Flying Under the Radar: The Effects of Short-Sale Disclosure Rules on Investor Behavior and Stock Prices*

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Abstract

This paper analyzes how newly introduced transparency requirements for short positions affect investors' behavior and security prices. Employing a unique data set, which contains both public positions above and confidential positions below the regulatory disclosure threshold, we offer several novel insights. Positions accumulate just below the threshold, indicating that a sizable fraction of short sellers avoid disclosing their positions publicly. The decision to cross the disclosure threshold appears to be persistent, with investors sticking to their secretive behavior. Short positions held by these secretive investors are associated with stronger negative returns compared to their peers, suggesting that secretive investors possess superior information. Furthermore, we document that negative information is incorporated more slowly into stock prices when a secretive investor is just below the disclosure threshold. Overall, these findings suggest that short sellers' evasive behavior in response to the transparency regulation imposes a negative externality on stock market efficiency.

Keywords: short selling, transparency, investor behavior, limits to arbitrage, stock market efficiency

JEL: G14, G15, G23

1 Introduction

Disclosure requirements for investors' holdings are a prevalent feature of financial market regulation. Traditionally, various transparency rules have been in place for investors' long positions, but not for their short positions.[1] This asymmetry of publication requirements between long and short positions has been highly debated in the aftermath of the financial crisis, with regulators on both sides of the Atlantic contemplating new transparency measures for short positions. Proponents of short-selling disclosure rules argue that greater transparency would help improve the price discovery process in the market (NYSE, 2015; NASDAQ, 2015). However, opponents often raise the concern that a timely publication of short positions may pose a threat to proprietary investment strategies, especially when the identity of the short seller is revealed. To protect their private information, investors may diminish their short-selling activities, which can, in fact, deteriorate price efficiency (U.S. SEC, 2014). While the debate on more transparency for short sales is still ongoing in the United States, the European Union already adopted a uniform short position disclosure rule in 2012.[2] Specifically, the European regulation requires the publication of investors' net short positions – including derivative equivalents – over a certain threshold one day after the position arises.

A priori, it is unclear how a mandatory disclosure threshold affects the behavior of short sellers, given the fact that there are arguments for both hiding and publicizing one's short position. On the one hand, an investor may strategically publicize its short

[1] In the United States, for example, several disclosure rules apply to long positions. First, anyone who acquires beneficial ownership of more than 5% of a voting class of a publicly traded company has to file a 13D or 13G filing with the Securities and Exchange Commission (SEC). Second, institutional investment managers of a certain size must report their quarterly holdings in 13F filings. Mutual funds also must regularly report their portfolio holdings to their shareholders (SEC forms N-CSR and N-Q.).

[2] Among the EU countries, Spain and the United Kingdom had already implemented short-sale disclosures in 2008; France followed in 2011. Japan also introduced disclosure requirements in 2008. In the United States, similar measures have been debated. The Dodd-Frank Act required the U.S. Securities and Exchange Commission (SEC) to conduct a study of the feasibility, benefits, and costs of real-time disclosures of shorting. However, the real-time disclosure of shorting was not adopted (U.S. SEC, 2014). Recently, the debate on short-sale disclosure resurfaced, with both large stock exchanges, NSYE and NASDAQ, filing rulemaking petitions for short-sale disclosure with the SEC (petition number: 4-689, October 7, 2015; petition number: 4-691, December 7, 2015, see https://www.sec.gov/rules/petitions.shtml).

position to induce other investors to sell their positions, thereby correcting overpricing faster (Ljungqvist and Qian, 2016). On the other hand, several possible reasons may prevent investors to publicize their short position: concerns about stock recalls or short squeezes, the protection of proprietary trading strategies, and adverse effects on the ability to access the company's management. Lamont (2012) documents even cases of legal actions or harassment against short sellers.

In this study, we investigate two key questions related to the new European short position disclosure rule: How do short sellers behave around the disclosure threshold; do they, for example, try to stay below the radar? If so, how would such behavior affect the efficiency of stock prices? We address these questions by exploiting unique regulatory short-sale notification data, which cover not only *public* positions *above the disclosure threshold* but also *confidential* positions *below the threshold*. Our data originate from the two-tier reporting system pursuant to the EU-wide short-selling regulation: First, investors must notify the regulator if their short position reaches 0.2% of the shorted stocks' issued share capital. Second, the short position must additionally be publicly disclosed if it reaches 0.5% of the issued share capital. Above these thresholds, the short position is updated whenever it falls into a new reporting interval of 0.1% width. These first- and second-tier notifications for the German stock market, as part of the European regulation, offer us a rare glimpse behind the curtain of the public disclosure threshold.

By studying short positions above and below the disclosure threshold, we offer several novel insights. First, we find strong evidence that a considerable fraction of investors avoid crossing the disclosure threshold, resulting in positions to pile up just below the threshold. Specifically, in the reporting interval just below the threshold, the probability of increasing a short position is the lowest, and the duration for which such a position is held is the longest, relative to all other reporting intervals. Compared with the neighboring reporting intervals, the duration is 22-55% longer, and the probability of increasing the short position is 20-34% lower. These effects emerge only when investors approach the

publication threshold for the first time and from below, not for positions that were already public, suggesting that the observed pattern in the data actually originates from a strategy designed to avoid crossing the disclosure threshold.

Studying the determinants of the decision to publish a short position, we find that it is predominantly influenced by investor-specific characteristics. In particular, the decision to cross the disclosure threshold appears to be persistent, with investors sticking to their secretive behavior. This finding suggests that some investors maintain a general policy not to disclose their positions. A large fraction of investors indeed never cross the disclosure threshold in our sample. Comparing the shorting performance of these secretive investors to that of non-secretive investors, we document stronger negative returns for stocks shorted by the former, which suggests that the concealment of positions is associated with superior information. The fact that secretive investors can generally be characterized as informed investors supports the hypothesis that the protection of private information plays an important role in the decision not to disclose positions. Hedge funds have expressed their concern that a disclosure of short positions would adversely affect their ability to access corporate management and, in turn, to produce fundamental research (AIMA/MFA, 2013). Concerns regarding management access provide a likely explanation for the fact that especially informed investors, i.e. investors that gather and produce fundamental information, never disclose their short positions.

Lastly, we also study how investors' evasive behavior with respect to the disclosure threshold affects asset prices. If the disclosure threshold prevents informed investors to further increase their positions, then negative information may be incorporated more slowly into prices. To study such an effect on returns we identify short positions that remain just below the disclosure threshold, never crossing it. For these secretive positions we find subsequent negative risk-adjusted returns when the investor is just below the disclosure threshold. To confirm that the return predictability originates from the disclosure threshold, we perform different placebo tests. The negative return predictability is not

present when we choose various hypothetical publication thresholds below and above the true one. Moreover, within investor-stock pairs, subsequent negative returns only occur when the position is just below the publication threshold and the constraint originating from it is binding.

