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Market Responses to Short Interest Announcements

- Does the Market Always Get it Right?

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ABSTRACT

We investigate the market reaction to short interest announcements and quantify the informativeness of short sellers using a comprehensive sample of OMX Stockholm firms from November 2012 to January 2014. Our primary aim with this paper is to understand whether the market reactions are rational. Public announcements of short interest in nonoptioned stocks result in average cumulative abnormal returns (ACARs) of -5.34% (-3.59%) after 15 (30) trading days whilst public announcements of short interest in optioned stocks yield ACARs of 0.31% (1.27%) after 15 (30) trading days. Short interest announcements of nonoptioned stocks are strong bearish signals whilst short interest announcements of optioned stocks are bullish signals. Furthermore, we find that short sellers in nonoptioned stocks are well informed market participants as heavily shorted nonoptioned stocks underperform lightly shorted nonoptioned stocks by a risk adjusted average of 0.52% (0.32%) over the following 10 (20) trading days. Although only nonoptioned shorts are informative, the market fails to realize this. Therefore, there is an overreaction to the announcement of optioned shorts implying irrational market expectations.

Keywords: Short selling, event study, market reaction, abnormal returns, informativeness

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INTRODUCTION

We investigate the market reaction to short selling announcements and quantify the informativeness of short sellers using a comprehensive sample of OMX Stockholm firms. Our primary aim with this paper is to gain an in depth comprehension of how market participants perceive short interest and understand whether these perceptions are rational. Market participants′ perceptions of short interest are embedded in their reaction to public announcements of short interest. The rationality of their perceptions to short interest can be evaluated by studying the market reaction to public short interest announcements in conjunction with the informativeness of short sellers.

Three different views have in the academic literature been offered on the expected relationship between short interest and stock returns. One view which has been very popular in Wall Street asserts that a high short interest in a particular stock is a bullish signal because it represents latent demand as the short positions must be covered in the future, eventually pushing up its share price. This view would be difficult to justify on information grounds as the costs of short selling are unlikely to attract a pool of relatively uninformed short sellers unless the costs that short sellers face are positively correlated with the quality of their information. A more recent appraisal of short interest is that it conveys adverse information and is thus a bearish signal (Diamond and Verrecchia 1987). The rationale underlying this idea is that short selling is costly and constrained relative to long positions; hence liquidity traders are less likely to engage in short selling. This increases the likelihood that informed market participants engage in short selling, hence comprising a larger proportion of the total short interest. Unexpected public announcements of an increase in the short interest in a stock thus convey negative information to market participants (e.g. Diamond and Verrecchia 1987, Senchack and Starks (1993) and Desai et al 2000). The final view asserts that there is no relation between short selling and stock returns if short selling is motivated by hedging strategies, arbitrage transactions or tax-related reasons (Brent, Morse and Stice (1990). Consistent with the tax selling arguments, Senchack and Starks (1993) find a seasonality pattern in short selling activity as short interest is higher during December to January. Several market participants also short against the box implying that they short the same stock in which they already have a long position in order to lock in the profit and delay the recognition of taxable gains. Short positions motivated by such strategies may not represent any latent demand for the shares nor convey any negative information about the stock. Furthermore, the informativeness of short sellers may vary with the type of trader initiating the short. Hence, the market reaction may differ with respect to the type of trader initiating the short. The typical short seller however uses fundamental information such as DCF-models and trad-

ing multiples in order to gauge the value of the firm. Statistical arbitrage hedge funds try to anticipate short term price movements based on recent order flow data. Other market participants such as e.g. option market makers and convertible arbitrage funds may take short positions with little consideration to whether the stock is overvalued or not (Boehmer et al 2008).

In the first part of our paper, we investigate the market reaction to short interest announcements by conducting an event study in which we analyze abnormal returns on and around the event dates. In the second part of the paper, we investigate whether short sellers are well informed market participants. We conduct a portfolio approach and sort stocks into quintiles based on 1 week′s shorting activity using four different flow measures and then compare the performance of portfolios comprising heavily shorted stocks with lightly shorted stocks. We finally assess whether market reactions to short interest announcements are rational by combining the evidence from both parts.

We obtain daily data on short interest from the Swedish Financial Supervision Authority. Data is available for 15 months, from 1 November 2012 (when the new EU regulation was implemented) to January 2014. In the first part of the paper, we only examine public data which is available to all market participants (short interest levels exceeding the 0.5% threshold) because we are interested in the market reaction to the public announcements of short interest. In the second part of the paper however, we analyze both public and "private" data (short interest levels between 0.2% and 0.5%). Furthermore, the data set provides us with rare characteristics such as the type of trader initiating the short and the order size. This allows us to compare how market reactions differ with respect to the type of trader initiating the short.

The short sellers in our public sample resemble the typical short seller described by Boehmer et al (2008) in the sense that they seem to target firms whose prices are high relative to their fundamentals. More specifically, we find that growth stocks (low book to market firms) are on average preferred over value stocks (high book to market firms). This is not surprising considering that the long run underperformance of growth stocks relative to value stocks is a well documented fact in the academic literature (Ilmanen 2011). Moreover, we also find that the short sellers mainly target highly liquid large cap firms with relatively high institutional ownership (40% on average) which is intuitive considering that the value premium is the least significant for such firms. This piece of evidence is also consistent with our finding that market participants prefer to short growth stocks over value stocks. We next find that the short sellers seem to target firms with negative pre 1 year stock returns but positive short term (2 weeks) stock returns. These two observations are consistent with the long term momentum effect as well short term mean reversal pattern in equities (Ilmanen 2011). Furthermore, over 95% of the

position holders in the public sample are either investment management firms or hedge funds. Overall, the short sellers in our public sample seem to be relatively sophisticated and resemble the well informed typical short seller as described by Boehmer et al (2008). This could potentially induce market participants to believe that short sellers are well informed market participants. Consequently, a bearish market reaction to the public announcement of short interest should not come as a surprise.

Our first piece of evidence on the market reaction to short interest is that the market responds negatively to public announcements of short interest. We are particularly interested in the "first short interest" announcement which is the announcement that has to be made when a certain market participant for the first time exceeds the 0.5% short interest threshold in a particular target firm. The short position is on average announced two days after the position date. Moreover, we find that the public announcement of a "first short interest" results in negative and statistically significant average cumulative abnormal returns (ACARs) of -1.2% (-1.42%) ten (fifteen) trading days post announcement date. Similar to the findings of Senchack and Starks (1993) and Desai et al (2000), we observe that this effect is not incorporated into share prices immediately, but gradually over time. However, this effect lasts only for a short period of time because we find that the negative CARs revert to zero using a longer post event window of 6 weeks. This reversal pattern suggests that the price impact is only temporary and reflects a trading friction (selling pressure post announcement caused by market participants who take follow on the short seller) rather than information about prospective value changes. Combining this piece of evidence with our finding that abnormal trading volume increases with 2% to 4% immediately following the announcement of short interest, we conclude that the negative CARs observed in the short post event window are caused by selling pressure from market participants who believe that short sellers are well informed market participants.

We next break our analysis down by examining the market reaction to nonoptioned shorts and optioned shorts separately and find that the market reacts differently to these two groups. Nonoptioned shorts comprise about 32% of the public sample and exhibit -3.46% (-5.34%) ACARs 10 (15) trading days post announcement whereas optioned shorts exhibit -0,11% (0,31%) ACARs respectively. There is also no longer term reversal pattern observed in ACARs of nonoptioned shorts. Furthermore, average cumulative abnormal trading volume increases by 62% immediately following the "first short interest" announcements of nonoptioned shorts, whereas it barely changes for optioned shorts. The substantial difference in market reactions can potentially be explained by the fact that traders who posses negative private information about the stock have an incentive to enter the options market (which is considered the low cost way of shorting) rather than

the common stock of the company. Because the only mechanism for revealing private information is through trading in the common stock of the firm for nonoptioned stocks, there is a higher probability that informed traders will comprise a relatively larger proportion of the total short interest in the stock. Consequently, it is not surprising that short interest announcements of nonoptioned stocks convey more negative information about the stock and triggers a more aggressive market reaction. Furthermore, informed traders may have an additional incentive to enter the options market rather than the common stock because they can take advantage of the higher leverage available in options. Hence, it is more likely that informed traders will comprise a relatively smaller proportion of the total short interest in optioned stocks.

Similar to Senchack and Starks (1993), we find that the market response to nonoptioned shorts is consistent with Diamond and Verrecchia′s (1987) view that short interest is a bearish signal. It could be argued that the market reaction to short interest announcements of optioned stocks is consistent with the bullish view which asserts that a high short interest in a particular stock is a bullish signal because it represents latent demand. You can observe this latent demand in figure II as ACARs for optioned shorts increase significantly 20 trading days post announcement and reach a statistically significant ACAR of 1.6% after 28 trading days. This may potentially reflect the latent demand embedded in the high short interest. Hence, you may argue that the public announcement of short interest in optioned stocks represents the bullish view.

We also conduct a more formal risk adjusted return analysis using calendar time portfolio regressions in order to test the validity of our findings. We conduct an implementable investment strategy and form "short portfolios" by short selling all the stocks targeted by the short sellers on the announcement day and repurchasing them at the end of 1, 1.5, 2 and 6 weeks respectively. This event portfolio is rebalanced each calendar day. Because the number of firms experiencing the event is not uniformly distributed over the entire sample period, the number of firms included in the short portfolio also varies through time. The resulting time series of weekly excess portfolio returns are regressed on the Fama French and Carhart factors. The intercept (the alpha) measures the weekly abnormal return to this investment strategy. Moreover, for nonoptioned stocks, this investment strategy yields statistically significant and positive weekly alphas ranging from 0.60% to 2.1% for short holding periods of 1 to 2 weeks and 0.34% to 0.59% for a longer holding period of 6 weeks. This confirms our finding that nonoptioned shorts are bearish signals. Furthermore, for optioned stocks, the short portfolio strategy yields statistically significant and positive weekly alpha of 0.49% for holding periods of 1 week but negative alphas of -0.2% to -0.46% for a longer holding period of 6 weeks. This illustrates that optioned shorts seem consistent with the price pressure view which asserts that short

interest is a bullish signal because it represents latent demand. Because short positions must be covered in the future, buying pressure will eventually push up the share price.

We next examine the cross section of abnormal returns and find that market reactions differ with respect to two particularly important criteria. The first criterion relates to whether the short sold stocks are tradable in the options market. The second criterion relates to the stock book to market ratio. Low book to market stocks (growth stocks) exhibit statistically significant lower CARs compared with high book to market stocks (value stocks). Consequently, the market responds more bearish to stocks that are not tradable in the options market or are relatively more overvalued. Finally, we compare the market reaction to short interest announcements made by hedge funds with investment management firms and cannot find any significant difference in CARs.

In the second part of our paper, we investigate whether short sellers are well informed market participants. We construct a long daily panel of short sales using both public and private data. Contrary to the findings of Boehmer et al (2008), we find no evidence supporting the hypothesis that short sellers overall are well informed market participants. We sort portfolios into five quintiles based on one week′s shorting activity and run regressions using the Fama French Carhart model (and an extended 8-factor model) in order to calculate the alpha. We find that a value weighted portfolio of heavily shorted stocks does not significantly underperform a value weighted portfolio of lightly shorted stocks. This result holds true regardless of flow measure, time window and asset pricing model. Secondly, raw portfolio returns are not significantly different from market returns. This implies that short sellers do not seem to earn profits in absolute terms either. Furthermore, we break the analysis down into nonoptioned versus optioned shorts and replicate the analysis made above. We find that short sellers in nonoptioned stocks are well informed market participants whilst short sellers in optioned stocks are not. Heavily shorted nonoptioned stocks underperform lightly shorted nonoptioned stocks by a risk adjusted average of 0.52% (0.32%) over the following 10 (20) trading days. This also suggests that short sellers are on average important contributors to efficient prices in the context of nonoptioned stocks.

To conclude, our examination of the market reaction to public announcements of short interest reveals that a short interest in nonoptioned stocks is a strong bearish signal whilst a short interest in optioned stocks is a bullish signal. Unlike Boehmer et al (2008), we do not find that short sellers overall are well informed market participants. We do, on the other hand, find that traders in nonoptioned stocks are well informed market participants. Although only nonoptioned shorts are informative, the market fails to realize this. Therefore, there is an overreaction to the announcement of optioned shorts and this behaviour leads to reversals in returns. Consequently, market reactions to short interest

announcements are irrational.

