion on the part of the market as a whole (Lucca and Moench, 2012). It appears to be a pre-emptive action by the entire market. Ever since the FOMC became transparent about its monetary policy actions in 1994, stock returns have ballooned thirty fold in the days prior to the committee's announcements as compared to other days. Lucca and Moench (2012) found that 80 percent of the equity premium was earned during the twenty-four hours prior to scheduled FOMC announcements. Similar results are found for major global equity indexes, but not for other asset classes or other economic news announcements. According to studies, consistently deriving profits from stocks entails two essential elements: predictability and heightened market activity (Hausman and Wongswan, 2006). These facts further affirm the hypothesis of the possibility for abnormal return.

The increase in return are explained by more recent studies to be the risk premium investors receive for making preemptive moves in the days preceding announcements. These studies purport the existence of an economic equilibrium which is disrupted in the days prior to the announcements by higher risk premiums and lower risk free rates. This disruption is caused by the variance in aggregate risk as manifested by potential changes in money market policy by the FOMC (Savor, Pavel and Wilson, 2013). In the days prior to FOMC announcements, the heightened market activity allows for a more predictable movement in the prices of stocks.

The risk in stock price movement in the days prior to FOMC announcements is borne largely from economic policy. This is in stark comparison to risk in stock price movement during poor market conditions during which the predictability of the price is
dependent on external events. The stark difference in the number of factors to consider for predictability points toward the existence of a possibility of systematizing of risk (Pastor and Veronesi, 2012). With economic policy as the sole determinant, it can be said that the risk during the days prior to a FOMC announcement is highly systematized compared to other days wherein the other factors influencing the price of stocks can be said to be in a tumultuous affray (Hanson and Stein, 2012).

Data confirms the persistence and consistency of the daily excess returns generated in the short span of time prior to an FOMC announcement. In perusing data from the time when the mode of announcement by the FOMC was changed in 1994, it can be observed that the daily excess returns have spiked in the last 5 years. This applies generally to U.S. equity prices. A need for a cross sectional sample of excess returns yielded in days prior and subsequent to FOMC is necessary in order to make an in depth study for this, the capital asset pricing model (CAPM) is available but still fails to account for excess returns on all other days. The comparative nature of the statistical analysis in this study will interstitially supplement the gaps in previous literature (Bernard and Thomas, 1989).

The consistency of the occurrence of the pre-FOMC announcement drift is often pegged as the by-product of the overreaction of people to sudden events which influence the market. Evidence gathered by the Centre for Research in Security Prices (CRSP), concur with the hypothesized overreaction by market players (DeBondt and Thaler, 1985). Studies have often contrasted the eerie calm of the stock market prior to economic policy announcements with the days immediately preceding and subsequent to such announcements which exhibit a high degree of volatility (Bomfin and Antulio, 2003).
RESEARCH DESIGN

The paper aims to adopt the following methodologies in order to determine if, given the premise that the daily excess return from the OMX30 is significantly higher in day(s) preceding the Federal Open Market Committee (FOMC) and Swedish Central Bank (Riksbanken) rate decisions, such a timeframe can be exploited for generating risk-free return.

Variables

The study aims to test the effect of FOMC and Swedish Central Bank announcement meetings on daily excess return from the OMX 30. Henceforth, the following variables are present in this study:

Independent Variables
1. FOMC rate decision announcements
2. Riksbanken rate decision announcements

Dependent Variable
1. Daily excess return of the OMX 30 in the first day preceding FOMC announcement meetings or Riksbanken announcement meetings.
2. Daily excess return of the OMX 30 in the second day prior to FOMC announcement meetings or Riksbanken announcement meetings.
3. Daily excess return of the OMX 30 in the third day prior to FOMC announcement meetings or Riksbanken announcement meetings

Event Definition

\[ T_{-3} \ldots T_{-2} \ldots T_{-1} \ldots T_{0} \]