The new rule represents an ideal setting to study how mandatory position disclosure affects investors' behavior and, in turn, the informational efficiency of prices. Price discovery is a key function of the financial market: Informed investors exploit their private information by trading in the market, and in doing so reveal part of their information to uninformed investors. Through this mechanism the information is eventually incorporated into prices (Glosten and Milgrom, 1985; Kyle, 1985). However, investors also face various disclosure rules pertaining to their holdings, which may convey private information to the market, especially if positions are published in a timely manner. So informed investors have an incentive to avoid disclosure by trading less, which can reduce price efficiency. Early academic literature highlighted this trade-off especially in the context of insider trading (Leland, 1992; DeMarzo, Fishman and Hagerty, 1998; Huddart, Hughes and Levine, 2001). More recently, it has been discussed in connection with hedge fund opacity (Agarwal, Jiang, Tang and Yang, 2013; Easley, O'Hara and Yang, 2014) and mutual funds' portfolio disclosure (Agarwal, Mullally, Tang and Yang, 2015). Two features make the analyzed disclosure rule particularly interesting with regard to informational efficiency. First, the rule applies to short sellers, which are typically perceived as informed investors.[3] Second, the disclosure rule is highly revealing because positions crossing the disclosure threshold must be publicized as early as the next trading day.

Our findings contribute to the literature on limits to arbitrage, in particular, short-sale constraints. A widely studied source of short-sale constraints are frictions in the lending

[3]For example, the model by Diamond and Verrecchia (1987) predicts that short sellers are more likely to be informed than uninformed because shorting is costly. A robust finding of the empirical literature is that short sales are followed by negative returns, suggesting that short sellers are generally informed investors (e.g. Seneca, 1967; Aitken, Frino, McCorry and Swan, 1998; Asquith, Pathak and Ritter, 2005; Boehmer, Jones and Zhang, 2008; Diether, Lee and Werner, 2009). For a recent survey on this topic, see Reed (2013).

market (e.g. Jones and Lamont, 2002; Asquith et al., 2005; Nagel, 2005; Cohen, Diether and Malloy, 2007; Prado, Saffi and Sturgess, 2014). Our key contribution to this literature is to show that transparency requirements already constitute a sizable impediment to short selling. Our paper also relates to the literature on short-sale regulations (e.g. Diether et al., 2009; Boehmer, Jones and Zhang, 2013; Beber and Pagano, 2013; Battalio and Schultz, 2011). The consequences of short-sale bans following the financial crisis of 2007-2008 have attracted great interest among researchers. For instance, Boehmer et al. (2013) and Beber and Pagano (2013) analyze short-sale bans in the United States and internationally, respectively, documenting a deterioration in market quality.

On the contrary, much less is known about the effects of higher transparency requirements on short sellers. Jones, Reed and Waller (2016) are the first to study the recent introduction of short-sale disclosure rules in Europe. They document a reduction in short interest and the bid-ask spread, and a decrease of price informativeness as proxied by the Hou and Moskowitz (2005) price delay measure. Overall, their findings suggest a change in investors' behavior in response to increased transparency. Duong, Huszár and Yamada (2015) present similar findings for Japan. Our study is, to the best of our knowledge, the first to *directly* analyze short sellers' evasive behavior in response to higher transparency requirements. In particular, using confidential positions below the publication threshold, we are able to offer insights about the rationale underlying investors' avoidance to cross the publication threshold. In addition, we show that this behavior has a critical impact on stock prices, which has previously not been documented: Mandatory disclosure especially constrains *informed* investors, resulting in lower pricing efficiency, reflected in short-term mispricing and predictability of stock returns.

The remainder of this paper is organized as follows: Section 2 provides background information on the short position disclosure regulation and discusses relevant theory. In Section 3, we describe how we construct the sample. Section 4 examines whether investors avoid crossing the disclosure threshold, Section 5 explores the reasons for such avoidance,

and Section 6 studies the implications of the disclosure rule on asset prices. Section 7 provides further analyses which corroborate the main results. Section 8 concludes.

2 Institutional background and theory

2.1 Background on the short position disclosure rule

The EU regulation on short selling (No 236/2012) has been in effect since November 1, 2012, requiring investors to report and disclose any short positions of a considerable magnitude. The regulation consists of a two-tier reporting system: First, a net short position must be reported to the regulator if the position reaches 0.2% of the issued share capital of the company shorted and for each 0.1% above that. Second, a net short position must be disclosed to the public if the position reaches 0.5% of the issued share capital of the company shorted and for each 0.1% above that. Also, positions have to be reported or disclosed when they fall below the relevant thresholds.

The notification and disclosure rules apply to all stocks for which the principal trading venue is located in the EU. Short positions are reported separately for each country on the websites of the national authorities. In Germany, the national authority for reporting short positions is the Federal Financial Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht, BaFin), and short positions are published on the Internet platform of the Federal Gazette (Bundesanzeiger).[4] Short positions have to be reported or disclosed by 3:30 p.m. (local time) on the next trading day after they arise. Disclosures contain the name of the investor, the date of the short position, the International Securities Identification Number (ISIN), and the name of the shorted stock, as well as the magnitude of the position reported as a percentage of the issued share capital.

The following example illustrates the disclosure rule. In autumn 2015, the hedge fund company Marshall Wace LLP shorted the stock of Deutsche Lufthansa AG considerably,

[4]For recent examples of published net short positions in Germany, see: https://www.bundesanzeiger.de/nlp.

presumably in light of the airline's restructuring plan and labor disputes with its pilots and cabin crews. Marshall Wace's net short position in Lufthansa stock exceeded the publication threshold of 0.5% on October 29, 2015, with a reported value of 0.59%. On November 2, 2015, the position exceeded the next reporting threshold of 0.6%, with a reported value of 0.61%, and on November 5, 2015, the next threshold of 0.7% was crossed, with a reported value of 0.71%. Thus, short positions are publicly disclosed when each new publication threshold is crossed, until the position falls below the threshold of 0.5%. The regulator receives confidential short position notifications in the same manner, but here the threshold is 0.2%.

After the reporting day, the exact value of a short position is unknown between the two disclosure thresholds until a new threshold is crossed. That is, the reported short position of 0.61% on November 2, 2015, could range between 0.60% and 0.69% on the next day, because no further information about crossing another threshold became available. Therefore, we sort the positions into short position bins of 10 basis points (bps) each: 0.20-0.29%, 0.30-0.39%, 0.40-0.49%, and so forth. For brevity, we refer to these reporting intervals as the 0.2, 0.3, 0.4, ... reporting bin or interval.

Several features of the regulation and its scope need to be highlighted. First, the disclosure rule applies to all investors, irrespective of whether they are domiciled in the EU or abroad. In fact, a large proportion of the reporting position holders are hedge funds domiciled outside the EU. Second, the regulation applies not only to short positions but also to derivative positions, which must be accounted for on a delta-adjusted basis. Thus, reporting requirements cannot be circumvented by substituting short positions with positions in derivatives. Third, the reported *net* short positions are calculated by netting all long, short, and delta-adjusted derivative positions of the respective stock. Consequently, a short position established to hedge an exposure originating from a derivative position in the same underlying does not have to be reported or disclosed as long as the overall shorting exposure is below the respective thresholds. Lastly, market making activities

are exempted from the EU short-selling regulation with the purpose of ensuring liquidity provision. Exemptions comprise market making in a specific stock, but also market making in the related derivatives of that stock. To meet the conditions for this exemption, institutional investors are required to file a detailed statement on their market making activities in specific securities, which is monitored by the national authorities (ESMA, 2013*b*). According to the list of market makers published by ESMA, mainly banks are using this exemption in our sample (ESMA, 2016).