Although several papers study whether shorts sellers are informed market participants, only a few examine the market responses to public announcements of short interest. Our paper is novel in the sense that it combines the two features and thus examines whether the market reactions to public announcements of short interest are rational. This is also important from a regulatory point of view as there is quite some new set of regulations worldwide on public disclosure of short positions (e.g new EU regulations that were implemented 1 November 2012). In addition, we have access to daily data where as previous studies on the market reaction to short interest announcements only had access to monthly data. Our results should thus have higher statistical power. Furthermore, our paper contributes to existing literature that investigates whether short sellers are well informed market participants. Broadly speaking, our paper is related to previous studies such as Senchack and Starks (1993) and Desai et al (2000), both of which have access to monthly data only. However, they do not focus on assessing whether the market reactions are rational. Finally, our paper is also related to a strand of literature that aims to understand the impact of short selling regulations.

PREVIOUS LITERATURE

Little research has been conducted with the aim of examining the market reaction to the announcement of short interest. Senchack and Starks (1993) conduct an event study on the NYSE and ASE in which they investigate whether stocks with unexpected increases in short interest experience negative abnormal returns following the announcement of short interest. They use monthly data on short interest from 1980 to 1986. They examine abnormal returns 15 days prior to and 15 days after short interest announcements in the Wall Street Journal. Their findings are consistent with the view that short interest announcements convey adverse information and are a bearish signal (Diamond and Verrecchia 1987). However, they find that this condition only holds for nonoptioned stocks. Furthermore, they find that larger unexpected increases in short interest result in more negative reactions to short interest announcements. They also report that smaller firms experience more negative abnormal returns post announcement. The rationale underlying this result is that larger firms are more actively analyzed and followed by market participants which results in relatively less private information. As such, there should be relatively more uninformed traders selling short and thus less information value in the announcements for larger firms. Finally, they also find a seasonality pattern in short selling activity. December to January reflects the highest short interest which is consistent with the tax selling motive of short sellers.

The bearish signal of short interest has been confirmed by other authors too. Desai et al (2000) finds that firms with high short interest experience significant negative abnormal returns ranging from -0.76% to -1.1% per month during the period in which they are heavily shorted (using Nasdaq data from 1988 to 1994). Moreover, smaller firms and firms with a higher level of short interest experience more negative abnormal returns which is similar to the findings of Senchack and Starks (1993). Furthermore, they also analyze the survival characteristics of firms that are short sold and they find that these firms experience a higher frequency of liquidations and bankruptcies than their size and industry matched peers. This is consistent with the view that short selling conveys negative information.

Relatively more research has been conducted with the aim of quantifying the informativeness of short sellers. Diamond and Verrechia (1987) argue that short sales are never undertaken for liquidity reasons as short sale proceeds cannot be used for consumption. All else equal, this should imply that short sellers are more informed market participants than others. The informativeness of short sellers is further investigated by Boehmer et al (2008) who find that short selling is common in the NYSE as it stands for at least 12.9% of the trading volume on average during 2000 to 2004. Their main finding, however,

is that short sellers as a group are well informed market participants. They construct a long daily panel of short sales in the NYSE from 2000 to 2004 and form portfolios sorted into quintiles based on 1 week′s shorting activity. They find that a value weighted portfolio of heavily shorted stocks underperform lightly shorted stocks by a risk adjusted average of 1.16% the next month (15.6% annualized). The positive gross alphas suggest that institutional short sellers have identified and acted upon important value related information that has not yet been incorporated into share prices. Finally, they find that the informativeness of short sellers differ with respect to the identity of the trader. More specifically, non-program institutional investors earn higher abnormal returns compared to other investor types (such as individuals and member firm proprietary trades).

Contrary to Boehmer et al (2008), Barclay and Warner (1993) find that medium sized orders are the most informed ones. This is consistent with the "stealth trading" hypothesis which argues that informed investors break up larger trades into smaller trades in order to "disguise" their information. Furthermore, Dechow et al (2001) find that short sellers generate positive abnormal returns by targeting firms with low fundamental to price ratios (such as book to market, earnings to price and cash flow to price), and covering their positions when the fundamentals mean revert.

Various research has been conducted with the aim of identifying the source of the underperformance of heavily shorted stocks. Boehmer et al (2012) find that a quarter of the underperformance of heavily shorted stocks can be attributed to analyst related news releases and earnings announcements. They show that heavier shorting occurs the week before negative earnings surprises and analyst downgrades. This fact is also documented by Christophe et al (2004) who find that negative earnings surprises and analyst downgrades are preceded by abnormal short selling using data on NASDAQ-listed stocks between 2000 and 2001. Francis et al (2005) also come to the conclusion that short sellers are able to predict downward analyst revisions. Analysts revise their earnings forecasts downward more frequently for firms with high unexpected short interest compared to firms with low unexpected short interest. Daske et al (2005) do in contrast to previous findings not find any evidence that short sellers are able anticipate negative earnings surprises using NYSE SuperDOT data between 2004 and 2005. They find no evidence of an increase in short sales prior to the announcement dates. Neither do Diether et al (2005).

INSTITUTIONAL BACKGROUND

The new EU regulation on short selling was implemented on 1 November 2012. The regulation applies to securities traded on EU trading venues, sovereign debt issued by EU countries and related credit default swaps. The new transparency requirements require that net short positions in shares have to be notified to the Financial Supervision Authority whenever they exceed or fall below the 0.2% threshold of the issued share capital of a firm or each 0.1% above that. The Financial Supervision Authority only discloses significant net short positions that exceed or fall below the 0.5% threshold of the issued share capital of a firm or each 0.1% above that. Information on significant net short positions is disclosed on a daily basis and includes the short seller, the target firm and the net short interest. Transactions that are due to market making activities are exempt from the transparency requirements.

A firm enters the Financial Supervision Authority′s "public" short interest list whenever its reported short interest in a certain stock is at least 0.5%. The firm remains in the "public list" as long as its net short interest in the stock exceeds the 0.5% threshold. Furthermore, the short seller needs to notify the Financial Supervision Authority each time its short interest exceeds the initial threshold with 0.1% (e.g. at short interest levels above 0.6%, 0.7%, 0.8% and so forth). The firm stays in the "public list" until its reported short interest falls below the 0.5% threshold.

In our paper, we denote significant net short positions that exceed 0.5% of the issued share capital of a firm as "public data" and net short positions between 0.2% and 0.5% as "private data". We only use public data to assess the market reaction to announcements of net short positions but use both public and private data when we evaluate the informativeness of short sellers.

DATA AND METHODOLOGY (PART 1): ESTIMATING THE MARKET REACTION TO SHORT INTEREST ANNOUNCEMENTS

A)SAMPLE SELECTION AND EVENT DEFINITION

In the first part of the paper, we conduct an event study in which we investigate the market reaction to short interest announcements by generating abnormal returns on and around the event dates using a comprehensive sample of OMX Stockholm firms. Our primary aim with the event study is to find out if short interest announcements convey information to the stock market which is the case if there is a correlation between the information and the observed change in the market value of the event firms. Furthermore, we are primarily interested in a post-event window of 15 trading days because it can take time for new information to be incorporated into share prices (as markets are not necessarily efficient). We also analyze a longer time window of 30 trading days post announcement in order to analyze the longer term effects on abnormal returns. However, it is important to note that larger event dates reduces the statistical power of the test.

We obtain daily data on short interest from the Swedish Financial Supervision Authority for the period November 2012 to January 2014 (15 months). Daily stock and market related data such as trading prices, trading volume and share turnover is downloaded from Nasdaq OMX Nordic whereas information related to the financial statements of event firms is obtained from Datastream and annual reports.

We are particularly interested in "new information" that has not been incorporated into share prices. Consequently, the event of interest is particularly the "first short interest" announcement. The event day (t_0) is defined as the day in which the Financial Supervision Authority announces the "first short interest". The "first short interest" announcement is defined as a certain market participant′s (company ABC′s) initial short interest announcement of a particular target firm (company X). This is the net short position that company ABC has to report to the Financial Supervision Authority for the first time because the company now has a short interest in company X which exceeds the 0.5% threshold. Short interest is defined as the ratio of net shares sold short to the total number of shares outstanding. The Financial Supervision Authority then announces company ABC′s short interest in company X to the public. A "follow up short" occurs when the same market participant (company ABC) increases its already public short position in the same target firm (company X) with at least 0.1% of the target firm′s issued share capital (which we analyze at a later stage). Initially however, we are only interested in the market′s reaction to "first short interest" announcements.

B)SUMMARY STATISTICS

Our public data sample in the first part of the paper consists of 128 "first short interest" announcements on firms that are listed on the Stockholm Stock exchange. These are distributed between November 2012 and January 2014 (15 months). Table I provides descriptive statistics for the sample firms.

Table I
Descriptive Statistics

The table below reports summary statistics for our sample of "first short interest" announcements, which occur between November 2012 and January 2014 (15 months). Short interest is defined as the number of shares shorted divided by the total number of shares outstanding. A firm enters the sample when it for the first time reaches a level of short interest equivalent to or above 0.5%. Market value of equity has been computed on the announcement date. Book value of equity has been calculated using the latest fiscal year closing value in order to avoid potential look-ahead bias for the book to market ratio. We exclude firms with negative book values of equity and firms that have experienced a stock split from momentum.

Variable	Observations	Mean	Median	25th percentile	75th percentile
Panel A: Summary Statistics for "First Short Interest" Announcements					
Short interest	128	0,9%	0,60%	0,50%	0,80%
Market value of equity (in SEK million)	128	26 800	14 314	9 830	36 318
Book value of equity (in SEK million)	126	12 230	5 072	2 295	20 429
Book to Market	126	0,70	0,40	0,20	0,75
1 Year Return (Momentum)	127	-4%	-4%	-25%	15%
2 Week Return (Mean Reversal)	128	14%	1%	-3%	4%
Institutional Ownership	128	40%	43%	27%	52%

The short sellers in our public sample resemble the typical short seller described by Boehmer et al (2008) in the sense that they seem to target firms whose prices are high relative to their fundamentals. More specifically, we find that growth stocks (low book to market firms) are on average preferred over value stocks (high book to market firms). This finding is not surprising considering that the long run underperformance of growth stocks relative to value stocks is a well documented fact in academic literature (Ilmanen 2011). A potential explanation to growth stocks′ long run underperformance is "excessive" extrapolation of multi year growth rates′ and overpricing of growth. In reality, market participants generally underestimate the pace at which earnings growth mean reverts making growth stocks more likely to disappoint relative to value stocks (Ilmanen 2011). Moreover, the short sellers mainly target highly liquid large cap firms with relatively high institutional ownership (40% on average) which is intuitive considering that the value premium is the least significant for such firms. This piece of evidence is also consistent with our finding that short sellers prefer to target growth stocks over value stocks. Furthermore, the short sellers seem to target firms with negative pre 1 year stock returns but positive short term (2 week) stock returns. These two observations are consistent

with the long term momentum effect as well short term mean reversal pattern in equities (Ilmanen 2011). In addition, over 95% of the position holders in the public sample are either investment management firms or hedge funds.

The summary statistics illustrate that the short sellers in our public sample are relatively sophisticated and resemble the typical and well informed short seller as described by Boehmer et al (2008). This piece of evidence could in conjunction with the costs of short selling potentially induce market participants to believe that short sellers are well informed market participants. Consequently, bearish market reactions to short interest announcements should not be surprising.