*Figure 1 Event definition*

Event window

\[ T_{0} = \text{Rate decision announcement} \]

Estimation window

1. \( T_{0} - T_{-1} \) = -1 day to 0 day (Pre event window)
2. \( T_{-1} - T_{-2} \) = -2 day to -1 day (Pre event window)
3. \( T_{-2} - T_{-3} \) = -3 days to -2 day (Pre event window)
Sampling

Purposive Sampling

In selecting the periods designated as independent variables, the study makes use of purposive sampling which entails including only samples which meet a certain criteria. In this case, only three 24h periods preceding FOMC and Riksbanken rate decision announcements from 1994 to 2013 will be selected. The reason for the timeframe which has been specified is that the FOMC changed the way announcements were made in 1994. Prior to the change in method, no announcements were made and FOMC decisions were confined to the members of the committee. The general public simply had to infer FOMC decisions from the ebb and flow of open market operations in the subsequent days. The data from Riksbanken is drawn from 1999-2013, spanning a total of 15 years. Until 1999 Riskbanken announcements were not publicly notified in advance.

Times of Recession

In order to track whether a central bank rate decision has less or greater impact in times of recession, the time set has been divided into alternative recession days. Those days that according to The International Monetary Fund are considered global recession days are in time frame Mars 2003- May 2004; December 2007- June 2009.

Data Gathering

For the independent variables, FOMC and Riksbanken announcements are published online in designated websites. For FOMC announcements, the study intends to refer to www.federalreserve.gov/fomc. Riksbanken announcements will be obtained from www.riksbank.se/en/. Daily OMX 30 closing price has been obtained from www.nasdaqomxnordic.com/. Three months Treasury bill yield has been used as risk free rate. That data can be found on www.riksbank.se/en.

Data analysis methods

Upon obtaining the data, the study will attempt to prove the hypothesis of the study by comparing and contrasting data samples of excess returns from the days preceding FOMC and Riksbanken announcement meetings against return on all other days. To statistically
prove that excess returns are higher around FOMC and Riksbanken rate announcements, two different approaches will be used.

First averages will be compared and T-tests will be computed to see if excess return is significantly higher prior to FOMC and Riksbanken rate decision announcements. The study divides the data set into three categories. These categories are as follows:

1. Daily excess return in the first, second and third day prior FOMC rate decisions
2. Daily excess return in the first, second and third day prior Swedish Riksbanken rate decision
3. Daily excess return of all days.

A 1 tailed t-test is then conducted to determine if there is a difference in the values from the categories involving decision returns and those involving the absence of any decision.

Secondly a multiple linear regression with dummy variables will be carried out. Here the dummy variables of FOMC decision and Swedish Riksbanken decision are regressed against the daily excess return to see if what impact the announcement has on the OMX30 excess return.

Average excess returns

Raw OMX30 return: Calculated by taking the current day OMX30 index close dividing by previous day OMX30 close and then subtracting 1.

\[
\left( \frac{\text{Index}_{T0} - \text{Index}_T}{1} \right) - \text{rf}
\]

Formula 1 - Daily excess return

Excess OMX30 return: Taking the raw OMX30 return and subtracting the risk free rate

Hypothesized Mean Difference T-test

A t-test was conducted on every time set which compares the average return before Riksbanken announcements. This was compared against time sets involving no Riksbanken announcements. Accordingly a set of similar t-tests which compare the average return before FOMC announcements against all other days.
**Dummy variable regression model**

For pre-FOMC announcement days, a dummy variable called \( \text{pre-FOMC} \) was used and coded as 1 if the day is an announcement day and 0 if the day is a NON announcement day. Similarly (NON) Riksbanken announcement days are coded 1 and 0.

\[
R_{xt} = \alpha + [ \beta_1 \text{(pre-FOMC}_{t-1}) + \beta_2 \text{(pre-FOMC}_{t-2}) + \beta_3 \text{(pre-FOMC}_{t-3}) ] + \hat{\epsilon}
\]