2.2 Short positions: To publish or not to publish

A priori, it is unclear whether investors prefer to publicize their short positions or prefer to keep it secret. Lamont (2012), whose arguments we follow subsequently, states that depending on the situation, a short seller might either publicize its position or try to remain undetected. Publicizing a short position could be helpful if the investor is attempting to convince other investors that a certain stock is overpriced. If other investors agree and follow suit, prices will converge faster to fundamentals, thus reducing borrowing costs for the stock and potential noise trader risk (De Long, Shleifer, Summers and Waldmann, 1990; Shleifer and Vishny, 1997). As a prominent example of this strategy, in November 2012, Bill Ackman, CEO of the hedge fund management company Pershing Square Capital Management LP, announced that the fund had massively shorted Herbalife stock, accusing the company of a pyramid scheme.[5] The Herbalife case received widespread media attention, but such short-sale campaigns are comparatively rare.[6]

At the same time, there are plenty of reasons why short sellers may want to keep their short positions secret. If other investors follow on shorting the stock, existing stock loans may be called back by the lender, or borrowing fees may rise. This effect would be especially pronounced if lending supply for the stock were low. Investors may also be

[5]See: Alden, W.: "Ackman Outlines Bet Against Herbalife" *The New York Times* (November 20, 2012).

[6]Ljungqvist and Qian (2016) collect 124 short-sale campaigns in the United States employed by 31 individuals or small boutique hedge funds during 2006-2011, finding evidence that such campaigns contribute to the correction of mispricing.

concerned about their intellectual property, such as information they have gathered about the shorted company or a proprietary trading strategy, which they do not want to reveal to their competitors. The disclosure of a short position may also have adverse effects on the ability to access corporate management, an important channel for compiling fundamental information. The Alternative Investment Management Association (AIMA) and the Managed Funds Association (MFA) report anecdotal evidence that some hedge funds "have been excluded from corporate access events as a consequence of their short positions, notwithstanding the fact that the same managers may have had long positions in the past, or elsewhere in their firms or in other of their funds" (AIMA/MFA, 2013). Similarly, the fear of being sued or harassed by the shorted firm, which occurs in extreme cases as Lamont (2012) documents, may prevent short sellers from publicizing their position.

Given that there are reasons both for and against publicizing a short position, it is unclear whether and how investors would change their behavior in response to a mandatory disclosure threshold. However, the primary concern raised by participants of the survey conducted by the European Securities and Markets Authority (ESMA) is that investors would try to avoid a publication by just remaining below the disclosure threshold (ESMA, 2013*a*). Therefore, we pose the question accordingly and ask whether investors on aggregate avoid crossing the publication threshold. Yet, it is important to note that our proposed empirical framework would also capture the opposite, an "eagerness" to cross the threshold.[7]

3 Data and descriptive statistics

We obtain public and confidential short position disclosures from the German Federal Financial Supervisory Authority (BaFin) from November 1, 2012, through March 31, 2015. We merge the short position notifications with stock data from *Thomson Reuters*

[7]In this paper we focus on short sellers' behavior around the disclosure threshold of 0.5%. It is possible that the two-tier reporting system impacts the behavior at 0.2%, where positions are reported to the regulator but not to the public. We are unable to investigate this question because the positions below 0.2% are by definition unobservable.

Datastream and institutional investor data from *FactSet Ownership*, formerly known as *LionShares*. For our analysis, we restrict the sample to common equity traded on the German regulated market. To ensure the quality of the data from Datastream, we apply several standard data filters (see Ince and Porter, 2006; Griffin, Kelly and Nardari, 2010; Karolyi, Lee and Van Dijk, 2012). We start our analysis on November 5, 2012, to account for some delay in the notification of short positions, due to a statutory holiday in some federal states. The Appendix provides further details on the sample construction, and Table A.1 contains a description and the sources of all variables used in our analyses.

Table 1 provides summary statistics on various stock characteristics for the entire population of stocks in the regulated market and for stocks that have at least one short position notification. Out of all stocks, 19.9% have at least one short position notification. In particular, 8.3% of the sample consists of stocks that have at least one public short position disclosure and 11.6% of stocks have at least one confidential but no public position. In terms of stock characteristics, we observe short position notifications mainly for stocks with a large market capitalization, a low book-to-market ratio, and a high share of institutional investors, as well as stocks that are very liquid, measured by both the Amihud illiquidity ratio and the bid-ask spread. In fact, the vast majority (73.5%) of stocks with short positions are in the highest market capitalization quartile, and almost all stocks with short position notifications (95.8%) appear above the median value of the market capitalization distribution. In economic terms, there are no apparent differences between stocks with public and confidential short positions.

The panel dimension of the analysis in Sections 4 and 5 pertains to the investor-stock level. Table 2 contains summary statistics for the stock and investor characteristics for which we observe a short position of at least 0.2% of issued share capital. As these details indicate, hedge funds constitute the largest investor group, accounting for 66% of the observations whereas banks account for only 2%.[8] The remaining groups of investors are

[8] As mentioned in Section 2.1, banks predominantly use the exemption rule for market makers, which most likely explains their low share in our sample.

mutual funds and other investment advisors. For 47% of the observations, the investor is domiciled in Europe and only 2% of investors are local (i.e., domiciled in Germany). For 10% of the observations, the investor has no other public record and is thus not present in the *Factset* database. Finally, 23% of the position days are associated with investors that never had a public short position in the past.

Figure 1(a) shows the frequency distribution of days with an open short position notification over the different reporting bins. Recall that short positions are reported to the regulator when greater or equal to 0.2% of total shares outstanding, and they are disclosed to the public when greater or equal to 0.5%. As can be seen from the graph, publicly disclosed short positions are only the tip of the iceberg. The majority of short positions are not disclosed: 79% of observations with an open short position fall below the publication threshold.

4 Do investors avoid crossing the disclosure threshold?

Looking at the overall distribution in Figure 1(a), it is hard to determine whether investors avoid crossing the disclosure threshold. To uncover a potential accumulation of short position below the disclosure threshold, we split the sample into positions at their historic high and positions below their historic high. Specifically, we define the following dummy variable for the sequence of position notifications of each investor-stock (i, j) pair:

$$Position\ record\ high_{i,j,t} = \begin{cases} 1 & \text{if } bin_{i,j,t} = \max\limits_{s \leq t} bin_{i,j,s} \\ 0 & \text{if } bin_{i,j,t} < \max\limits_{s \leq t} bin_{i,j,s}, \end{cases} \tag{1}$$

where $bin_{i,j,t}$ denotes the short position's reporting bin of investor i in a given stock j on trading day t. A sample split according to Equation (1) exploits the fact that avoidance of crossing the threshold should be particularly pronounced for investors who approach the threshold from below for the first time. Comparing two exemplary situations of investors

just below the disclosure threshold provides the economic intuition behind this sample split. First, imagine an investor being short in a specific stock with a position value of 0.4 and the position is at its record high. Because this position has not been higher in the past, it has also never been public. If some investors avoid crossing the threshold, we expect to find evidence of avoidance especially in this situation. Now imagine an investor with a short position in the 0.4 bin in a specific stock, but the position is below its record high. This position has been higher in the past and consequently has also been public. We expect in the latter situation no or less signs of avoidance compared to the former situation. The idea is that investors that have demonstrated no avoidance disclosing a particular position in the past are most likely not hindered in crossing the publication threshold again in the near future.

Figure 1(b) shows the frequency of days with open short positions for the two subsamples. Positions that are at their record high, for which we expect strong signs of avoidance, amass below the disclosure threshold, suggesting that some investor prefer to stay below the threshold. The relative frequency in the 0.4 bin is 17.0%, nearly reaching the frequency of the previous bin. Positions that are below their record high instead decline fairly geometrically with increasing reporting bins. Their relative frequency in the 0.4 bin is 8.6%, about half the relative frequency of positions at their record high. Overall, Figure 1(b) yields initial, descriptive evidence that some investors try to stay below the radar.