ESTIMATING THE MARKET REACTION TO SHORT SELLING ANNOUNCEMENTS

Appraising an event′s impact requires a measure of the abnormal return which is the actual ex post return of a security minus the normal return of the firm over a specific event window. The abnormal return for security i at time t is defined as:

$$AR_{it} = R_{it} - E(R_{it}|X_t) \tag{1}$$

where
AR_{it} : Abnormal returns
R_{it} : Realized returns
$E(R_{it}|X_t)$: Expected or "normal" returns
X_t : Explanatory variables "normally" determining returns

MacKinlay (1997) suggests two different approaches for estimating the expected return variable $E(R_{it}|X_t)$. In the first approach (the constant mean return model), X_t is a constant. In the second approach, (the market model), X_t is the market return. Both models assume that asset returns are jointly multivariate normal and independently and identically distributed through time. While these assumptions seem strong, the market model tends to be robust to deviations from these assumptions. In our paper, we will only use the market model which relates the return of any security to the return of the market portfolio. The market model is considered more accurate because it reduces the variance of the abnormal return by removing the portion of the return that is due to variation in the market′s return (MacKinlay 1997). This increases the market model′s ability to detect event effects. For any given security i, the market model states that:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it} \tag{2}$$

where
$E(\epsilon_{it}) = 0$
$V(\epsilon_{it}) = \sigma^2_{\epsilon,i}$

where R_{it} is the period-t return on a given security i and R_{mt} is the corresponding return on the market portfolio. We use the OMX Stockholm PI index as a proxy for the market portfolio. ϵ_{it} is the zero mean disturbance term. The abnormal return is the disturbance term of the market model. Using the market model, the sample abnormal return is generated by the following equation:

$$AR_{it} = R_{it} - \widehat{\alpha_i} - \widehat{\beta_i} R_{mt} \tag{3}$$

In the market model approach, it is assumed that the beta of the stocks in the sample is 1 and that $\widehat{\alpha}$ equals 0. Abnormal returns are thus generated by simply deducting the market return from the stock return. In order to be able to draw overall inferences for the event of interest, we aggregate abnormal returns first through time, and at a later stage, also across securities. We generate cumulative abnormal returns (abbreviated CAR) for each event by aggregating abnormal returns through as it may take several days to incorporate new information.

$$CAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} AR_{it} \tag{4}$$

We also aggregate cumulative abnormal returns cross sectionally in order to generate average CARs (abbreviated ACAR) because we are interested in the average effect of "first short interest" announcements. This procedure makes the implicit assumption that there is no event clustering which implies that abnormal returns will be independent across securities (MacKinlay 1997). This assumption is valid only if there is no overlap in the event days of the short interest announcements in our sample. This assumption enables us to calculate variances of the ACARs without having to adjust for covariances between short interest announcements because they are non-existent. We believe that this assumption is fulfilled because "first short interest" announcements are distributed unevenly through time.

$$\overline{CAR}(t_1, t_2) = \sum_{t=t_1}^{t_2} \overline{AR_{it}} \tag{5}$$

$$Var(\overline{CAR}(t_1,t_2)) = \frac{1}{N^2}\sum_{i=1}^{N}\sigma_i^2(t_1,t_2) = \frac{\sigma_A^2(t_1,t_2)}{N} \tag{6}$$

assuming no correlation across events. Inferences about CARs can be drawn assuming that

$$\overline{CAR}(t_1,t_2) \sim N[Var(\overline{CAR}(t_1,t_2))] \tag{7}$$

The test statistic equals:

$$\theta_1 = \frac{\overline{CAR}(t_1,t_2)}{\sqrt{Var(CAR(t_1,t_2))}} \rightarrow N(0,1) \tag{8}$$

and is asymptotic with respect to the number of events N and the length of the estimation window.

TESTING THE MARKET REACTION TO "FIRST SHORT INTEREST" ANNOUNCEMENTS USING THE MARKET MODEL

Our null hypothesis is that the "first short interest" announcements have no impact on the behaviour of CARs within the specified event windows with the alternative hypothesis stating that "first short interest" announcements have an impact on the behaviour of CARs.

$$H_0 : \overline{CAR}(t_1,t_2) = 0 \tag{9}$$
$$H_1 : \overline{CAR}(t_1,t_2) \neq 0 \tag{10}$$

CALENDAR TIME PORTFOLIO APPROACH

We also use the calendar time portfolio approach (Jensen-alpha approach) to estimate both the short and the long term risk adjusted abnormal performance of short interest announcements. Using this approach, an event portfolio is formed each week by short selling all stocks targeted by the short sellers in the "public sample" on the announcement day and repurchasing them at the end of different holding periods e.g. 1, 1.5, 2 and 6 weeks. We do this analysis separately for optioned and non-optioned stocks. The benefit of using this approach is that the variance of the event portfolios automatically takes into account cross sectional correlation across the securities that comprise the event portfolio (Mitchell and Stafford 2000). Consequently, you do not have to assume there is no event clustering as in the market model approach. Another benefit with this approach is that

it represents a viable investment strategy. Furthermore, this approach is used to generate calendar time portfolio returns for firms that experience the specific event and calibrate whether they are abnormal in a multifactor regression. The estimated intercept from the regression (the alpha) is the post event abnormal performance. Because the number of firms that experience the event are unevenly distributed over the entire sample period, the number of firms included in the short portfolio varies through time. The portfolios are rebalanced each calendar day. We generate equally weighted excess portfolio returns on a weekly basis from November 2012 to January 2014. The resulting time series of weekly excess portfolio returns is regressed on the Fama and French (1993) and Carhart (1997) factors.

$$R_{pt} - R_{ft} = \alpha_p + \beta(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + w_p PR1YR_t + \epsilon_{pt} \tag{11}$$

where
R_{pt} : is the equally weighted return of the portfolio for calendar week t.
R_{ft} : is the risk free rate.
R_{mt} : is the return on the OMX Stockholm PI index.
SMB_{pt} : is the difference between the return on the portfolio of small stocks and big stocks.
HML_{pt} : is the difference between the return on the portfolio of high and low book to market stocks.
$PR1YR_t$: is the momentum factor.
α_p : is the average weekly abnormal return (Jensen′s alpha) of the portfolio.

Our null hypothesis is that the "first short interest" announcements have no impact on the weekly abnormal performance (alpha) of the event portfolio with the alternative hypothesis stating that the "first short interest" announcements have an impact on the weekly abnormal performance (alpha) of the event portfolio.

$$H_0 : \alpha_p = 0 \tag{12}$$
$$H_1 : \alpha_p \neq 0 \tag{13}$$

"FIRST SHORT INTEREST" VS "FOLLOW UP SHORT INTEREST" ANNOUNCEMENTS

We next compare the market reaction of "first short interest" announcements with "follow up short interest" announcements. Our public sample comprises 903 "follow up

short interest" announcements distributed from November 2012 to January 2014. The assumption of no event clustering is not valid for "follow up short interest" announcements. Consequently, we use the calendar time portfolio approach in order to evaluate the market reaction to follow up shorts by forming viable investment strategies as described in the previous section. Our null hypothesis is that there is no difference in the average weekly abnormal performance (alpha) between the "first short" portfolio and the "follow up short" portfolio with the alternative hypothesis being that there is a difference in the average weekly abnormal performance (alpha) between the two portfolios.

$$H_0 : \alpha_p(\text{"}First\ Short\text{"}) = \alpha_p(\text{"}Follow\ up\ Short\text{"}) \tag{14}$$
$$H_1 : \alpha_p(\text{"}First\ Short\text{"}) \neq \alpha_p(\text{"}Follow\ up\ Short\text{"}) \tag{15}$$

ANALYZING THE CROSS SECTION OF ABNORMAL RETURNS

We next examine the cross section of cumulative abnormal returns using of multi-factor regressions:

$$\widehat{CAR}(t_1, t_2) = \alpha + \beta OptionDummy_1 + \beta BTM_2 + \beta Size_3 + \beta PR1YR_4 + \beta ShortInterest_5 \tag{16}$$

where we control for size (market cap), value (book to market), pre 1 year return (momentum), short interest and a dummy variable which takes the value of 1 for firms that are tradable in the options-market and 0 for those that are not. The benefits from employing multifactor models come from reducing the variance of abnormal returns by explaining more of the variation in the normal return. However, the benefits from employing multifactor models for event studies are generally limited. The marginal explanatory power of additional factors relative to the market factor is small. Thus, there is only little reduction in the variance of the abnormal return and this reduction is the greatest when sample firms have a common characteristic (MacKinlay 1997).

ANALYZING THE EFFECT OF SHORT SELLER TYPE ON THE MARKET REACTION TO FIRST SHORTS

Although, this is not the main focus of our paper, we partition short sellers by type in order to find out whether market reactions differ with respect to the type of short

seller. Certain types of market participants such as option market makers may short sell for hedging reasons with little consideration to whether the stock is overvalued or not (Boehmer et al 2008). Some short sellers naturally take their positions based on fundamental information about a company′s valuation. Very few individuals sell short and those who do are most likely not doing it for hedging reasons as several institutions are. These individuals are generally considered very sophisticated and knowledgeable investors. We find that over 95% of the short sellers in the public sample are either investment management firms or hedge funds. It would have been interesting to analyze if the market reacts differently to short interest announcements of individuals. However, individuals are financially constrained and are unlikely to be able to short over 0.5% of a listed company′s market cap. As expected, there are no individuals in the public data set and we can thus not analyze whether the market reacts differently to short interest announcements of individuals. Since nearly all "first shorts" belong to two distinct types of short sellers, we run standard OLS regressions:

$$\widehat{CAR}(t_1, t_2) = \alpha + \beta X_i + \epsilon_i \tag{17}$$

where the explanatory variable X_1 is a dummy variable that takes the value of 1 for CARs pertaining to investment management firms and 0 for CARs pertaining to hedge funds. Since this is not the main focus of this paper, we report the results from this analysis in the appendix (table VIII).

DATA AND METHODOLOGY (PART 2): ESTIMATING THE INFORMATIVENESS OF SHORT SELLING

A) SAMPLE SELECTION

We obtain daily data on net short positions above the 0.2% threshold (i.e. both private and public data) from the Swedish Financial Supervision Authority. Data on short interest is available for the period November 2012 to January 2014 (15 months), which is equivalent to 6529 observations. The main weakness with the dataset is that all short sales are not recorded, only the net short positions which exceed certain thresholds require reporting. However, we believe that it is unlikely to be a major issue as our data set still captures a substantial proportion of all short sales on the Stockholm Stock Exchange and should therefore be sufficient from a statistical standpoint. Previous studies on the

informativeness of short selling e.g. Boehmer et al (2008) use a dataset with electronic trades only, and are believed to capture at most 70% (probably less) of all short sales on NYSE.

B) SUMMARY STATISTICS

We construct a long daily panel of short sales on the Stockholm Stock exchange using both public and private data. Table II summarizes some key characteristics of the combined data set. The public data comprises 18% of all short interest observations and the "private data" comprises the remaining 82% of the dataset. Moreover, large cap (small cap) firms comprise 78% (6%) of all net short positions. This is expected considering that it is easier to borrow the securities of larger and more liquid stocks. Large cap stocks are also likely to carry less recall risk. Consequently, large cap stocks are relatively less expensive to short sell. Furthermore, the book to market ratio is the highest in the large cap segment which implies that the value premium is the least significant in this segment. This makes sense as it is best covered by analysts. Short sold stocks in the mid cap segment exhibit the lowest book to market ratio.

Table II
Descriptive Statistics

The table reports descriptive characteristics for the dataset including private and public short sales for the 15 month period. Market capitalization is calculated using daily close prices. Book value of equity as of the ingoing total equity as reported in the annual report for each trading year respectively. 1 year return (momentum) is calculated as the return for the announcement day minus 1 year return. Public and private shorts are the number of shorts sales.

Variable	Small Cap	Mid Cap	Large Cap	All Shares
Panel A: Summary Statistics for Public and Private Short Sales				
% of Data Set	6%	16%	78%	100%
Market Value of Equity (in SEK million)	885	4 148	36 152	29 150
Book Value of Equity (in SEK million)	493	2 323	17 880	14 508
Book to Market	0,19	0,06	0,37	2,62
1 Year Return (Momentum)	41,73%	121,13%	-2,89%	17,62%
Nr of Shares Outstanding	107 127 170	82 526 374	323 918 500	272 116 445
Daily Volume	2 424 039	627 018	1 905 860	1 680 900
Nr of Public Shorts (>0.5%)	14	118	1 049	1 181
Nr of Private Shorts (0.2%-0.5%)	201	898	4 050	5 149
Count	215	1 016	5 099	6 330

FLOW MEASURES

In order to evaluate the informativeness of short sellers, we conduct a portfolio approach and sort stocks into quintiles based on 1 week′s shorting activity using four different flow measures. We then compare the performance of portfolios comprising heavily shorted stocks to the performance of portfolios comprising lightly shorted stocks.

Flow measures are simply used to analyze the extent of shorting activity in a particular stock. We use flow measures to sort short sold stocks into quintiles based on how heavily shorted they are during a particular week. Four different flow measures are used in order to make sure that the results and conclusions do not hinge upon the flow measure used, and are therefore general and unbiased.