**Formula 2 pre-FOMC excess return regression model**

\[
R_{xt} = \alpha + [ \hat{\beta}_1 \text{(pre-Riksbanken t-1}) + \hat{\beta}_2 \text{(pre-Riksbanken t-2}) + \hat{\beta}_3 \text{(pre-Riksbanken t-3}) ] + \hat{\epsilon}
\]

**Formula 3 pre-Riksbanken excess return regression model**

\( R_{xt} \) express the excess return over the risk free rate on the OMX 30. The independent variable is a dummy variable equal to 1 on the first, second and third day prior to scheduled central bank rate decision announcements and equal to zero on all other days.

\( \hat{\epsilon}_t \) is excess return in the estimation windows when the constant \( \hat{\epsilon} \) is omitted.
RESULTS

Average excess returns

Prior to Riksbanken rate decision announcements, an increase in excess return is observed. This is corroborated by the fact that on 71 of the 118 Riksbanken rate decision announcements during the period 1999-2013 which were observed in this study, the excess return was higher than the average daily excess return obtained from all other days. While excess return seems to be significantly higher on the day immediately before the announcement, the excess returns two days prior were significantly lower and dips into negative values.

However, the lower numbers on the preceding second were not statistically significant. This is in stark contrast to the statistically significant higher returns on the day immediately prior to the Riksbanken announcement. Thus, no further conclusion is to be drawn from the contradictory result from between the two days immediately before the announcements. Three days prior to the Riksbanken rate decision announcements the return was again higher than on other days. Unfortunately, the excess return value was not found to be statistically significant.

Concurring evidence is observed in the first day preceding the FOMC announcements as the average excess returns were found to be positive by 54 basis points over the average excess return found in the period 1994-2013. Transitively, the excess return on the second and third day prior the FOMC rate decisions announcements again were found negative. Again as those numbers were not statistically significant, no conclusions may be drawn from that fact. Furthermore, on 108 out of the 157 observed FOMC announcements the excess return was found to be higher on the day immediately preceding the announcement than on all other days in the period 1994-2013.

<table>
<thead>
<tr>
<th></th>
<th>One day pre announcements excess return</th>
<th>Second day pre announcements excess return</th>
<th>Third day pre announcements excess return</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Riksbanken</td>
<td>0.2241746</td>
<td>-0.1077896</td>
<td>0.359802</td>
<td>118</td>
</tr>
<tr>
<td>Pre-FOMC</td>
<td>0.5682331</td>
<td>-0.0753904</td>
<td>-0.069</td>
<td>157</td>
</tr>
<tr>
<td>All other days jan1999-sep2013</td>
<td>0.0198069 (0.0295846)</td>
<td>0.0198069 (0.0295846)</td>
<td>0.0198069 (0.0295846)</td>
<td>3724 (4978)</td>
</tr>
</tbody>
</table>

Table 1 Excess return % on OMX 30 in the days prior to rate decision announcements
Table 2 Excess return % in the days prior to rate decision announcements in time of recession

**T-test result**

<table>
<thead>
<tr>
<th></th>
<th>1 day prior to Riksbanken rate decision announcements</th>
<th>2nd day prior to Riksbanken rate decision announcements</th>
<th>3rd day prior to Riksbanken rate decision announcements</th>
<th>All other days</th>
<th>Mean</th>
<th>Variance</th>
<th>Observations</th>
<th>Pooled Variance</th>
<th>Hypothesized Mean Difference</th>
<th>df</th>
<th>t Stat</th>
<th>P(T&lt;=t) one-tail</th>
<th>t Critical one-tail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Riksbanken</td>
<td>0.00691447</td>
<td>0.1219067</td>
<td></td>
<td></td>
<td>0.002241746</td>
<td>-0.001077896</td>
<td>0.00359802</td>
<td>0.00025537</td>
<td>0</td>
<td>3840</td>
<td>1.367710091</td>
<td>0.085741438</td>
<td>1.645250538</td>
</tr>
<tr>
<td>Pre-FOMC</td>
<td>1.12511694</td>
<td>0.0612312</td>
<td></td>
<td></td>
<td>0.000242906</td>
<td>0.000329464</td>
<td>0.000293787</td>
<td>0.00025537</td>
<td>0</td>
<td>3840</td>
<td>-0.84955109</td>
<td>0.197813838</td>
<td>1.645250538</td>
</tr>
<tr>
<td>All other days</td>
<td>-0.0685919</td>
<td>-0.0685919</td>
<td></td>
<td></td>
<td>0.0002241746</td>
<td>0.000329464</td>
<td>0.000293787</td>
<td>0.00025537</td>
<td>0</td>
<td>3840</td>
<td>2.268508212</td>
<td>0.011676765</td>
<td>1.645250538</td>
</tr>
</tbody>
</table>