In the following, we take an alternative more rigorous approach to testing the avoidance hypothesis. First, we study the probability that the next position change is an increase across reporting intervals. Second, we investigate the duration spent in each reporting interval. Lastly, we employ several saturated fixed-effects models to ensure that the avoidance effect is not driven by unobserved stock-, investor- or time-specific effects.

Due to data reporting issues our methods differ from the common approach to identify discontinuities in economic outcomes, in which the density of the variable of interest is estimated just below and above a certain threshold. Such an approach is, for example,

widely used in the earnings management literature (e.g., Degeorge, Patel and Zeckhauser, 1999). However, this method requires a continuous outcome variable. A density estimation is not feasible with only three reporting bins below the publication threshold. Also, using the actual reported value of the short position at higher, two-digit precision is also not satisfying because of the specific reporting rule. Namely, the value of the short position is only recorded on the day at which the position crosses the threshold of a reporting bin. Afterward, the position can take any value within the corridor of two thresholds without additional reporting (see also Section 2.1).[9] As a consequence, investors' short position can only be measured with one-digit precision and the true fraction of investors within the reporting bin would be misrepresented when using the second digit of the reported values.

4.1 Probability of a short position increase

Our first hypothesis of avoidance relates to the probability of increase. In the presence of avoidance, the probability of a position increase should be lower in the bin just below the threshold compared to that of the neighboring bins. Table 3 shows the probability that the next position change is an increase, conditional on currently having a short position in a specific reporting interval. For this test, we ignore the time dimension of the positions and we completely infer our results from the decision whether the investor increases or decreases its position on the next change. Looking first at the overall sample, we find that the probability of an increase rises with the value of the current reporting interval. Beyond this general pattern, we observe an unusual value for the 0.4 reporting interval. The bin just below the publication threshold exhibits the lowest probability of all reporting intervals, which is significantly different from all other bins except the

[9]Such setting induces a distorted picture of the distribution of positions *within* a reporting corridor. If a position crosses the 0.4 threshold from below, it is more likely to have a low than a high second digit on that day. Changes in the second digit are not incorporated into the distribution. In contrast, when crossing the 0.4 threshold from above, it is more likely to have a high than a low second digit on that day. This reporting rule mechanically creates a U-shaped distribution of positions within a reporting corridor.

lowest. This unusually low likelihood of increasing a short position just below the threshold suggests that some investors avoid crossing the disclosure threshold.

To determine whether this effect is really due to an avoidance strategy, we split the sample into positions at and positions below their record level. As discussed previously, the avoidance of passing the disclosure threshold should be present in particular for positions at their record high, but less pronounced for positions below their record high. The second panel shows the probability of increasing a short position only for positions at their historic high. For this subsample, the avoidance effect of the 0.4 bin is much stronger than it is in the overall sample. The probability of increasing a short position takes a minimal value of 0.338 for the 0.4 class, which is significantly lower than all reporting intervals except for the lowest. To gauge the economic significance of this avoidance effect, we compare this probability with the neighboring reporting intervals, just below and just above. In the 0.3 bin, the probability of increasing a short position is 0.423, equivalent to a difference of -0.085; in the 0.5 bin, it is 0.514, amounting to a difference of -0.176. In relative terms, in the bin just below the disclosure threshold it is 20% and 34% less likely to increase a short position than in the two neighboring intervals.

Positions that are below their maximum serve as a comparison. If the low probability of increasing a short position is truly due to avoidance of revealing one's position, we should observe a smaller or no effect at all for these positions. The right-hand side panel of Table 3 supports this notion: For positions below their maximum, we find nothing extraordinary about the 0.4 reporting interval. The probability of increasing the position is even the second largest, not statistically significant when compared to the class below, and significantly larger than the class above.

4.2 Duration in reporting bins

The second testable hypothesis for avoidance pertains to the duration spent in the reporting intervals. If investors avoid crossing the disclosure threshold, they remain just below it,

resulting in a longer duration in the 0.4 reporting bin. We test this hypothesis in Table 4, which shows the average duration in each reporting interval in trading days. The durations in the bins are prone to severe outliers, so we winsorize the upper tail at 1% before reporting the mean durations in Panel A. As an alternative, we report the median durations in Panel B.

In general, the duration in each 10 bps interval declines with the size of the position. For example, the mean duration for the overall sample in Panel A declines from 18.3 days (lowest class) to 12.6 days for all positions greater than or equal to 1.0% (highest class). Again, we observe an unusual value for the 0.4 bin: The duration in this class, just below the disclosure threshold, is the longest of *all* classes, at 20.6 days. The difference in mean duration is statistically significant when compared with *all* other reporting intervals. As in our previous analysis, we exploit the fact that avoidance of passing the disclosure threshold should be present particularly for positions which approach the threshold from below for the first time. With the sample split, we discover that the pattern of the overall sample is driven entirely by the positions at their record high, for which the maximum duration of 26.0 days is reached in the 0.4 bin, significantly higher than any other class. For positions below their record high, we find no unusual value for the class just below the publication threshold; instead, the durations decline fairly monotonically with the position value. The same pattern can be observed for median durations: For positions at their record high, the median duration is 10 days for the reporting class just below the publication threshold, significantly higher than any other reporting class. For positions below their record level, on the contrary, durations decline monotonically.

To illustrate the economic magnitude of the duration effect, it is again useful to compare the maximum duration of the 0.4 class with its neighboring classes. The mean duration of 26.0 days is 22% higher than the next lower class (21.3 days) and 55% higher than the next higher class (16.7 days). Considering medians, the results are much alike: The median

duration of 10 days is 25% higher than the next lower class (8 days) and 43% higher than the next higher class (7 days).

In summary, investors spend an abnormally long time in the reporting class just below the publication threshold, which is significantly longer than in any other reporting interval. The likelihood of increasing the short position is also the lowest in the reporting class just below the publication threshold. The economic magnitude of these effects is substantial: Compared with the neighboring bins, the duration is 22-55% longer, and the probability of a short position increase is 20-34% lower. Overall, these combined results suggest that a considerable share of investors avoid crossing the disclosure threshold.[10]

4.3 Accounting for unobserved time-varying stock and investor effects

The results of an abnormally low probability of increase and abnormally long average duration in the bin just below the publication threshold indicate that a large fraction of investors avoid increasing their positions because of the publication threshold. However, this reduced probability of increase might stem from changes in stock or investor characteristics that coincide with the phase in the 0.4 bin. To rule out these alternative mechanisms, we conduct panel regressions with progressively saturated fixed-effects specifications in the spirit of Jiménez, Ongena, Peydró and Saurina (2014).