Nr.	**Flow Measure**	**Description**
1	Short Interest (%)	Ratio of shares shorted to shares outstanding
2	Shares Shorted	Nr of shares sold short
3	Shorting Share of Volume	Ratio of shares shorted to total trading volume
4	Orders	Nr of short sale transactions

The current EU regulation is based on the first flow measure (short interest). This flow measure thus encompasses regulatory authorities view on short sales (Boehmer et al 2008). The benefit with this flow measure is that it is standardized and is thus directly comparable across securities and through time, which is important for the formation of portfolios later on. The second flow measure (shares shorted) is different in the sense that it is not standardized and is thus not ideal for comparing shorting activity across securities. Furthermore, the third flow measure (shorting share of volume) relates the shorting activity of a stock to its trading activity. The measure gives an indication of the short selling activity on a daily basis, i.e. the shorting intensity. The main benefit with this measure is that it is comparable across securities and through time for any given security (Boehmer et al 2008). The rationale for including the fourth flow measure (number of orders or transactions) is that it is able to capture the effects of a stealth-trading strategy i.e. many orders comprising a small number of shares may be more informed than few orders comprising a large number of shares. Moreover, the number of orders may also give a better indication of the shorting pressure on a single share. Jones et al (1994) concludes that the number of short orders is the flow measure with the highest correlation to changes in the share price.

We further examine the contemporaneous correlations between different flow measures in order to evaluate the benefits of using many different flow measures. The contemporaneous correlations between the flow measures are ranging from -0.01 to 0.52. The low correlation implies that including many different flow measures is beneficial as they will

complement each other. The overall conclusion is thus not relying upon one specific flow measure. Furthermore, the positive correlation observed was anticipated as the flow measures are just different ways of quantifying the same event and should thus move in tandem. The highest correlation is seen between the number of shares shorted and the percentage of shares shorted (relative to the shares outstanding). The correlations are basically zero between flow measure 3 and 1 and 3 and 2. This is expected due to the different nature of the flow measures.

We next examine autocorrelations for different flow measures in order to gauge the independency assumptions used in the statistical tests below. Autocorrelation measures the tendency of a sample to remain in the same state over time. An autocorrelation close to 1 implies that the state of the observed sample does not change over time whereas an autocorrelation close to 0 that the system is not stable over time and that the observations are independent. The measured cross-sectional autocorrelations between the different flow measures are almost zero. This implies independent observations and that statistical tests based on this key assumption can be applied later on.

Table III illustrates the characteristics of the different flow measures. The values are calculated on a daily basis. Panel A reports the descriptive statistics. Panel B illustrates daily cross-sectional time series correlations whereas Panel C reports the autocorrelations.

Table III
Flow Measures Descriptives

The table reports descriptive statistics and correlations for the flow measures. Data is available from November 2012 to January 2014 (15 months). Panel A reports descriptives wheareas panel B reports the contemporaneous correlations. Panel C reports the autocorrelations between the flow measures.

Panel A: Descriptive Statistics

Variable	Short Interest (%)	Shares Shorted	Shorting Share of Volume (%)	Orders
Mean	0,53%	1 357 163	4,55	16,59
St.Dev	0,55%	1 804 004	118,02	6,65
25%	0,21%	327 251	0,45	12,00
50%	0,36%	768 721	0,93	16,00
75%	0,63%	1 678 788	1,90	20,25
Count	6529	6 417	6424	6418

Panel B: Contemporaneous Correlations

Variable	Short Interest (%)	Shares Shorted	Shorting Share of Volume (%)	Orders
Short Interest (%)	1,000	0,520	0,012	0,005
Shares Shorted		1,000	-0,009	-0,004
Shorting Share of Volume (%)			1,000	-0,006
Orders				1,000

Panel C: Autocorrelations

Variable	Short Interest (%)	Shares Shorted	Shorting Share of Volume (%)	Orders
Short Interest (%)	0,108	0,029	0,010	0,005
Shares Shorted	0,021	0,120	-0,001	-0,004
Shorting Share of Volume (%)	-0,001	-0,009	0,002	-0,006
Orders	0,005	-0,004	-0,006	0,100

ANALYSIS OF PROFITS IN SHORT SELLING

PORTFOLIO APPROACH AND THE FORMATION OF QUINTILES

The most heavily shorted stocks should underperform the most lightly shorted stocks if short sellers in general are well informed market participants. Hence, within each flow measure, five quintiles are formed based on the level of shorting activity. The formation of quintiles is straightforward. The securities are ranked within each flow measure with respect to the shorting activity, on a weekly basis. This implies that the stocks are split into five equally large (number of event firms) portions based on the weekly shorting activity. This results in four flow measures times five quintiles, in total 20 quintiles. We form weekly portfolios that are held for ten and twenty trading days respectively. The specific time windows are narrow in order to enhance the statistical power of the tests. The portfolios are value weighted (with respect to market capitalization) and rebalanced each week. Each weekly return is the arithmetic average of the consecutive 10 and 20 trading days. Furthermore, the portfolio returns of the twenty portfolios are evaluated using two approaches (buy and hold abnormal returns and the calendar time portfolio approach also known as Jensen′s alpha approach) which are discussed below. The results are reported as monthly returns in order to make the interpretation more intuitive and comparable.

An advantage with forming portfolios is that it is possible to simulate a viable trading strategy. A sophisticated investor is unlikely to hold single stocks if no superior information is at hand. In addition, the formation of portfolios is likely to account for joint effects (nonlinearities) of stocks which can be of importance in predicting future returns. The construction of portfolios is further likely to minimize the effect of outliers (Boehmer et al 2008).

BUY AND HOLD ABNORMAL RETURN (BHAR) APPROACH

The BHAR method involves shorting all target firms on the position date and holding the position for a pre-specified holding period and comparing the outcome to nonevent firms (OMX Stockholm PI index). Two time windows are used (ten and twenty trading days) in order to account for potential time variations of stock returns. Value weighted abnormal returns (actual returns minus actual index returns) are calculated for each flow measure and each quintile respectively. The buy and hold return calculation is determined by the equation below:

$$BHAR_i(t,T) = \prod_{t=1\,to\,T}(1+R_{i,t}) - \prod_{t=1\,to\,T}(1+R_{B,t}) \tag{18}$$

where
R_i : is the return on event portfolio.
R_B : is the return on benchmark portfolio (OMX Stockholm PI index).
T : is the pre-specified holding period.

In order to be able to draw overall inferences and evaluate whether portfolios comprising of the most heavily shorted stocks (quintile five) earn lower abnormal returns than portfolios comprising the most lightly shorted stocks, the student´s t-test is used. The specific null hypothesis to be tested is that there is no statistically significant difference between the average abnormal returns of quintile one and five against the alternative hypothesis that there is a significant difference. Specifically:

$$H_0 : BHAR(Q1) = BHAR(Q5) \tag{19}$$
$$H_1 : BHAR(Q1) \neq BHAR(Q5) \tag{20}$$

Potential issues with the BHAR approach include e.g. event induced volatility for event firms (Khotari and Warner 2006), higher cross correlations as the time horizon is extended and most importantly the implicit assumption that buy and hold returns are cross sectionally independent. To overcome this issue, Mitchell and Stafford (2000) recommends the use of time series regressions, or more specifically, the calendar time portfolio approach.

CALENDER-TIME PORTFOLIO APPROACH

The calendar time portfolio approach (the Jensen′s alpha approach) is suggested by leading economic researchers such as Fama (1998) and Mitchell and Stafford (2000). It is used to estimate both the shorter and longer term risk adjusted abnormal performance of short interest for each quintile using the four flow measures. An event portfolio is formed each week by short selling all stocks targeted by the short sellers in the combined sample and repurchasing them at the end of 10 and 20 trading days respectively. The time series of weekly excess calendar time portfolio returns will then be regressed against multifactor models in order to generate the alphas. Moreover, this procedure is repeated for each quintile using all of the four flow measures. This results in twenty alphas for both holding periods. The analysis is implemented for all short positions executed during the fifteen month period ranging from November 2012 to January 2014.

The main benefit with this approach is that event portfolios automatically take into

account potential cross sectional correlation across the securities that comprise the event portfolio (Mitchell and Stafford 2000). Furthermore, the rationale for using a multifactor regression model is that it simultaneously controls for many different firm characteristics. Hence the observed intercept will be controlled for several important effects. The original Fama French three factor model (1993) extended by Carhart (1997) is used along with an extended model using four additional control variables (presented in the appendix). Carhart Four Factor model (1997):

$$R_{pt} - R_f t = \alpha_p + \beta(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + w_p PR1YR_t + \epsilon_{pt} \tag{21}$$

where
$R_{pt} - R_{ft}$: is the value weighted excess portfolio returns.
$R_{mt} - R_{ft}$: is the excess market returns.
SMB_{pt} : is the difference between the return on the portfolio of small stocks and big stocks.
HML_{pt} : is the difference between the return on the portfolio of high and low book to market stocks.
$PR1YR_t$: is the momentum factor.
α_{pt} : is the average weekly abnormal return (Jensen′s alpha) of the portfolio.
ϵ_{pt} : is the error term.

Hypothesis Testing of Differences in Alphas

The specific null hypothesis to be tested is that there is no difference in the alphas of the portfolios comprising heavily shorted stocks (quintile 5) and the alphas of the portfolios comprising lightly shorted stocks (quintile 1). The alternative hypothesis is that there is a difference in the alphas between quintile one and quintile five. The general hypothesis to test becomes:

$$H_0 : \alpha(Q1) = \alpha(Q5) \tag{22}$$
$$H_1 : \alpha(Q1) \neq \alpha(Q5) \tag{23}$$

POTENTIAL LIMITATIONS

In this paper both equally and value weighted portfolios are constructed. Plyakha et al (2014) conclude that the choice of weighting could determine the conclusions in asset-pricing studies. Advantages of using equal weights: pricing errors are avoided and the risk of individual stocks disrupting the prices is minimized. The major drawback is that the relative value of stocks is not taken into account. Value weights offer more or less the opposite advantages and drawbacks.

In this study only one benchmark index is implemented. The index is an all-share index for the Stockholm Stock Exchange. The rational for choosing this index is that our sample consists of small, mid and large cap shares. One should keep in mind that the market proxy is essential when determining the abnormal returns. Hence, the results and conclusions for these models are as solid as the data sample, but also as solid as accuracy in choosing the benchmark index.

It is obvious that the reporting thresholds exclude some of the short positions from our sample. However, 128 first short and 6000 first and second shorts over 15 months should provide a sample which is sufficient for detecting and correctly describing the effects which we analyze. This limitation is perhaps the most relevant in this paper but is also the drawback which is the most difficult to change due to the reporting regulation.

In this paper four different flow measures are used. The flow measures are widely used among other researchers who are also trying to estimate the intensity of short selling. However, as discussed in the methodology section, the flow measures are far from perfect, which motivates the usage of four to eliminate any potential bias. The results and conclusions from the second part of this essay are heavily dependent on the flow measures as a basis for dividing stocks by shorting intensity and the reader should keep this discussion in mind.

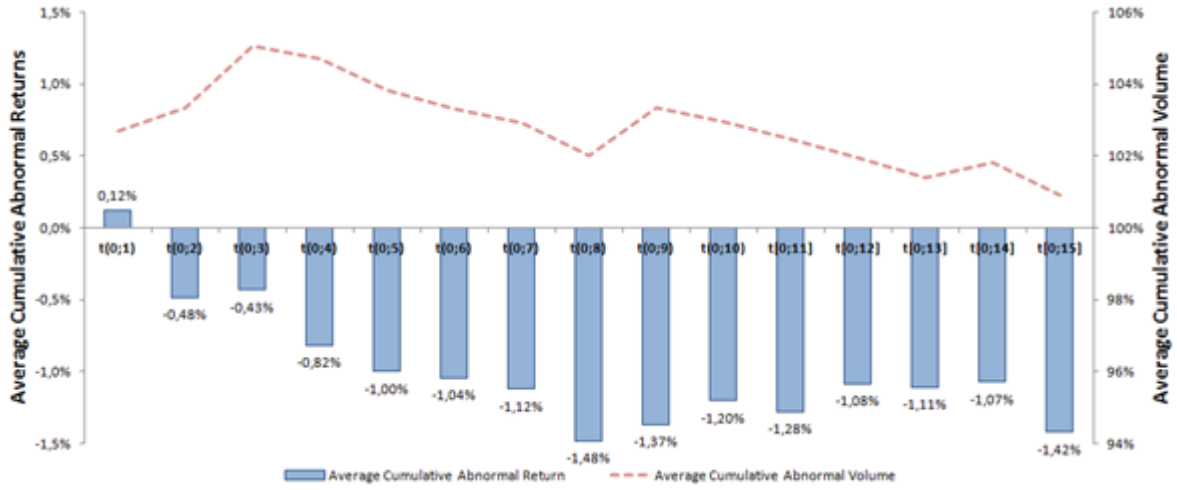
RESULTS (PART 1): ESTIMATING THE MARKET REACTION TO SHORT INTEREST ANNOUNCEMENTS

THE OVERALL MARKET REACTION

Our first piece of evidence on the market reaction to short interest announcements is that the market reacts unfavourably to "first short interest" announcements (figure I). We find negative and statistically significant cumulative abnormal returns of -1.2% (-1.42%) ten (fifteen) trading days post announcement date. Similar to the findings of Senchack and Starks (1993) and Desai et al (2000), we observe that this effect is not incorporated into share prices immediately, but gradually over time. Furthermore, average cumulative abnormal trading volume (abbreviated ACAV) increases around 2% to 4% immediately following the "first short interest" announcement. A potential explanation to the increase in abnormal trading volume is that market participants who believe that short sellers are well informed market participants take follow on the short seller as soon as they hear about the short interest announcement. This triggers a downward short term selling pressure.