Table 3 Significance of average excess returns - t-test result - Riksbanken
<table>
<thead>
<tr>
<th></th>
<th>1 day prior to FOMC rate decision announcements</th>
<th>2nd day prior to FOMC decision announcements</th>
<th>3rd prior to FOMC rate decision announcements</th>
<th>All other days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.005682331</td>
<td>-0.000753904</td>
<td>-0.00069</td>
<td>0.000198069</td>
</tr>
<tr>
<td>Variance</td>
<td>0.000166974</td>
<td>0.000217301</td>
<td>0.000197</td>
<td>0.000255762</td>
</tr>
<tr>
<td>Observations</td>
<td>157</td>
<td>157</td>
<td>157</td>
<td>3724</td>
</tr>
<tr>
<td>Pooled Variance</td>
<td>0.000232387</td>
<td>0.000234402</td>
<td>0.000234</td>
<td></td>
</tr>
<tr>
<td>Hypothesized Mean Difference</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>df</td>
<td>5133</td>
<td>5133</td>
<td>5133</td>
<td></td>
</tr>
<tr>
<td>t Stat</td>
<td>4.354654073</td>
<td>-0.845886825</td>
<td>-0.79181</td>
<td></td>
</tr>
<tr>
<td>P(T&lt;=t) one-tail</td>
<td>6.79359E-06</td>
<td>0.198827656</td>
<td>0.214255</td>
<td></td>
</tr>
<tr>
<td>t Critical one-tail</td>
<td>1.645150538</td>
<td>1.645150538</td>
<td>1.645151</td>
<td></td>
</tr>
</tbody>
</table>

Table 4 Significance of average excess returns \( \bar{\tau} \) test result FOMC

<table>
<thead>
<tr>
<th></th>
<th>1 day prior to Riksbanken rate decision announcements</th>
<th>1 day prior to FOMC rate decision announcements</th>
<th>All other days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>6.91447E-05</td>
<td>0.012511694</td>
<td>-0.000557284</td>
</tr>
<tr>
<td>Variance</td>
<td>0.000562036</td>
<td>0.000363364</td>
<td>0.000550343</td>
</tr>
<tr>
<td>Observations</td>
<td>18</td>
<td>19</td>
<td>581</td>
</tr>
<tr>
<td>Pooled Variance</td>
<td>0.000550676</td>
<td>0.000545469</td>
<td></td>
</tr>
<tr>
<td>Hypothesized Mean Difference</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>df</td>
<td>597</td>
<td>598</td>
<td></td>
</tr>
<tr>
<td>t Stat</td>
<td>0.111540964</td>
<td>2.423816224</td>
<td></td>
</tr>
<tr>
<td>P(T&lt;=t) one-tail</td>
<td>0.455612437</td>
<td>0.007826984</td>
<td></td>
</tr>
<tr>
<td>t Critical one-tail</td>
<td>1.647409993</td>
<td>1.647405712</td>
<td></td>
</tr>
</tbody>
</table>

Table 5 Significance of average excess returns \( \bar{\tau} \) test result \( \bar{\tau} \) In time of recession
**T-test Interpretation**

Looking at the p-value, \( \bar{P}(T \leq t) \) one-tail, it is ideal that the value is below .05. It can be observed that for FOMC announcements, this value (6.79359E-06) is below .05 in 1 day prior to announcement and hence is statistically significant.