We start with a standard binary outcome model and construct a dependent variable equal to one on day t if a short position increases from one bin to another one between two consecutive trading days, and is zero otherwise: $y_{i,j,t} = \mathbb{1}\left(bin_{i,j,t+1} > bin_{i,j,t}\right)$, capturing the decision made by an investor today to increase a position on the next trading day. To identify short sellers' avoidance of crossing the disclosure threshold, we include as explanatory variables a dummy variable for each reporting bin, including the bin just

[10] It is worth noting that these results describe the aggregate behavior of investors around the disclosure threshold. The results are not at odds with the possible existence of individual short-sale campaigns as for example documented by Ljungqvist and Qian (2016).

below the disclosure threshold and omitting one of the neighboring bins. We specify the following general fixed-effects model:

$$y_{i,j,t} = \beta_0 + \beta_1 \; \textit{Just below threshold}_{i,j,t} + \sum_k \beta_k \; k \; \textit{bin}_{i,j,t} + u_{i,j,t}. \tag{2}$$

where *Just below threshold* is a dummy variable, indicating the reporting bin just below the publication threshold ($bin = 0.4$). The indicator k $bin_{i,j,t}$ is equal to one if investor j has a short position in stock i in bin k at time t. In our first specification the omitted benchmark bin is 0.3, i.e. $k \in \{0.2, 0.5, 0.6, \ldots, 1.0^+\}$, where 1.0^+ indicates position bins greater or equal to 1.0. The disturbance term $u_{i,j,t}$ includes – depending on the specification – stock-, investor-, and time-fixed effects and an idiosyncratic error term $\varepsilon_{i,j,t}$. In case of an avoidance strategy we expect the coefficient of the *Just below threshold* dummy β_1 to be significantly negative relative to the omitted 0.3 bin.

Our first benchmark specification includes daily time-fixed effects. Formally, we have $u_{i,j,t} = \alpha_t + \varepsilon_{i,j,t}$. Column 1 of Panel A in Table 5 reports the estimates of this specification. The results are in line with our previous findings. The probability of an increase conditional on being in the bin just below the disclosure threshold is significantly lower than in the 0.3 bin. In economic terms, when a short seller is in the 0.4 bin, it is 0.54 percentage points less likely to increase the position relative to the 0.3 bin. This effect is economically significant, given that the baseline unconditional probability of an increase on the next day is slightly below 2.0%. The second benchmark specification includes stock-, investor- and time-fixed effects, respectively, i.e. $u_{i,j,t} = \alpha_i + \alpha_j + \alpha_t + \varepsilon_{i,j,t}$. As can be seen from Column 2, the avoidance effect is even larger: For a position just below the threshold the likelihood of a position increase is 0.92 percentage points lower compared to the next lower bin.

Next, we exploit the three-dimensional structure of our data set, and gradually include stock-day or investor-day fixed effects to suppress the influence of stock or investor

unobservables on the decision to increase a short position. In the first step, we saturate the model with stock×time fixed effects to account for both observed and unobserved time-varying stock characteristics. Relating to Equation (2), our residual has the following functional form: $u_{i,j,t} = \alpha_{i,t} + \varepsilon_{i,j,t}$. The fixed effects control for characteristics, such as stock's overall borrowing demand, supply of stocks to borrow, borrowing fees, liquidity or any other stock-specific variable that may have an effect on the decision of a position increase. The identification stems from comparing the probability of an increase on the *same* day by different short sellers for the *same* stock. The results are reported in Column 3 of Table 5. The estimated regression coefficients indicate that observed or unobserved stock-specific characteristics do not explain the abnormally low probability in bin 0.4. That is, the coefficient of the just below the threshold dummy is negative and statistically significant.

Instead of a stock-driven explanation for the low probability in the bin just below the threshold, time-varying investor characteristics may potentially explain the low probability of increase in the 0.4 bin. Therefore, in the next specification, we control for any observable and unobservable investor characteristics that may account for this abnormally low probability by including investor×time fixed effects: $u_{i,j,t} = \alpha_{j,t} + \varepsilon_{i,j,t}$. In this way, we control for investor's size, leverage, and funding constraints or any other investor-specific characteristic that does or does not vary over time. In this specification, the identification resides from the different positions of the *same* short seller at the *same* day. As can be seen from Column 4 of Table 5, the coefficient for the bin just below the disclosure threshold remains negative and statistically significant at any conventional level.

In our last and most saturated specification from Equation (2), we add both stock×time and investor×time fixed effects: $u_{i,j,t} = \alpha_{i,t} + \alpha_{j,t} + \varepsilon_{i,j,t}$. The results are reported in Column 5 of Table 5. As before, the probability of an increase when the investor is in the bin just below the publication threshold is on average significantly lower than in the next lower bin. The inclusion of the different fixed effects results in the exclusion of obsolete

observations due to missing variation. However, the loss of observations is relatively small in this rich data set. Even in the very last specification with both stock×time and investor×time fixed effects, the number of observations with sufficient variation within stock and investor level, accounts for 73% of the overall sample size.

The result so far compare the probability of increase in the bin just below the threshold to the omitted next lower 0.3 bin. In Panel B of Table 5 we compute the difference to the next higher 0.5 bin and also the difference to all other bins. Across all different specifications, the probability of an increase in the bin just below the publication threshold is on average significantly lower than in both neighboring bins and this difference is of comparable magnitude. Thus, in the following analyses, we will focus on the 0.3 bin as benchmark category. Finally, in the most saturated fixed-effects model in Column (5) the probability of increase when the investor is in the bin just below the publication threshold is on average significantly lower than in *any* other reporting bin.

5 Understanding investors' avoidance of position disclosure

5.1 Which characteristics influence the likelihood of crossing the disclosure threshold?

In the previous section, we uncovered considerable avoidance of passing the disclosure threshold. As discussed in Section 2, there are different possible motivations for being secretive about one's short position, such as borrowing costs, recall risk, cultural or institutional reasons, or the protection of private information. The purpose of this section is to examine these mutually non-exclusive explanations. The analysis proceeds in two steps: First, we analyze which characteristics drive the decision to increase a given short position in general. Second, we investigate which of these factors affect the decision to cross the threshold, given that a position is just below it.

Following our approach in the previous section, we characterize investors' decisions to increase their short positions in a standard binary outcome model. Specifically, we examine the probability of a position increase on the next day $Pr\left(y_{i,j,t}=1|\mathbf{x}_{i,j,t}\right)$ for a vector of predictors $\mathbf{x}_{i,j,t}$, which we discuss in detail subsequently. We specify the following linear probability model:

$$\begin{aligned} y_{i,j,t} \;=\; & \beta_0 + \beta_1\, \textit{Just below threshold}_{i,j,t} + \boldsymbol{\beta}_2'\mathbf{x}_{i,j,t} + \boldsymbol{\beta}_3'\, \textit{Just below threshold}_{i,j,t} \times \mathbf{x}_{i,j,t} \\ & + \beta_4\, \textit{0.2 bin}_{i,j,t} + \beta_5\, \textit{Public short position}_{i,j,t} \\ & + \boldsymbol{\beta}_6'\, \textit{0.2 bin}_{i,j,t} \times \mathbf{x}_{i,j,t} + \boldsymbol{\beta}_7'\, \textit{Public short position}_{i,j,t} \times \mathbf{x}_{i,j,t} + \alpha_t + \varepsilon_{i,j,t}, \end{aligned} \tag{3}$$

where *Just below threshold* is a dummy variable, indicating the reporting bin just below the publication threshold. The vector $\mathbf{x}$ describes several stock-specific and investor-specific characteristics that may relate to the likelihood of increasing a short position.[11] Next, we include interactions of the covariates $\mathbf{x}$ with the *Just below threshold* dummy to measure which characteristics influence the decision to increase a short position, given that the position is close to, but below the publication threshold. We will refer to this decision as the publication decision.