Figure I
Market Reactions to Short Interest Announcements

The graph plots the average market reaction to "first short interest" announcements on a daily basis for 15 trading days post announcement. Data is available from November 2012 to January 2014 (15 months). The "first short interest" announcement is defined as the announcement that has to be made when a certain market participant for the first time exceeds the 0.5% short interest threshold in a particular target firm. Short interest is defined as the ratio of shares sold short to the number of shares outstanding. The left axis plots the average cumulative abnormal returns of "first short interest" announcements whereas the right axis plots the average cumulative abnormal trading volume. The cumulative abnormal trading volume is defined as the average trading volume across the shorted shares post announcement relative to the average trading volume (-80;-20) trading days pre announcement.



BREAKING DOWN THE MARKET REACTION: OPTIONED SHORTS VERSUS NONOPTIONED SHORTS

Our next piece of evidence on the market reaction to short interest announcements comes from the separation of short interest announcements into two distinct groups: Optioned shorts and nonoptioned shorts (figure II and table IV). We define optioned shorts as "first short interest"announcements on stocks that can be traded in the options market. The market reacts differently to these two groups. Nonoptioned shorts exhibit substantially lower abnormal returns than optioned shorts. Nonoptioned shorts comprise about 32% of the public sample and exhibit -3.46% (-5.34%) ACARs 10 (15) trading days post announcement whereas optioned shorts exhibit -0.11% (0.31%) ACARs respectively. There is also no longer term reversal pattern observed in ACARs of nonoptioned shorts. Furthermore, whilst cumulative abnormal trading volume increases by approximately 62% immediately following the "first short interest" announcements of nonoptioned stocks, it barely changes for optioned stocks. The substantial differences in market reaction can potentially be explained by the fact that traders who posses negative private information about the stock have an incentive to enter the options market (considered the low cost way of shorting) rather than the common stock of the firm. Because the only mechanism for revealing private information in nonoptioned stocks is through trading in the common stock of the firm, there is a higher probability that informed traders will comprise a relatively larger proportion of the total short interest in the stock. Consequently, it is not surprising that short interest announcements of nonoptioned stocks convey more negative information about the stock. This triggers a more aggressive market reaction.

Figure II
Comparing the Market Reactions of Nonoptioned Shorts with Optioned Shorts

The first graph plots the average market reaction to "first short interest" announcements for nonoptioned shorts and optioned shorts separately. Data is available from November 2012 to January 2014 (15 months). The "first short interest" announcement is defined as the announcement that has to be made when a certain market participant for the first time exceeds the 0.5% short interest threshold in a particular target firm. Short interest is defined as the ratio of shares sold short to the number of shares outstanding. The average cumulative abnormal return is abbreviated as ACAR whereas the average cumulative abnormal trading volume is abbreviated as ACAV. The left axis plots the average cumulative abnormal returns of "first short interest" announcements whereas the right axis plots the average cumulative abnormal trading volume. The cumulative abnormal trading volume is defined as the average trading volume across the shorted shares post announcement relative to the average trading volume (-80;-20) trading days pre announcement. The second graph plots the average cumualtive abnormal returns using a longer time window of up to 30 trading days post announcement.

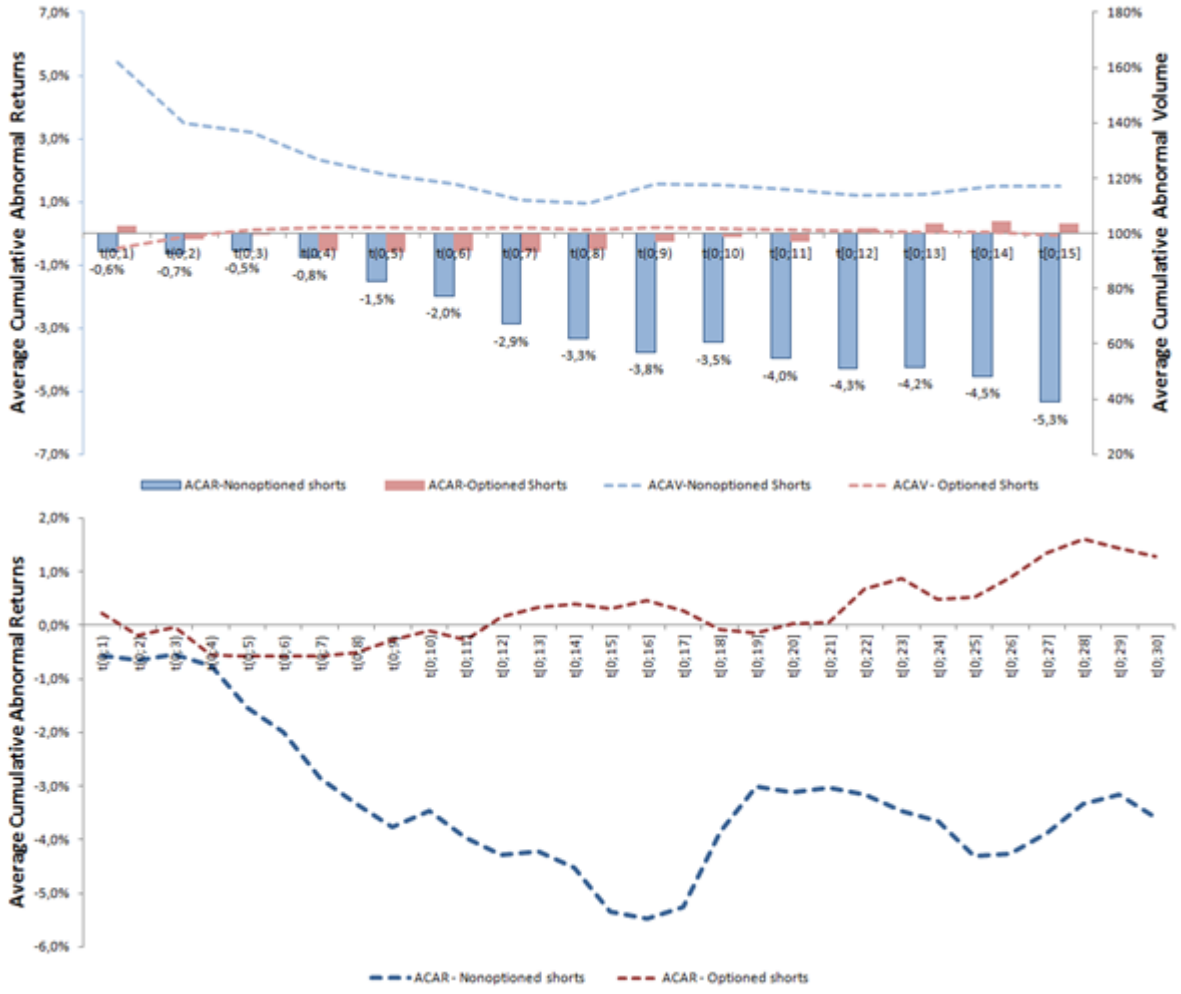


Table IV
Descriptive and Inferential Statistics for Short Interest Announcements

The table reports descriptive and inferential statistics with respect to the average market reaction following "first short interest" announcements. Data is available from November 2012 to January 2014 (15 months). The "first short interest" announcement is defined as the announcement that has to be made when a certain market participant for the first time exceeds the 0.5% short interest threshold in a particular target firm. Short interest is defined as the ratio of shares sold short to the number of shares outstanding. * means that the average cumulative abnormal return (abbreviated ACAR) is statistically significant at the 10% level whereas ** means that the ACAR is significant at the 5% level. *** implies that the ACAR is significant at the 1% level.

Time Window	Average CAR	Standard Deviation	t-statistic	25th percentile	75th percentile	Observations
Panel A: All Short Interest Announcements						
t(0;1)	0,12%	0,2%	0,71	-0,8%	0,9%	128
t(0;2)	-0,48%	0,3%	-1,63	-1,5%	0,8%	128
t(0;3)	-0,43%	0,3%	-1,24	-1,4%	0,7%	128
t(0;4)	-0,82%	0,4%	-2,21**	-2,0%	0,4%	128
t(0;5)	-1,00%	0,4%	-2,36**	-2,1%	0,6%	128
t(0;6)	-1,04%	0,4%	-2,52**	-2,0%	1,1%	128
t(0;7)	-1,12%	0,4%	-2,54**	-2,4%	1,2%	128
t(0;8)	-1,48%	0,5%	-2,87***	-2,8%	0,9%	128
t(0;9)	-1,37%	0,6%	-2,42**	-3,1%	1,9%	128
t(0;10)	-1,20%	0,6%	-2,07**	-3,0%	1,5%	128
Panel B: Nonoptioned Shorts Only						
t(0;1)	-0,58%	0,5%	-1,3	-1,6%	0,8%	41
t(0;2)	-0,66%	0,8%	-0,8	-2,2%	1,2%	41
t(0;3)	-0,54%	1,0%	-0,6	-2,3%	2,3%	41
t(0;4)	-0,77%	1,0%	-0,8	-2,7%	1,7%	41
t(0;5)	-1,53%	1,0%	-1,5	-3,5%	1,1%	41
t(0;6)	-1,99%	1,1%	-1,8*	-2,9%	1,2%	41
t(0;7)	-2,87%	1,2%	-2,4**	-5,0%	1,2%	41
t(0;8)	-3,33%	1,4%	-2,3**	-4,7%	1,2%	41
t(0;9)	-3,77%	1,7%	-2,2**	-4,8%	1,2%	41
t(0;10)	-3,46%	1,7%	-2,0*	-4,7%	1,3%	41
Panel C: Optioned Shorts Only						
t(0;1)	0,22%	0,1%	1,8*	-0,6%	0,8%	87
t(0;2)	-0,18%	0,2%	-0,9	-1,5%	1,0%	87
t(0;3)	-0,03%	0,2%	-0,2	-1,1%	0,4%	87
t(0;4)	-0,55%	0,2%	-2,4**	-1,8%	0,5%	87
t(0;5)	-0,59%	0,2%	-2,3**	-2,1%	0,8%	87
t(0;6)	-0,58%	0,3%	-2,1**	-2,5%	0,7%	87
t(0;7)	-0,59%	0,3%	-2,1**	-1,8%	0,7%	87
t(0;8)	-0,51%	0,3%	-1,8*	-2,1%	0,7%	87
t(0;9)	-0,29%	0,3%	-0,8	-2,5%	1,6%	87
t(0;10)	-0,11%	0,4%	-0,3	-1,9%	1,7%	87

Similar to Senchack and Starks (1993), we find that the market response to nonoptioned shorts is consistent with Diamond and Verrecchia′s (1987) view that short interest is a bearish signal. There is no reversal in CARs even after extending the post event window to 30 trading days (1,5 months). It could be argued that the market reaction

to short interest announcements of optioned stocks represent the bullish view which asserts that a high short interest in a stock is a bullish signal because it represents latent demand. Because shorts positions must be covered in the future, buying pressure will eventually push up the share price. Figure II illustrates that ACARs for optioned shorts begin to increase after 20 trading days and reach a statistically significant CAR of 1.6% after 28 trading days. This could potentially reflect the latent demand embedded in the high short interest. Hence you may argue that optioned shorts are consistent with the bullish view of short interest.