Conversely, it is seen that for 1 day pre-Riksbanken the p-value (0.085741438) is above the .05 mark. This indicates it cannot be considered statistically significant. However, straying from technicalities it probably influences the OMX30 index to a certain extent.

Since the difference between the average daily returns is positive, there is a similarly positive effect from arising from Riksbanken announcements. While looking at the test period during times of recession, the altered excess returns yielded on the day preceding FOMC announcements may be considered statistically significant at a level of 0.007826984. Unfortunately the values representing excess returns from the days preceding the Riksbanken announcements again were found less reliable and statistically insignificant.

**Result from regression**

In terms of regression analysis, the study intends to look at the slope coefficients and the p-value associated with those coefficients. If the p-value is below .05 it indicates a strong relationship.

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Standard Error</th>
<th>t Stat</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>5.17775E-05</td>
<td>0.00027518</td>
<td>0.188159</td>
</tr>
<tr>
<td>Riksbanken t-1</td>
<td>0.002261257</td>
<td>0.00150292</td>
<td>1.504576</td>
</tr>
<tr>
<td>Riksbanken t-2</td>
<td>-0.001066519</td>
<td>0.00150292</td>
<td>-0.70963</td>
</tr>
<tr>
<td>Riksbanken t-3</td>
<td>0.003461585</td>
<td>0.00150292</td>
<td>2.30324</td>
</tr>
</tbody>
</table>

Table 6 Regression pre-Riksbanken rate decision announcements

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Standard Error</th>
<th>t Stat</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.000178961</td>
<td>0.0002279</td>
<td>0.785264</td>
</tr>
<tr>
<td>FOMC t-1</td>
<td>0.005503369</td>
<td>0.001242148</td>
<td>4.430525</td>
</tr>
<tr>
<td>FOMC t-2</td>
<td>-0.00093287</td>
<td>0.001242148</td>
<td>-0.75101</td>
</tr>
<tr>
<td>FOMC t-3</td>
<td>-0.00086446</td>
<td>0.001242148</td>
<td>-0.69594</td>
</tr>
</tbody>
</table>

Table 7 Regression pre-Riksbanken rate decision announcements
Regression Interpretation

Upon perusing the p-values in each regression, it is observable that the FOMC announcements are once again statistically significant on the day immediately prior to announcement. Conversely, looking at the p-values for the Riksbanken announcements it can be observed that they are not statistically significant. Nevertheless, it must be noted that the p-values for the days immediately preceding Riksbanken announcements are on the borderline of statistical significance. Thus they may actually have an effect on the OMX30.

Subsequently, the slopes of each of the coefficients can be interpreted. In evaluating the values for the one-day-pre-regression, the FOMC has a coefficient of 0.005503369 which indicates that in the day preceding an announcement from the FOMC the average daily return increases by 0.55%. On the other hand the counterpart value for Riksbanken announcements has a coefficient of 0.002261257 which indicates an increase in average daily return of 0.23%.

Violation of normal distribution

The other thing to note about the regression model is that there is a contradiction of the normality of distribution of returns. This can be seen in the normal probability plots associated with each regression. There should be straight lines but instead the tails/ends are curved. This is also a well-established result for stock returns, so it shouldn’t be a cause for alarm. It just means this model will give us fewer extreme values than occur in reality (Karoglou, 2009).
CONCLUSION

Upon perusing the tests as a whole, it can be concluded that the FOMC is statistically significant indicator of return (at the 0.05 level) one day prior to announcement. However, the p-values for the various tests of FOMC announcements vary. This is the case although excess returns were found to be lower on the second and third day preceding FOMC announcements.