Building on the analysis in Section 4, we also include dummy variables for the different reporting bins and the corresponding interaction terms with the covariates $\mathbf{x}$. In other words, we allow the effect of the covariates to vary across our specified bins. As before, the 0.3 bin is omitted, thus serving as the reference category relative to which the baseline avoidance effect β_1 and interaction effects $\boldsymbol{\beta_3}$ are measured. However, for this analysis, we combine all bins above the threshold into the indicator *Public short position* instead of including a dummy for each public interval. The reason for adopting a more parsimonious

[11] Details about the definition of each variable and the underlying data sources are in Table A.1 in the Appendix.

specification is to ensure having enough observations to estimate the interaction coefficients for positions above the disclosure threshold.[12]

We adopt a linear probability model instead of the non-linear logit or probit model to facilitate a straightforward interpretation of the various interaction terms.[13] To avoid reverse causality, we lag the stock-specific variables by 20 trading days when estimating the regression model. The model specification also includes daily time fixed effects. Standard errors are clustered on the investor-stock and time level (Petersen, 2009; Thompson, 2011).

Estimation results are shown in Table 6. In the first two models we examine the determinants of increasing a short position in general. Model 1 resembles our previous specification of Section 4.3, focusing on the probability of increase across bin categories, i.e. setting $\boldsymbol{\beta}_2$, $\boldsymbol{\beta}_3$, $\boldsymbol{\beta}_6$ and $\boldsymbol{\beta}_7$ to $\mathbf{0}$. The model shows a negative coefficient of -0.55 for the *Just below threshold* dummy and a positive coefficient of 1.08 for public short positions. These estimates imply that in the bin just below the publication threshold, the probability of increasing a position is 27% lower than in the 0.3 reference bin and 52% lower than for public short positions.[14] Note that the estimate of the baseline avoidance effect is in line with the one presented in Column (1) in Table 5, where in both cases daily fixed effects are taken into account. Model 1 captures avoidance to disclose short position in a parsimonious specification, underlining the essence of our previous findings.

Model 2 enriches the first model by including additional covariates related to the likelihood of a short position increase. Several interesting insights emerge: Consistent with the idea that it is difficult to establish the same relative position in larger stocks, market

[12] As evident from Figure 1(a), the number of observations in each single public reporting bin is relatively low. Given the combination of a large set of covariates and the small number of observations of large public positions, an estimation of the interaction effects with single bins is unfeasible.

[13] Assuming the model is correctly specified, both the linear probability model and the logit or probit model provide consistent estimates of the marginal effects, though non-linear models may be more efficient. Given the overall sample size of more than 250,000 observations, efficiency gains may be small, however. Moreover, the linear probability model allows assessing the contribution of an interaction term in the most straightforward manner; see also Ai and Norton (2003) for issues related to inference and interpretation of interaction terms in non-linear models.

[14] The probability of a short position increase in the 0.4 bin is 0.55 percentage points (pps) lower than in the 0.3 bin (probability: 2.04 pps), and 1.63 pps lower than in the ≥ 0.5 bin (probability: 2.04 + 1.08 = 3.12 pps), which reflects reductions in likelihood by 27% and 52%, respectively.

capitalization relates negatively to the probability of an increase. Furthermore, a short seller may be concerned about illiquidity: If stocks are traded less frequently, investors may find it more difficult to cover their position when closing the position or when stocks are recalled. Illiquidity measures, the bid-ask spread, and the Amihud illiquidity ratio, show the expected negative sign, which is statistically significant for the latter. Moreover, a large supply of stocks to borrow, as suggested by the share of institutional owners (D'Avolio, 2002; Asquith et al., 2005; Nagel, 2005), relates positively to short position increases. As described on page 7, the reported net short positions also include equivalent derivative positions, which are accounted for on a delta-adjusted basis. Thus, derivatives constitute a second channel through which regulatory net short positions can be established. It is not observed through which of these channels the position is created. However, if futures or listed options for an underlying stock exist, it is presumably easier to establish and increase a net short position as defined by the regulator. Consistent with this notion, the dummy indicating the existence of futures or listed options yields a positive coefficient.

Turning to investor-specific variables, we find that hedge funds and institutions domiciled in Europe are more likely to increase their positions. Finally, the short interest ratio, serving as a proxy for overall bad news associated with the stock, is positively associated with the likelihood of a short position increase. Notably, the baseline avoidance effect as measured by the coefficient of the *Just below threshold* dummy is of comparable magnitude in both models. That is, after controlling for a plethora of stock- and investor-specific variables, we observe a significantly lower probability of increase just below the publication threshold, which is consistent with the evidence presented in Table 5.

Having established the general determinants of a short position increase, we now examine which factors contribute to the likelihood of crossing the disclosure threshold, estimating the full model specified in Equation (3). Referring to our discussion in Section 2, we hypothesize the following signs of the interaction terms involving the *Just below threshold* indicator. If investors are concerned about rising borrowing costs or recall risk following a

short position disclosure, they should be more inclined to avoid crossing the publication threshold for stocks with low institutional ownership and high illiquidity. If institutional ownership is low, the supply of stocks to borrow is low, which results in higher borrowing fees once possible copycat investors follow. If illiquidity is high, adverse effects from a recall would be more pronounced, due to the higher price impact when buying stocks back from the market. Cultural and institutional reasons for not disclosing a short position may be reflected in the investor type and origin dummies. Specifically, banks might be more concerned about the reputational costs arising from a public short position. Cultural reasons, such as the negative and unpatriotic image associated with shorting (Lamont, 2012), might prevent domestic investors more than foreign investors from publicizing their position. Finally, we include two variables as proxies for operational secrecy: a dummy that indicates whether the investor has other public filings and another dummy that indicates whether the investor has ever had a public short position in the past.

Model 3 in Table 6 reports the results of the full model as shown in Equation (3). For brevity, we focus on the coefficients $\boldsymbol{\beta_3}$, and do not report coefficients of interactions for the other bin indicators.[15] Regarding the stock-specific interactions in Model 3, the coefficients for the liquidity proxies and institutional ownership are insignificant, providing no support for the borrowing cost hypothesis. That is, even though liquidity proxies influence the decision to increase a short position in general, they do not appear to determine the decision to publicize a position. Investors in the bin just below the threshold seem less likely to increase their position if the stock price is volatile, yet this effect is only marginally significant.

Turning to the investor-specific variables, we find no significant effect for the investor type and country dummies, providing no support for the institutional or cultural concerns hypotheses. A caveat comes from the relatively few banks and German investors in the sample, though, so that the power of this test is relatively low. An important investor-

[15] In the Internet Appendix, we show the full list of estimated coefficients for this table.

specific determinant of the publication decision is whether the investor has a public record somewhere else. This effect is statistically and economically significant, being associated with a reduction in probability of 1.61 percentage points. If an investor is generally very secretive about its long positions, it is very unlikely that it crosses the publication threshold for short positions. Moreover, the likelihood of a publication is substantially reduced by 0.91 percentage points for investors that never had a public short position disclosure in their past. The effects of both secrecy proxies are substantial, given that the unconditional probability of increasing a position is about 2%.

Overall, the results suggest that investor-specific characteristics determine the probability to publicize a short position rather than stock-specific characteristics. In particular, the decision to cross the disclosure threshold appears to be persistent, with investors sticking to their secretive behavior over time. This finding suggests that some investors adopt a general policy not to disclose their positions, irrespective of whether the positions are on the long or short side of the portfolio. A general policy not to disclose short positions may be motivated by concerns about negative spillovers on the ability to access corporate management.