As table V and VI illustrate, we conduct a more formal risk adjusted return analysis using the calendar time portfolio approach in order to test the validity of our findings. We conduct implementable investment strategies and form short portfolios by short selling all the stocks of all the firms targeted by short sellers on the announcement day and repurchasing them at the end of 1, 1.5, 2, 6 weeks respectively. The short portfolio is rebalanced each calendar day. Because the number of firms experiencing the event is not uniformly distributed over the entire sample period, the number of firms included in the short portfolio varies through time. The resulting time series of weekly excess portfolio returns are regressed on the three Fama French and Carhart factors. The intercept (the alpha) measures the weekly abnormal return to this investment strategy. Furthermore, for nonoptioned stocks, this investment strategy yields statistically significant and positive weekly alphas ranging from 0.60% to 2.1% for short holding periods of 1 to 2 weeks and 0.34% to 0.59% for a longer holding period of 6 weeks. For optioned stocks, the short portfolio strategy yields statistically significant and positive weekly alpha of 0.49% for short holding periods of 1 week but negative alphas of -0.2% to -0.46% for a longer holding period of 6 weeks (which is consistent with the bullish view of short interest).

Table V
Nonoptioned shorts - Estimating Abnormal Returns Using Calendar Time Portfolio Regressions

The table reports the coefficients from the calendar time portfolio regressions of excess weekly portfolio returns on the four factors suggested by Fama and French (1993) and Carhart (1997). Data is available from November 2012 to January 2014. We conduct an implementable trading strategy and form short portfolios by short selling the non-optioned stocks of all firms targeted by the short sellers at the announcement day and repurchasing them at the end of different holding periods (specified in the table). Because the number of firms that experience the event are not uniformly distributed over the entire sample period, the number of firms included in the short portfolio varies through time. Some new firms are added to the portfolio each day while some firms exit. The portfolios are thus rebalanced each calendar day. We generate excess equally weighted portfolio returns on a weekly basis from November 2012 to January 2014. The resulting time series of weekly excess portfolio returns is regressed on the three Fama and French and Carhart factors. The alpha measures the weekly abnormal return from this short selling strategy. The following time series regression is estimated:

$$R_{pt} - R_f t = \alpha_p + \beta(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + w_p PR1YR_t + \epsilon_{pt}$$

SMB_{pt} = is the difference between the return on the portfolio of small stocks and big stocks.

HML_{pt} = is the difference between the return on the portfolio of high and low book to market stocks.

$PR1YR_t$ = is the momentum factor.

Holding period (weeks)	Weekly alpha	alpha P-value	RMRF	SMB	HML	PR1YR
Panel A: CAPM						
1	1,67%	0,00%	0,03			
1.5	1,92%	0,06%	-0,63			
2	2,10%	0,02%	-0,13			
6	0,34%	6,99%	-0,14			
Panel B: Fama French						
1	1,54%	0,00%	0,09	1,07	-0,31	
1.5	1,40%	0,48%	-0,32	1,62	-0,17	
2	1,83%	0,12%	-0,19	1,03	0,52	
6	0,54%	0,95%	-0,11	0,34	-1,98	
Panel C: Fama French Carhart						
1	0,60%	7,30%	-0,12	0,33	-1,71	-1,02
1.5	1,02%	4,45%	-0,23	1,65	0,44	1,11
2	1,70%	0,9%	-0,20	1,04	0,64	0,28
6	0,59%	0,72%	-0,12	0,33	-1,71	-0,20

Table VI
Optioned shorts - Estimating Abnormal Returns Using Calendar Time Portfolio Regressions

The table reports the coefficients from the calendar time portfolio regressions of excess weekly portfolio returns on the four factors suggested by Fama and French (1993) and Carhart (1997). Data is available from November 2012 to January 2014. We conduct an implementable trading strategy and form short portfolios by short selling the optioned stocks of all firms targeted by the short sellers at the announcement day and repurchasing them at the end of different holding periods (specified in the table). Because the number of firms that experience the event are not uniformly distributed over the entire sample period, the number of firms included in the short portfolio varies through time. Some new firms are added to the portfolio each day while some firms exit. The portfolios are thus rebalanced each calendar day. We generate excess equally weighted portfolio returns on a weekly basis from November 2012 to January 2014. The resulting time series of weekly excess portfolio returns is regressed on the three Fama and French and Carhart factors. The alpha measures the weekly abnormal return from this short selling strategy. The following time series regression is estimated:

$$R_{pt} - R_f t = \alpha_p + \beta(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + w_p PR1YR_t + \epsilon_{pt}$$

SMB_{pt} = is the difference between the return on the portfolio of small stocks and big stocks.

HML_{pt} = is the difference between the return on the portfolio of high and low book to market stocks.

$PR1YR_t$ = is the momentum factor.

Holding period (weeks)	Weekly alpha	alpha P-value	RMRF	SMB	HML	PR1YR
Panel A: CAPM						
1	0,49%	6,38%	-0,78			
1.5	0,11%	63,73%	-0,50			
2	0,19%	34,45%	-0,45			
6	-0,20%	9,30%	-0,06			
Panel B: Fama French						
1	0,47%	7,48%	-0,75	0,15	0,42	
1.5	0,15%	51,82%	-0,50	0,09	0,33	
2	0,20%	32,30%	-0,48	-0,08	0,26	
6	-0,44%	0,15%	-0,05	-0,04	1,54	
Panel C: Fama French Carhart						
1	0,49%	9,67%	-0,75	0,15	0,39	-0,06
1.5	0,07%	79,61%	-0,51	0,13	0,44	0,26
2	0,16%	50,06%	-0,49	-0,03	0,35	0,18
6	-0,46%	0,15%	-0,05	-0,03	1,59	0,36

ANALYZING THE CROSS SECTION OF ABNORMAL RETURNS

We next examine the cross section of abnormal returns and find that market reactions differ with respect to two particularly important criteria (table VII). The first criterion relates to whether the short sold stocks are tradable in the options market (as explained previously). The second criterion relates to the stock′s book to market ratio. Low book to market stocks (growth stocks) exhibit statistically significant lower CARs compared with high book to market stocks (value stocks). Consequently, the market responds more bearish to stocks that are not tradable in the options market or are relatively more overvalued.

Table VII
Analyzing the Cross Section of Abnormal Returns

This table reports the coefficients from a multifactor regression of the abnormal returns to "first short interest" announcements. The "first short interest" announcement is defined as the announcement that has to be made when a certain market participant for the first time exceeds the 0.5% short interest threshold in a particular target firm. Data is available from November 2012 to January 2014 (15 months). The following regression is estimated:

$$\widehat{CAR}(t_1, t_2) = \alpha + \beta OptionDummy_1 + \beta BTM_2 + \beta Size_3 + \beta PR1YR_4 + \beta ShortInterest_5$$

where the option dummy is a dummy variable that takes the value of 1 for stocks that can be traded in the options market and 0 for stocks that cannot be traded in the options market. BTM is the book to market ratio of the stock at the announcement date. Size is the market cap of the firm and PR1YR is the 1 year return of the stock relative to the announcement date. Short interest is the defined as the ratio of; the number of shares sold short to the number of shares outstanding. A * sign means that the coefficient is statistically significant at the 10% level, ** means that it is significant at the 5% level and *** implies that it is significant at the 1% level.

Holding period (days)	Intercept	Option Dummy	BTM	Size	PR1YR	Short Interest (%)
Panel A: Effect of Options Dummy						
5	-3,3%***	2,7%**				
8	-3,3%***	2,7%**				
10	-3,2%***	2,9%**				
Panel B: Effect of Options Dummy and BTM						
5	-1,4%*	0,8%	0,1%*			
8	-2,8%***	2,3%**	0,2%***			
10	-2,3%**	2,2%**	0,2%***			
Panel C: Effect of Options Dummy, BTM, Size, PR1YR and Short Interest (%)						
5	-1,6%*	0,9%	0,1%*	0,0%	0,2%	0,2%
8	-2,9%**	2,2%*	0,2%***	0,0%	0,2%	0,1%
10	-2,8%**	2,4%*	0,3%***	0,0%	-0,4%	0,6%

FIRST SHORTS VERSUS FOLLOW UP SHORTS

We further find that cumulative abnormal returns and alphas (generated from calendar time portfolio regressions) are substantially lower for "first short interest" announcements relative to "follow up short interest" announcements (figure III, and table XIII (appendix)). This finding is consistent with the view that abnormal returns are only due to new information.

Figure III
Comparing the Market Reactions - "First Short Interest" versus "Follow Up Short Interest" Announcements

This graph plots the average market reaction to the Financial Supervision Authority's announcement of "first short sales" and "follow up short sales" on a daily basis for 15 trading days post announcement. Data is available from November 2012 to January 2014 (15 months). The "first short interest" announcement is defined as the announcement that has to be made when a certain market participant for the first time exceeds the 0.5% short interest threshold in a particular target firm. Short interest is defined as the ratio of shares sold short to the number of shares outstanding. A "follow up short interest" announcement occurs when the same market participant increases its already public short position in the same target firm with at least 0.1% of the target firm′s issued share capital. The left axis plots the average cumulative abnormal returns of short interest announcements.

RESULTS (PART 2): ESTIMATING THE INFORMATIVENESS OF SHORT SELLERS

BUY AND HOLD ABNORMAL RETURNS

We next analyze the informativeness of short sellers in order to determine whether the observed market reaction is rational or not. Table IX reports raw returns and abnormal returns for the quintile portfolios using the BHAR approach. The table also reports the difference in abnormal returns between the portfolio comprising the most heavily shorted stocks (quintile 5) and the portfolio comprising the most lightly shorted stocks (quintile 1) using four different flow measures. If short sellers are informed, then the portfolio comprising the most heavily shorted stocks should underperform the portfolio comprising the most lightly shorted stocks. Table X illustrates the p-values for the differences in both returns and abnormal returns between quintile 5 and quintile 1.

Regardless of the time window (ten or twenty days), and regardless of flow measure, there is no statistically significant difference in the abnormal returns (and raw returns) between the portfolios comprising the most heavily shorted stocks (quintile 5) and the portfolios comprising the most lightly shorted stocks (quintile 1). This is shown in table X. Firstly, this implies that short sellers in general are not well informed market participants, although there are of course several short sellers that are well informed. Secondly, because abnormal returns are not significantly different from market returns, short sellers overall seem to earn no profit in absolute terms either.

Table IX
Buy and Hold Abnormal Returns (BHAR)

Table reports the raw returns and buy and hold abnormal returns (BHAR) 10 and 20 trading days post a short position announcement. Four different flow measures are used: short interest (Panel A), shares shorted (Panel B), shorting share of volume (Panel C), orders (Panel D). Within each flow measure, the shorting activity is ranked for all shares and split into 5 equally large quintiles. All short positions within each week are accumulated into value weighted portfolios. Portfolios are rebalanced weekly. BHARs are calculated by deducting the market returns (OMX Stockholm PI index) from the stock returns. Raw returns and BHARs are reported as monthly returns. Raw returns and BHARs are t-tested against the matched index return (null hypothesis: no difference) for each quintile and holding period. Quintile 5 is t-tested against quintile 1 (null hypothesis: no difference). * indicates a significance at the 10% level, ** at the 5% level, *** at the 1% level.

$$BHAR_i(t,T) = \prod_{t=1\ to\ T}(1+R_{i,t}) - \prod_{t=1\ to\ T}(1+R_{B,t})$$

Quintile	Value Weighted Raw Return (Monthly)	Value Weighted BHAR (Monthly)	Value Weighted Raw Return (Monthly)	Value Weighted BHAR (Monthly)
	10 Trading Days		20 Trading Days	
Panel A: Short Interest (%)				
1	1,60%	-0,25%**	2,30%	0,30%*
2	1,20%	-0,25%**	1,92%	-0,11%*
3	2,11%	0,19%	2,49%	0,41%
4	0,84%	-1,05%**	2,37%	0,30%
5	0,65%	-1,24%***	1,38%	-0,61%**
5-1	-0,95%	-0,99%	-0,92%	-0,91%
Panel B: Shares Shorted				
1	2,48%	0,61%	3,09%	1,04%
2	2,63%	0,71%	3,34%	1,20%
3	2,07%	0,16%*	2,21%	0,16%
4	0,37%	-1,52%***	1,74%	-0,27%**
5	-0,32%**	-2,20%***	0,82%	-1,12%**
5-1	-2,80%	-2,81%	-2,27%	-2,16%
Panel C: Shorting Share of Volume (%)				
1	1,76%	-0,10%**	1,66%	-0,29%**
2	0,93%	-0,97%***	2,42%	0,35%*
3	1,66%	-1,45%***	2,21%	0,35%*
4	0,44%	-1,45%***	1,78%	-0,24%**
5	2,43%	0,51%	2,14%	0,10%
5-1	0,67%	0,61%	0,48%	0,39%
Panel D: Orders				
1	-0,24%	-2,11%**	1,72%	3,24%
2	1,33%	-0,53%	0,24%	2,27%
3	3,19%	1,30%	1,31%	3,49%
4	0,28%	-1,47%**	0,57%	3,01%
5	1,49%	-0,42%*	2,39%	4,70%
5-1	1,73%	1,70%	0,67%**	1,46%

Table X

P-Values for Difference Between Heavily and Lightly Shorted Stocks

The table reports the p-values for the average difference between quintile 5 and quintile 1 for both raw returns and BHARs. The sample consists of all short position announcements (above short interest levels of 0.2%) between November 2012 and January 2014.

$$H_0 : BHAR(Q1) = BHAR(Q5)$$
$$H_1 : BHAR(Q1) \neq BHAR(Q5)$$

P-Values				
Flow Measure	**Value Weighted Raw Return (Monthly)**	**Value Weighted BHAR (Monthly)**	**Value Weighted Raw Return (Monthly)**	**Value Weighted BHAR (Monthly**
	10 Trading Days		20 Trading Days	
Short Interest (%)	49,53%	38,95%	40,78%	41,69%
Shares Shorted	12,01%	10,49%	16,01%	18,63%
Shorting Share of Volume (%)	64,80%	62,84%	65,26%	72,83%
Orders	41,93%	42,00%	2,81%	61,91%

Test of model assumptions

There are two assumptions that need to be fulfilled in order to test the hypothesis in this section, namely; independent observations and normally distributed population.