The findings in the preceding paragraph are concurred with in the case of Riksbanken announcements as these were shown to have a positive effect on the OMX 30 on the first and third day preceding the announcements.

Unfortunately, the data preceding the Riksbanken announcements were not found to be statistically significant at the threshold level of 0.05. Nevertheless, the p-values for the day immediately preceding the announcement were at the brink of significance. Thus there is probably an effect on the OMX 30 in light of the anticipation of investors for the Riksbanken announcements.

Perhaps what needs to be considered and reconciled are the results from the second and third days preceding the announcements since these had mixed results. It was difficult to determine whether the rate decision announcements from the central bank had any effect on days beyond the first day preceding the announcements.

In times of recession it was found that excess return on OMX 30 prior to the FOMC announcements yielded an increase despite the fact that the overall average daily excess returns in those periods (March 2003 - May 2004; December 2007 - June 2009) were negative.

The result from the one day preceding the FOMC announcements proved fully significant at the 0.05 level for the period defined as times of recession. As for the average excess return on the first and third days preceding the Riksbanken announcements in times of recession the excess returns for those days were altered. The same applies for the days preceding the FOMC announcements as well.

As such, the study concludes that the FOMC announcements tend to be more anticipated by investors during recession which cause the returns preceding FOMC announcements skyrocket beyond average values.

As a contradictory point however, regression reveals that in recession the anticipation of a Riksbanken or FOMC announcements has a negative impact on the Swedish OMX30
index on the third the day before the announcement. Nevertheless, those numbers weren’t found statistically significant.

Observing the table of averages, it can be seen that the excess returns on the OMX 30 tend to go up on the days immediately preceding the announcements from both the central banks. Still it can be observed that the FOMC announcements have a more pronounced impact which manifests in the data. As a final note, it can be seen from the no announcement category that markets have a slow general upward trend for this data set. This observation is no surprise since this has been proven extensively in the past.

Although excess return was found to be substantially higher in the anticipation of rate decision announcements it is disputable whether or not such findings actually create opportunities for risk free profit. Nevertheless, using the data obtained from this study, it could be argued that systemic risk is potentially higher in anticipation of a monetary policy announcement. In synthesizing this matter, it would be beneficial for investors to exploit the predictability of the market which is found to be statistically significant in terms of excess returns.

Risk-free profit is an absolutist concept which does not come within the ambit of the data obtained by this study. What the study’s results have yielded however, is a window which investors can exploit during which risk is mitigated on the OMX30.
References


Internet sources
www.federalreserve.gov/fomc
www.imf.org
www.nasdaqomxnordic.com
www.riksbanken.se/en
## Appendix A – Descriptive statistics

<table>
<thead>
<tr>
<th></th>
<th>All days</th>
<th>t-1 Riksbanken</th>
<th>t-2 Riksbanken</th>
<th>t-3 Riksbanken</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>0.000198</td>
<td>0.002242</td>
<td>-0.00108</td>
<td>0.003598</td>
</tr>
<tr>
<td><strong>Standard Error</strong></td>
<td>0.000262</td>
<td>0.001435</td>
<td>0.001671</td>
<td>0.001578</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>0.000473</td>
<td>0.002878</td>
<td>-0.00048</td>
<td>0.002807</td>
</tr>
<tr>
<td><strong>Mode</strong></td>
<td>-6.9E-06</td>
<td>#N/A</td>
<td>#N/A</td>
<td>#N/A</td>
</tr>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>0.015993</td>
<td>0.015585</td>
<td>0.018151</td>
<td>0.003598</td>
</tr>
<tr>
<td><strong>Sample Variance</strong></td>
<td>0.000256</td>
<td>0.000243</td>
<td>0.000329</td>
<td>0.000294</td>
</tr>
<tr>
<td><strong>Kurtosis</strong></td>
<td>3.258556</td>
<td>2.16118</td>
<td>3.312724</td>
<td>1.298318</td>
</tr>
<tr>
<td><strong>Skewness</strong></td>
<td>0.186294</td>
<td>0.179040</td>
<td>0.074116</td>
<td>0.117181</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>0.185446</td>
<td>0.105794</td>
<td>0.141911</td>
<td>0.10874</td>
</tr>
<tr>
<td><strong>Minimum</strong></td>
<td>-0.08189</td>
<td>-0.04775</td>
<td>-0.07251</td>
<td>-0.05406</td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>0.103558</td>
<td>0.058045</td>
<td>0.069398</td>
<td>0.054676</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>0.737609</td>
<td>0.2064526</td>
<td>-0.12719</td>
<td>0.424566</td>
</tr>
<tr>
<td><strong>Count</strong></td>
<td>3724</td>
<td>118</td>
<td>118</td>
<td>118</td>
</tr>
</tbody>
</table>