5.2 Are secretive investors better informed?

The results so far show that the choice to disclose or not to disclose short positions is persistent, with investors sticking to their decision. Secretive investors may be concerned about protecting private information or their proprietary investment strategies. In the following, we explore the private information hypothesis by comparing the ex-post shorting performance of secretive investors with that of non-secretive investors. If non-disclosure is generally associated with superior information, we expect that, on average, secretive investors perform better than non-secretive investors when short selling.

To better understand which of the investors can be denoted as secretive, we first categorize the investors into groups according to their maximum position bin they have

reached throughout our sample period. For example, we define an investor to have reached the maximum bin of 0.3 if it has had at least one short position in the 0.3 reporting bin but no position above 0.3. We plot the distribution of investors according to their maximum bin reached in Figure 2.[16] As expected, the distribution is skewed similar to the distribution of position-day observations in Figure 1. The accumulation of investors just below the disclosure threshold is even more pronounced when looking at this figure. Namely, 16.1% of all short sellers have the 0.4 bin as their largest bin reached in our sample. This fraction is the second largest across all reporting bins even larger than the 14.6% of investors who have the 0.3 bin as their maximum, and 5.4% with a maximum bin of 0.5. This finding in combination with the results from the previous subsection suggests that the avoidance effect stems from the investor level and that the decision to stay under the radar is mainly driven by investor's general choice to act secretive.

To test whether secretive investors outperform non-secretive investors we split the sample of investors relying on the distribution in Figure 2. Namely, we define all investors with a maximum position bin of 0.4 as secretive. This definition is relatively broad and includes avoidant investors but also investors for which the maximum bin of 0.4 is optimal irrespective of the disclosure threshold. Importantly, such dilution of the group of secretive investors works against finding a significant performance differential of this investor group relative to non-secretive investors. Then, we define non-secretive investors as all investors with a *public* maximum reporting bin. In the second step, we compare the two investor groups' performance in short positions that were never public. That is, we only look at the performance of short positions with a maximum bin value of up to 0.4. This procedure ensures that we compare short positions of a similar magnitude, since secretive investors, as defined above, do not have any public positions. To compare their performance, we form for each investor group an equal-weighted portfolio of stocks originating from the

[16] In the figure, the height of bin k is equal to $1/I \sum_{i=1}^{I} \mathbb{1}\left(\max_{j=1,2,\ldots,S_i} \max_{t=1,2,\ldots,T_{i,j}} bin_{i,j,t} = k\right)$, for $k = 0.2, 0, 3, \ldots, 1.5$, where I is the total number of investors, S_i is the total number of stocks in which investor i holds short positions, and $T_{i,j}$ is the total number of trading days of investor-stock pair (i, j).

two groups. A stock is included in the portfolio if the respective investor established a short position greater than 0.20% the day before, and the stock is excluded from the portfolio if the investor's position fell below 0.20% the day before. This conservative timing convention assumes that investors trade at the end of each day. Finally, to estimate abnormal returns of the two portfolios we measure the performance by running time-series regressions of the portfolio returns on different risk factors. We employ the Capital Asset Pricing Model (CAPM) by Sharpe (1964) and Lintner (1965), the Fama and French (1993, 1996) three-factor model, and the Carhart (1997) four-factor model. To estimate standard errors, we follow Newey and West (1987), with the lag length selected according to the optimal lag-selection algorithm proposed by Newey and West (1994). If secretive investors are better informed than non-secretive investors, we expect the portfolio of stocks shorted by secretive investors to yield a more negative average return than the portfolio of non-secretive investors.

The results of the performance comparison are shown in Table 7. As can be seen from Panel A, confidential short positions of secretive investors have a negative alpha of -5.50 to -4.72 bps per day, which is statistically significant across all three-factor models. In contrast, short positions of non-secretive investors have a negative alpha of only -1.63 to -1.16 per day, which is not significantly different from zero at any conventional level. Accordingly, secretive investors on average outperform their peers by around 3.08 to 3.88 bps per day for all positions below the publication threshold. This difference in mean returns is robust across all factor models and statistically significant at the 5% level. In Panel B, we exclude all short positions with a maximum reporting bin of 0.4 for both investor groups. This exclusion ensures that the observed return difference is not driven by any confounding effect coming from the avoidance of secretive investors just below the threshold. As evident from Panel B, a similar pattern emerges for the positions with a maximum bin of 0.2 and 0.3. Stocks shorted by secretive investors have a negative alpha between -5.26 to -4.37 bps per day, whereas those of non-secretive investors have an alpha

of essentially zero. Across all three-factor models, stocks shorted by secretive investors significantly underperform those of non-secretive investors by an economically sizable range between 3.90 and 5.07 bps.

Results from Table 7 suggest that secretive investors have an informational advantage over non-secretive investors. This finding is consistent with the idea that private information or proprietary trading strategies play an important role in the decision not to disclose short positions. Next, we strive for a better understanding of the performance of secretive short sellers and study *how* they obtain this advantage. If the performance of secretive investors is a result of superior information about future changes of companies' fundamentals, we expect that (1) they short stocks with future negative changes in fundamentals and (2) their performance is largely explained by days when news about fundamentals are released and investors incorporate these news to attenuate possible overpricing (Engelberg, Reed and Ringgenberg, 2012; Engelberg, McLean and Pontiff, 2016). To test these conjectures in one framework, we study the predictive power of secretive investors for stock returns on days where firm-specific information is released: earnings announcements and ad-hoc corporate disclosures.[17] These events serve as an ideal setting given that those two types of disclosure, by their definition, convey important information about changes in fundamentals. In the Internet Appendix, we provide strong evidence that secretive investors take short positions in stocks that will experience negative earnings announcements and corporate news. In particular, stocks shorted by secretive investors experience on average a stock price decline of 30 bps on days with earnings announcements and 150 bps on days with ad-hoc corporate news releases. Although those days represent only 2% of trading days in a year, secretive short sellers generate around 44% of their performance on those events. Moreover, the average negative return of stocks shorted by these investors is 55 (13) times larger in absolute terms on corporate news (earnings announcement) days than on non-event days. Including an additional day after the announcement to our event window yields similar

[17]The ad-hoc corporate disclosure regulation in Germany is closely related to the U.S. Form 8-K reporting requirement. More detailed information about these filings is offered in the Internet Appendix.

results. Altogether, evidence on the trading behavior of secretive short sellers below the publication threshold suggests that their concealment of positions is associated with superior information about stock fundamentals.

6 Implications for stock prices

In this section, we analyze the consequences of investors' avoidant behavior on price efficiency. So far, we observe that the publication requirement for short positions represents an impediment to some investors to increase their position and evidence suggests that these secretive investors are informed. Following the literature on limits to arbitrage, impediments faced by informed investors may be reflected in a slower adjustment of prices to (private) information and in return predictability due to temporary deviation of prices from fundamental values (Shleifer and Vishny, 1997; Gromb and Vayanos, 2010).[18] In particular, in the rational expectations model of Diamond and Verrecchia (1987), in which investors are defined as informed and uninformed traders, and as traders with prohibited short selling and unconstrained traders, prices converge more slowly and the speed of adjustment to (private) information decreases as the fraction of prohibited short sellers increases.[19] Also, Jones et al. (2016) argue in the framework of DeMarzo et al. (1998) that trading impediments to informed investors in form of a disclosure threshold reduces price informativeness.[20]

[18] In general, short-selling risk, such as restrictions or costs related to establishing a short position, represent one prominent group of these frictions to eliminate mispricing. Theoretical studies include, e.g., Miller (1977), Harrison and Kreps (1978), Diamond and Verrecchia (1987), Duffie, Garleanu and Pedersen (2002), Hong and Stein (2003), and Hong, Scheinkman and Xiong (2006). However, the vast majority of empirical studies use market-wide short-selling restrictions, such as short-selling bans, or stock-specific characteristics to test for a slower price discovery process and return predictability.