- Independent observations: The autocorrelations presented in the table III illustrates that autocorrelations are close to zero for all flow measures. This proves that the observations are independent and the first assumption is fulfilled.
- Normally distributed population: Since the number of weeks analyzed is above 30, the central limit theorem is applied and the population can therefore be assumed to be normally distributed.

CALENDAR TIME PORTFOLIO REGRESSIONS

Table XI
Weekly Alphas for all Short Positions

The table reports the coefficients from the calendar time portfolio regressions of excess weekly portfolio returns on the four factors suggested by Fama and French (1993) and Carhart (1997). Data is available from November 2012 to January 2014. We conduct an implementable trading strategy and form short portfolios by short selling the stocks targeted by the short sellers at the announcement day and repurchasing them at the end of different holding periods (specified in the table). Because the number of firms that experience the event are not uniformly distributed over the entire sample period, the number of firms included in the short portfolio varies through time. Some new firms are added to the portfolio each day while some firms exit. The portfolios are thus rebalanced each calendar week. We generate excess value weighted portfolio returns on a weekly basis from November 2012 to January 2014. The resulting time series of weekly excess portfolio returns is regressed on CAPM, the three Fama and French and Carhart four factors. The alpha measures the weekly abnormal return from this short selling strategy. The table consists of four panels representing four flow measures. * means that the alpha is significant at the 10% level, ** at the 5% level and *** at the 1% level. The following time series regression is estimated:

$$R_{pt} - R_f t = \alpha_p + \beta(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + w_p PR1YR_t + \epsilon_{pt}$$

SMB_{pt} = is the difference between the return on the portfolio of small stocks and big stocks.

HML_{pt} = is the difference between the return on the portfolio of high and low book to market stocks.

$PR1YR_t$ = is the momentum factor.

Quintile	CAPM		Fama French		Fama French Carhart	
	Trading Days					
	10	20	10	20	10	20
Panel A: Short Interest (%)						
1	-0,01%	0,35%	-0,15%	0,37%	-0,20%	0,41%
2	0,00%	0,35%	0,03%	0,63%**	-0,13%	0,57%
3	0,09%	0,44%*	-0,02%	0,48%	0,03%	0,60%**
4	-0,10%	0,43%*	-0,12%	0,51%**	-0,33%	0,46%*
5	-0,23%	0,11%	-0,28%	0,15%	-0,34%	0,10%
Panel B: Shares Shorted						
1	0,51%	0,71%*	0,45%	0,89%**	0,32%	0,95%**
2	0,17%	0,71%***	0,23%	0,86%***	0,14%	0,86%***
3	0,20%	0,45%***	0,12%	0,50%***	0,01%	0,44%**
4	-0,5%**	0,02%	-0,49%**	0,07%	-0,63%***	0,00%
5	0,50%**	0,02%	-0,49%**	0,07%	-0,63%***	0,00%
Panel C: Shorting Share of Volume (%)						
1	0,07%	0,27%	0,00%	0,42%	-0,04%	0,37%
2	0,39%*	0,50%***	0,43%**	0,44%***	0,37%	0,40%**
3	0,39%*	0,50%***	0,43%**	0,44%***	0,37%	0,40%**
4	0,18%	0,41%**	0,24%	0,39%*	0,40%	0,41%*
5	0,71%**	0,49%*	0,68%**	0,33%	0,60%*	0,23%
Panel D: Orders						
1	-0,17%	0,33%	-0,18%	0,29%	-0,32%	0,25%
2	0,21%	-0,26%	0,18%	0,33%	0,20%	-0,24%
3	0,62%	-0,02%	0,42%	-0,11%	0,23%	-0,04%
4	0,19%	0,08%	0,02%	0,14%	-0,07%	0,38%
5	0,08%	0,26%	0,12%	0,34%	0,10%	0,28%

We also conduct a more formal risk adjusted return analysis using calendar time portfolio regressions in order to test the validity of our findings. More specifically, we examine the alphas using multifactor regression models in order to gauge the informativeness of market participants. Table XI reports the average monthly alphas for the portfolios formed for each flow measure and each quintile. The alphas for the portfolios comprising the most heavily shorted stocks (quintile 5) are tested against the alphas of the portfolios comprising the most lightly shorted stocks (quintile 1) for each flow measure respectively. Furthermore, we find that the alphas are close to zero and there is thus no statistically significant difference between the first and fifth quintile irrespective of flow measure. This is different from the findings of Boehmer et al (2008) who find statistically significant differences between the alphas of heavily and lightly shorted stocks.

INFORMATIVENESS OF SHORT SELLERS - OPTIONED SHORTS VERSUS NONOPTIONED SHORTS

We next break the analysis down into nonoptioned versus optioned shorts and replicate the analysis made above. We find that short sellers in nonoptioned stocks are well informed market participants (in 3 out of 4 flow measures) whilst short sellers in optioned stocks are not. Table XII illustrates that heavily shorted nonoptioned stocks significantly underperform lightly shorted nonoptioned stocks by a risk adjusted average of 0.52% (0.32%) over the following 10 (20) trading days. This also suggests that short sellers in nonoptioned stocks are on average important contributors to efficient prices. These results are also consistent with theory which asserts that there is a greater likelihood that informed traders will comprise a relatively larger proportion of the total short interest for nonoptioned stocks. Because the only mechanism for revealing private information is through trading in the common stock of the firm, informed traders are more likely to comprise a relatively larger proportion of the total short interest in the stock. In the case of optioned stocks however, informed traders have an incentive to enter the options market (considered the low cost way of shorting) rather than taking a short position in the common stock. Hence, short interest in optioned stocks are less likely to comprise as large proportion of informed traders as in the case of nonoptioned stocks.

Table XII
Difference in Alpha Between Heavily and Lightly Shorted Stocks

The table reports the difference in alpha (intercept) between heavily and lightly shorted from the calendar time portfolio regressions of excess weekly portfolio returns on the four factors suggested by Fama and French (1993) and Carhart (1997). Two time windows are implemented: 10 and 20 days post announcement. Data is available from November 2012 to January 2014. We conduct an implementable trading strategy and form short portfolios by short selling the stocks targeted by the short sellers at the announcement day and repurchasing them at the end of different holding periods (specified in the table). Because the number of firms that experience the event are not uniformly distributed over the entire sample period, the number of firms included in the short portfolio varies through time. Some new firms are added to the portfolio each day while some firms exit. The portfolios are thus rebalanced each calendar week. We generate excess value weighted portfolio returns on a weekly basis from November 2012 to January 2014. The resulting time series of weekly excess portfolio returns is regressed on CAPM, the three Fama and French and Carhart four factors. The alpha measures the weekly abnormal return from this short selling strategy. The table consists of four panels representing four flow measures. * means that the alpha is significant at the 10% level, ** at the 5% level and *** at the 1% level. The following time series regression is estimated:

$$H_0 : \gamma = 0$$
$$H_1 : \gamma \neq 0$$

$$Q1(R_{pt} - R_f t) = \alpha_p + \beta(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + w_p PR1YR_t + \epsilon_{pt}$$
$$Q5(R_{pt} - R_f t) = (\alpha_p + \gamma_p) + \beta(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + w_p PR1YR_t + \epsilon_{pt}$$

Flow Measure	**All Stocks**		**Non-Optioned**		**Optioned**	
			Trading Days			
	10	20	10	20	10	20
Panel A: CAPM						
Short Interest (%)	-0,219%	-0,186%	0,701%*	0,021%**	-0,511%	-0,343%
Shares Shorted	-0,707%	-0,564%	0,544%**	0,439%**	-0,930%	-0,806%
Shorting Share of Volume (%)	0,274%*	0,193%	0,304%*	0,315%	0,224%*	0,224%
Orders	0,116%	0,202%**	0,675%	0,541%	0,057%	0,117%*
Panel B: Fama French						
Short Interest (%)	-0,188%	-0,194%	0,545%**	0,046%*	-0,540%	-0,265%
Shares Shorted	-0,711%	0,552%**	0,598%*	0,426%**	-0,826%	0,415%*
Shorting Share of Volume (%)	0,274%*	0,194%	0,348%**	0,361%**	0,221%*	0,153%
Orders	0,117%	-0,208%	0,665%	0,557%	-0,110%	-0,564%
Panel C: Fama French Carhart						
Short Interest (%)	-0,173%	-0,190%	0,550%**	0,042%**	-0,435%	-0,276%
Shares Shorted	-0,702%	0,552%***	0,600%*	0,426%*	-0,926%	0,517%
Shorting Share of Volume (%)	0,278%*	0,206%	0,370%**	0,372%	0,220%	0,216%
Orders	0,114%	-0,211%	0,581%	0,459%	-0,049%	-0,470%

IMPLICATIONS: SUM OF THE PARTS ANALYSIS

Unlike Boehmer et al (2008), we do not find that short sellers in general are well informed market participants. We do, on the other hand, find that a particular segment of short sellers are well informed, namely traders in nonoptioned stocks. Although only nonoptioned shorts are informative, the market fails to realize this. Therefore, there is an overreaction to the announcement of optioned shorts and this behaviour leads to reversals in returns. Consequently, market reactions to short interest announcements are irrational.

CONCLUSION

Short interest has in the financial literature been described as bullish, bearish or neutral signals. Our examination of the market reaction to public announcements of short interest reveals that a high short interest in nonoptioned stocks is a strong bearish signal whilst a high short interest in optioned stocks is a bullish signal. Public announcements of short interest in nonoptioned stocks result in ACARs of -5.34% (-3.59%) after 15 (30) trading days whilst public announcements of short interest in optioned stocks yield ACARs of 0.31% (1.27%) after 15 (30) trading days. Furthermore, we find that cumulative abnormal trading volume increases by 62% immediately following the public announcement of short interest in nonoptioned stocks whilst it barely changes for optioned stocks. This is consistent with our finding that the market reacts more aggressively to short interest announcements of nonoptioned stocks.

Unlike Boehmer et al (2008), we do not find that short sellers overall are well informed market participants. We do, on the other hand, find that a particular segment of short sellers are well informed, namely traders in nonoptioned stocks. Heavily shorted nonoptioned stocks underperform lightly shorted nonoptioned stocks by a risk adjusted average of 0.52% (0.32%) over the following 10 (20) trading days. This also suggests that short sellers in nonoptioned stocks are on average important contributors to efficient prices.

Although only nonoptioned shorts are informative, the market fails to realize this. Therefore, there is an overreaction to the announcement of optioned shorts and this behaviour leads to reversals in returns. Consequently, market reactions to short interest announcements are irrational.