Table A.1 This table reports summary statistics for the daily excess returns on the OMX30. The sample period is January 1, 1999 to September 31, 2013.

<table>
<thead>
<tr>
<th></th>
<th>All days</th>
<th>t-1 FOCM</th>
<th>t-2 FOCM</th>
<th>t-3 FOCM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>0.000296</td>
<td>0.005682331</td>
<td>-0.00075</td>
<td>-0.00069</td>
</tr>
<tr>
<td><strong>Standard Error</strong></td>
<td>0.000217</td>
<td>0.001031277</td>
<td>0.001176</td>
<td>0.00112</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>0.000557</td>
<td>0.003334707</td>
<td>-0.00093</td>
<td>0.00166</td>
</tr>
<tr>
<td><strong>Mode</strong></td>
<td>-6.9E-06</td>
<td>#N/A</td>
<td>#N/A</td>
<td>#N/A</td>
</tr>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>0.015328</td>
<td>0.012921859</td>
<td>0.014741</td>
<td>0.014035</td>
</tr>
<tr>
<td><strong>Sample Variance</strong></td>
<td>0.000235</td>
<td>0.000166974</td>
<td>0.000217</td>
<td>0.000197</td>
</tr>
<tr>
<td><strong>Kurtosis</strong></td>
<td>3.833967</td>
<td>1.884071352</td>
<td>1.243937</td>
<td>0.912433</td>
</tr>
<tr>
<td><strong>Skewness</strong></td>
<td>0.209924</td>
<td>0.905378957</td>
<td>-0.0551</td>
<td>-0.35617</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>0.1982610</td>
<td>0.081570665</td>
<td>0.089275</td>
<td>0.087226</td>
</tr>
<tr>
<td><strong>Minimum</strong></td>
<td>-0.08189</td>
<td>-0.024765009</td>
<td>-0.04829</td>
<td>-0.04591</td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>0.116373</td>
<td>0.056805656</td>
<td>0.040982</td>
<td>0.041317</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>1.472719</td>
<td>0.892125913</td>
<td>-0.11836</td>
<td>-0.10762</td>
</tr>
<tr>
<td><strong>Count</strong></td>
<td>4978</td>
<td>157</td>
<td>157</td>
<td>157</td>
</tr>
</tbody>
</table>

Table A.2 This table reports summary statistics for the daily excess returns on the OMX30. The sample period is January 1, 1994 to September 31, 2013.
<table>
<thead>
<tr>
<th>Period</th>
<th>Days with positive excess return</th>
<th>Number of days</th>
<th>Percent of observations with positive excess return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every day 1994-2013</td>
<td>2596</td>
<td>4978</td>
<td>52%</td>
</tr>
<tr>
<td>Everyday 1999-2013</td>
<td>1929</td>
<td>3725</td>
<td>52%</td>
</tr>
<tr>
<td>one day pre FOCM</td>
<td>108</td>
<td>157</td>
<td>69%</td>
</tr>
<tr>
<td>one day pre Riksbanken</td>
<td>71</td>
<td>118</td>
<td>60%</td>
</tr>
<tr>
<td>two day pre FOCM</td>
<td>71</td>
<td>157</td>
<td>45%</td>
</tr>
<tr>
<td>two day pre Riksbanken</td>
<td>58</td>
<td>118</td>
<td>49%</td>
</tr>
<tr>
<td>three day pre FOCM</td>
<td>86</td>
<td>157</td>
<td>55%</td>
</tr>
<tr>
<td>three day pre Riksbanken</td>
<td>70</td>
<td>118</td>
<td>59%</td>
</tr>
</tbody>
</table>

Table A.2 Number of observation with positive excess return
Appendix B: Announcement dates

2000 4-Feb-00 23-Mar-00 5-May-00 08-Jun-00 7-Jul-00 17-Aug-00 10-Oct-00 07-Dec-00
2001 05-Dec-01
2002 08-Feb-02 19-Mar-02 26-Apr-02 06-Jun-02 05-Jul-02 16-Aug-02 17-Oct-02 15-Nov-02
2002 05-Dec-02
2003 07-Feb-03 18-Mar-03 24-Apr-03 05-Jun-03 12-Jul-04 15-Aug-03 16-Oct-03 05-Dec-03
2006 20-Jan-06 23-Feb-06 28-Apr-06 20-Jun-06 30-Aug-06 26-Oct-06 15-Dec-06
2008 13-Feb-08 23-Apr-08 03-Jul-08 04-Sep-08 08-Oct-08 23-Oct-08 04-Dec-08
2009 11-Jan-09 21-Apr-09 2-Jul-09 03-Sep-09 22-Oct-09 16-Dec-09
2010 11-Feb-10 20-Apr-10 1-Jul-10 09-Sep-10 26-Oct-10 15-Dec-10
2012 16-Mar-12 18-Apr-12 04-Jul-11 6-Sep-12 25-Oct-12 18-Dec-12
2013 13-Feb-13 15-Apr-13 01-Jul-13 05-Sep-13

Table B.1 Scheduled Riksbanken announcement dates January 1999-September 2013.
1995 1-Feb-95 28-Mar-95 23-May-95 6-Jul-95 22-Aug-95 26-Sep-95 15-Nov-95 19-Dec-95
1996 31-Jan-96 26-Mar-96 3-Jul-96 20-Aug-96 24-Sep-96 13-Nov-96 17-Dec-96
2000 2-Feb-00 21-Mar-00 16-May-00 28-Jun-00 22-Aug-00 3-Oct-00 15-Nov-00 19-Dec-00]
2002 30-Jan-02 19-Mar-02 7-May-02 26-Jun-02 13-Aug-02 24-Sep-02 6-Nov-02 10-Dec-02
2003 29-Jan-03 18-Mar-03 6-May-03 25-Jun-03 12-Aug-03 16-Sep-03 28-Oct-03 9-Dec-03
2005 2-Feb-05 22-Mar-05 3-May-05 30-Jun-05 9-Aug-05 20-Sep-05 1-Nov-05 13-Dec-05
2006 31-Jan-06 28-Mar-06 10-May-06 29-Jun-06 8-Aug-06 20-Sep-06 25-Oct-06 12-Dec-06
2008 30-Jan-08 18-Mar-08 30-Apr-08 25-Jun-08 5-Aug-08 16-Sep-08 29-Oct-08 16-Dec-08
2009 28-Jan-09 18-Mar-09 29-Apr-09 24-Jun-09 12-Aug-09 23-Sep-09 4-Nov-09 16-Dec-09
2010 27-Jan-10 16-Mar-10 28-Apr-10 23-Jun-10 10-Aug-10 21-Sep-10 3-Nov-10 14-Dec-10
2012 25-Jan-12 13-Mar-12 25-Apr-11 20-Jun-12 01-Aug-12 13-Sep-12 24-Oct-12 12-Dec-12

Table B.2 Scheduled FOMC announcement dates and times January 1994-September 2013