In future work, we are interested in expanding the geographical scope of our analysis by including for instance other Scandinavian countries. Through this, our findings would be more general and less country specific. We are also interested in understanding more about the source of the underperformance in heavily shorted non-optioned stocks. Although Boehmet et al (2012) find that a quarter of the underperformance of heavily shorted stocks is attributed to analyst related news releases and earnings announcements, a large part of the underperformance still remain unexplained.

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APPENDIX

MARKET REACTION TO DIFFERENT TYPES OF SHORT SELLERS

Although cumulative abnormal returns observed following the announcement of an investment management firm is more than twice as low on average compared to a hedge fund, this difference is not statistically significant.

Table VIII
Analyzing the Market Reaction to Different Types of Short Sellers
The table reports summary statistics for "first short interest" announcements with respect to the type of short seller. Data is available from November 2012 to January 2014. We only analyze two types of short sellers as they comprise over 95% of the public sample.

Holding period (days)	Average CAR	Max	Min	Observations
Panel A: Hedge Funds				
5	-0,7%	5%	-8%	22
8	-0,7%	6%	-10%	22
10	-0,7%	8%	-10%	22
Panel B: Investment Management Firms				
5	-1,1%	12%	-34%	101
8	-1,7%	12%	-38%	101
10	-1,4%	17%	-44%	101

FIRST SHORTS VERSUS FOLLOW UP SHORTS

Table XIII
Estimating Abnormal Returns of "Follow up Shorts" Using Calendar Time Portfolio Regressions

The table reports the coefficients from the calendar time portfolio regressions of excess weekly portfolio returns on the four factors suggested by Fama and French (1993) and Carhart (1997). Data is available from November 2012 to January 2014. We conduct an implementable trading strategy and form "follow up short" portfolios by short selling the stocks of all firms targeted by the short sellers at the announcement day and repurchasing them at the end of different holding periods (specified in the table). Because the number of firms that experience the event are not uniformly distributed over the entire sample period, the number of firms included in the short portfolio varies through time. Some new firms are added to the portfolio each day while some firms exit. The portfolios are thus rebalanced each calendar day. We generate excess equally weighted portfolio returns on a weekly basis from November 2012 to January 2014. The resulting time series of weekly excess portfolio returns is regressed on the three Fama and French and Carhart factors. The alpha measures the weekly abnormal return from this short selling strategy. The following time series regression is estimated:

$$R_{pt} - R_f t = \alpha_p + \beta(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + w_p PR1YR_t + \epsilon_{pt}$$

SMB_{pt} = is the difference between the return on the portfolio of small stocks and big stocks.

HML_{pt} = is the difference between the return on the portfolio of high and low book to market stocks.

$PR1YR_t$ = is the momentum factor.

Holding period (weeks)	Weekly alpha	alpha P-value	RMRF	SMB	HML	PR1YR
Panel A: CAPM						
1	0,1%	65,41%	-0,89			
1.5	0,1%	71,88%	-0,93			
2	0,1%	70,77%	-0,87			
Panel B: Fama French						
1	0,1%	74,91%				
1.5	0,0%	90,72%	-1,00	-0,08	0,21	
2	0,1%	84,44%	-0,96	-0,07	0,23	
Panel C: Fama French Carhart						
1	0,0%	99,58%	-0,99	-0,06	0,24	0,21
1.5	-0,1%	65,34%	-1,07	-0,09	0,33	0,28
2	-0,1%	67,16%	-1,02	-0,07	0,36	0,30

BHAR METHOD: HYPOTHESIS TESTING OF DIFFERENCE IN ABNORMAL RETURNS

The construction of the null hypothesis requires a double sided test to be implemented. Let $\mu_{Q1}, \sigma_{Q1} and \mu_{Q5}, \sigma_{Q5}$ represent the mean and standard deviation of the population for lightly (Q1) and heavily (Q5) shorted stocks. Furthermore, let $n_{Q1}, \overline{x}_{Q1}, s_{Q1} and n_{Q5}, \overline{x}_{Q5}, s_{Q5}$ represent the sample size, sample mean and sample standard deviation for the lightly and heavily shorted stocks respectively. Then

$$SE = \sqrt{\frac{s_{Q5}^2}{n_{Q5}} + \frac{s_{Q1}^2}{n_{Q1}^2}}$$

is the standard error of the sampling distribution. If population is assumed to be normally distributed, then

$$\frac{(\overline{x}_5 - \overline{x}_{Q1}) - (\mu_{Q5} - \mu_{Q1})}{SE}$$

approximately follows a t-distribution with

$$DF = \frac{(\frac{s_{Q5}^2}{n_{Q5}} + \frac{s_{Q1}^2}{n_{Q1}})^2}{\frac{(\frac{s_{Q5}^2}{n_{Q5}})^2}{n_{Q5}-1} - \frac{(\frac{s_{Q1}^2}{n_{Q1}})^2}{n_{Q1}-1}}$$

degrees of freedom. Assuming that the null hypothesis is true, then

$$\frac{\overline{x}_{Q5} - \overline{x}_{Q1}}{SE}$$

approximately follows a t-distribution with DF degrees of freedom. The p-value can then be calculated as

$$P(T \geq T_0)$$

where,

$$T_0 = \frac{\overline{x}_Q 5 - \overline{x}_Q 1}{SE}$$

A p-value below 5% is considered significant. If p-value $< 5\%$, the null hypothesis is rejected and the alternative hypothesis accepted, i.e. there is a significant difference in means between heavily and lightly shorted stocks.

EXTENSION OF CALENDAR TIME PORTFOLIO APPROACH - 8 FACTOR MODEL

The Extended 8 Factor Model

In order to control for any omitted varibles, we include 4 additional independent variales. These are discussed below. However, none of these factors proved to be significant. In addition, none of these factors could remove any of the unexplained variance. Therefore, this extension is presented in the appendix.

We expand the Fama and French (1993) and Carhart′s four factor model in order to account for other important effects of short selling. Volume is for instance included as a proxy for liquidity. The rationale is that more liquid stocks should incorporate corporate events and information more quickly and efficiently, in comparison to less liquid stocks (Chordia and Swaminathan 2000). The proxy for liquidity is important to include since it also is a measure of the firm′s size, i.e. large firms are more likely to be more liquid. Furthermore, Saffi and Sigurdsson (2011) suggest that larger firms are more liquid and that their prices are thus more efficient. The liquidity factor is closely related to size but also to cost. As discussed in detail below, the higher the liquidity and the larger the size, the lower is the potential cost of short selling. Hence, liquidity is intimately connected to short selling and should be included in the estimation of the alpha.

The value weighted average price is included in order to account for price discreteness. Price discreteness is a potential source of measurement error since trading prices do not reflect the actual prevailing market prices (French and Foster 2002). Larger stocks and those which are actively traded have a higher possibility of correct valuation (Boehmer and Wu 2012). The rationale for including this factor is that small deviations in market prices could potentially skew our estimation of the alpha, but is also in close relation to liquidity. Therefore, it is a perfect complement.

French and Foster (2002) among others [Blume and Stambaugh (1983), Gottlieb and Kalay (1985), Amihud and Mendelson (1987), Kaul and Nimalendran (1990)] also discuss the bid-ask spread as a source of error similar to the price discreteness and this control factor is therefore also included. Moreover, Saffi and Sigurdsson (2011) conclude that firms with higher bid-ask spread tend to have less efficient prices. Consequently, it is essential to include an explanatory factor that adjusts the estimation of the intercept for any price inefficiencies. The price efficiency is in addition closely related to the cost of short selling. It is reasonable to assume that short sellers actively avoid stocks with low liquidity (i.e. low price efficiency) since they are related to higher recall risk and potential costs.

The fourth factor (turnover divided by market cap) that we add is a transaction level estimate of trading cost. This is in fact volume divided by the total number of shares outstanding (assuming that both market cap and turnover are calculated using the same price). This is an indicator of how heavily (as a percentage of shares) the stock is traded and could give an indication of the prevailing trading costs. Furthermore, higher trading costs imply less trading and result in a lower ratio (Saffi and Sigurdsson 2011). Trading costs is important to account for since high trading cost could potentially make prices deviate from their fundamental values. In addition, the trading cost depends on the share type. Furthermore, different stock types imply different trading costs (e.g. small stocks are more expensive to short than large stocks). By adding trading cost as an

explanatory variable, the confounding risk of measuring the selection of cheap stocks instead of informed choices is minimized. In addition, the inclusion of trading cost as an explanatory variable adjusts for the effect that small stocks are more expensive, as discussed above.

$$R_{pt} - R_f t = \alpha_p + \beta(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + w_p PR1YR_t + v_p VOL_t + vw_p VWAP_t + b_p BAS_t + t_p TMC_t + \epsilon_{pt} \quad (21)$$

where
$R_{pt} - R_{ft}$: is the value weighted excess portfolio returns.
$R_{mt} - R_{ft}$: is the excess market returns.
SMB_{pt} : is the difference between the return on the portfolio of small stocks and big stocks.
HML_{pt} : is the difference between the return on the portfolio of high and low book to market stocks.
$PR1YR_{pt}$: is the momentum factor.
VOL_{pt} : is the volume factor.
$VWAP_t$: is the value weighted prices, i.e. average prices divided by daily volume.
BAS_{pt} : is the bid ask spread i.e. bid price minus ask price on a daily basis, accumulated into weekly averages.
TMC_t : is the turnover divided by market cap i.e. indirect volume divided by shares outstanding.
α_{pt} : is the average weekly abnormal return (Jensen′s alpha) of the portfolio.
ϵ_{pt} : is the error term.

The specific null hypothesis to be tested is the same as for the implementation of the Carhart four factor model whhen performing the calender-time portfolio approach in the second part of the paper:

$$H_0 : \alpha(Q1) = \alpha(Q5) \quad (22)$$
$$H_1 : \alpha(Q1) \neq \alpha(Q5) \quad (23)$$

HYPOTHESIS TESTING OF DIFFERENCES IN ALPHA

In the case that the null hypothesis turns out to be false, the interpretation is that the heavily shorted stocks generate a higher alpha than the lightly shorted stocks. More specifically, this null hypothesis can be tested using a dichotomous factor approach. The null hypothesis for each regression model is set up below.
Fama French Carhart four factor Model:

$$Q1(R_{pt} - R_f t) = \alpha_p + \beta(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + w_p PR1YR_t + \epsilon_{pt}$$
$$Q5(R_{pt} - R_f t) = (\alpha_p + \gamma_p) + \beta(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + w_p PR1YR_t + \epsilon_{pt}$$

Extended 8 factor model:

$$Q1(R_{pt} - R_ft) = \alpha_p + \beta(R_{mt} - R_{ft}) + s_pSMB_t + h_pHML_t + w_pPR1YR_t + v_pVOL_t + vw_pVWAP_t + b_pBAS_t + t_pTMC_t + \epsilon_{pt}$$
$$Q5(R_{pt} - R_ft) = (\alpha_p + \gamma_p) + \beta(R_{mt} - R_{ft}) + s_pSMB_t + h_pHML_t + w_pPR1YR_t + v_pVOL_t + vw_pVWAP_t + b_pBAS_t + t_pTMC_t + \epsilon_{pt}$$

where γ_p is the constant vertical difference between the parallel regressions of quintile 1 and quintile 5. In the dichotomous model, quintile 5 takes the value 1 and quintile 1 the value of zero. The null hypothesis to be tested becomes:

$$H_0 : \gamma = \gamma^0$$
$$H_1 : \gamma \neq \gamma^0$$

where the coefficient γ^0 is set to 0 in this case.
The null hypothesis is tested by computing the t-statistic. Let

$$\widehat{\sigma}^2 = \frac{\sum e_i^2}{n-2} = \frac{\sum (y_i - \widehat{y}_i)^2}{n-2} = \frac{SSE}{n-2}$$

be the unbiased estimated variance for the regression factors. The standard error (SE) for the intercept can be written:

$$SE(\tilde{\gamma}) = \widehat{\sigma}\sqrt{\frac{1}{n} + \frac{\overline{x}^2}{\sum (x_i - \overline{x})^2}}$$

where $\widehat{\sigma}$ and $\overline{x}$ are the estimated standard deviation and mean of the sample respectively. The t-statistic can then be written as:

$$T_0 = \frac{\widehat{\gamma} - \gamma^0}{SE(\widehat{\gamma})}$$

A p-value below 5% is considered significant and constitutes the decision rule for rejecting the null hypothesis. Specifically, we can conclude that there exists a true difference in the intercept (i.e. the alpha) if γ is significantly different from zero.