[19] Also, Diamond and Verrecchia (1987) argue that in a more general model, in which there are no liquidity short sales or in which there are somewhat informed traders in addition to informed and uninformed traders, short-selling *costs* have a similar effect on price efficiency as short-sale prohibitions.

[20] DeMarzo et al. (1998) originally focus on the regulators' optimal policy in insider trading investigation. They argue that the investors' welfare maximizing outcome entails investigations following large insider trading volumes, whereas small trades remain unpunished. As a consequence, such policy discourages insiders to trades above a certain threshold. Although the authors employ corporate insiders as the agents of main interest, their arguments and implications apply to any group of informed investors.

If the publication threshold represents a restriction on short selling for informed investors, we argue that the price discovery process is slower when these secretive investors are just below the threshold. As a consequence, we expect that these stocks are temporary mispriced and that return predictability is particularly pronounced when investors face this friction.

We rely on the following empirical approach to identify periods for which the disclosure threshold may impede secretive investors to further increase their positions:

$$\begin{matrix} \textit{Secretive position} \\ \textit{just below threshold}_{i,j,t} \end{matrix} = \begin{cases} 1 & \text{if } \left(\max_{s=1,2,\ldots,T_{i,j}} bin_{i,j,s} = 0.4\right) \cap \left(bin_{i,j,t} = 0.4\right) \\ 0 & \text{otherwise,} \end{cases} \tag{4}$$

where $T_{i,j}$ is the total number of trading days of investor-stock pair (i, j). First, secretive investors do not cross the publication threshold, so the maximum bin reached is the 0.4 bin. Thus, for each investor-stock pair, we determine (ex-post) the maximum reporting interval reached during the sample period. Second, the friction is only binding when the position is in the maximum bin of 0.4, just below the threshold. In other words, we flag the investor-stock pair if it has a maximum reporting bin of 0.4 *and* this maximum has been reached. Note that the measure is diluted by noise, because Equation (4) defines only the necessary, but not the sufficient conditions for the friction to be binding.[21] During these position days, we expect price adjustments to negative information to be slower resulting in temporary overpricing and predictable negative abnormal returns.

6.1 Calendar-time portfolio approach

To test the hypothesis of return predictability, we employ a calendar-time portfolio approach. In a first step, we form, on a daily basis, an equal-weighted portfolio of stocks for which

[21] Not crossing the disclosure threshold does not necessarily imply that the investor is avoidant. Naturally, there are some investors with positions for which the maximum bin of 0.4 is optimal. These positions are included in our measure, even though these investors are not affected by the threshold. Importantly, though, this effect works against finding lower speed of price adjustment and predictability in stock returns.

we observe at least one secretive investor who is just below the publication threshold on the *previous* day.[22] In a second step, we measure the average risk-adjusted return of the portfolio by running time-series regressions of the returns using the risk factor models introduced in Section 5.2. If the publication threshold represents a friction to secretive investors, we expect that those particular stocks have future negative abnormal returns as a result of a slower price adjustment to (private) information.

Column 3, Panel A of Table 8 shows the average risk-adjusted returns of the portfolio across the three-factor models. Stocks with secretive positions just below the publication threshold exhibit predictability of strong, statistically significant negative returns. The return predictability is robust across the CAPM, three-factor model, and four-factor model, with daily alpha values ranging between -4.82 and -5.42 bps, which translates into a return of around -1% per month.[23]

Economically, the predictability effect inflicted by the publication threshold is substantial, especially considering that these short position notifications almost exclusively take place in highly liquid, large-cap stocks (see Table 1 and Section 3). Recall that the measure for identifying restricted investors is diluted considerably by noise. Thus, the estimated return effect of around 5 bps per day likely represents a lower bound.

6.2 Placebo tests

Our finding of abnormal negative returns when short sellers hold positions just below the disclosure threshold is consistent with the notion of slower price discovery and return predictability due to short-sale impediments originating from the publication avoidance of investors. However, to show that the effect is unique to the disclosure threshold and to rule out other potential explanations we employ several placebo tests.

[22] For the majority of these stocks (82%) there is only one secretive investor. In 14% there are two, in the remaining 4%, three to a maximum of six secretive investors. The portfolio contains 32 stocks on average, with a median of 31, a minimum of 21, and a maximum of 49 stocks.

[23] In our data, the median time period for which a position is restricted is 16 days, the mean duration is 41 days. To reflect this fact and to make our results comparable with other studies, we express the abnormal return on a monthly basis.

First, we conduct an analysis similar to the one in Section 6.1 and form calender time portfolios. However, now we choose hypothetical publication thresholds below and above the true one:

$$\text{Placebo}^{A}_{i,j,t} = \begin{cases} 1 & \text{if } \left(\max_{s=1,2,\ldots,T_{i,j}} bin_{i,j,s} = p\right) \cap \left(bin_{i,j,t} = p\right) \\ 0 & \text{otherwise.} \end{cases} \tag{5}$$

where $p = 0.2,\ 0.3,\ 0.5,\ 0.6$. Specifically, we look at positions when they reach their maximum, but with a maximum other than 0.4. As before, we include the stock in the placebo portfolio if at least one investor-stock observation fulfills the condition in Equation (5). With this exercise, we want to rule out that the negative return reported in the previous section is a finding present when short positions *generally* reach their maximum. If the publication threshold truly constitutes a trading friction, we should find strongest return predictability for stocks with investors present in their 0.4 maximum interval, but not for the other intervals.

Columns 1, 2, 4 and 5 in Panel A of Table 8 report the risk-adjusted average returns for the other maximum reporting bins, using the same factor models as in the previous analysis. Consistent with our hypothesis that binding short-sale impediments are imposed by the publication threshold, we find that stocks with investors in a maximum reporting bin other than 0.4 are not associated with significant negative future returns. Even the average return for the closest non-public maximum reporting bin, 0.3, is not significantly negative, and its economic magnitude is only one-fourth of the return associated with the 0.4 bin. These results suggest that the return effect is unique to stocks with investors that hold a position just below the disclosure threshold and cannot be generalized to other positions.

Another potential concern is that the result in Column 3 of Panel A is entirely driven by informed trading in secretive positions rather than informed investors being constrained by the threshold. To extract this additional effect arising from the disclosure threshold

we compare the return of the same (secretive) investor-stock pair when the disclosure threshold is binding and non-binding. That is, we look at positions with a maximum bin of 0.4 but during periods below the maximum:

$$\text{Placebo}^{B}_{i,j,t} = \begin{cases} 1 & \text{if } \left(\max_{s=1,2,\ldots,T_{i,j}} bin_{i,j,s} = 0.4\right) \cap \left(bin_{i,j,t} < 0.4\right) \\ 0 & \text{otherwise.} \end{cases} \tag{6}$$

If the return just below the disclosure threshold is solely driven by informed trading, we expect a return of similar magnitude inside and outside the maximum bin phase. As before, we include the stock in the placebo portfolio if at least one investor-stock observation fulfills the condition in Equation (6).

The average risk-adjusted return of this portfolio is reported in the shaded column in Panel B of Table 8. Outside the maximum bin phase, the average alpha is negative but not statistically different from zero. Moreover, in Panel C, we compute the difference between the return generated inside (Panel A) and outside (Panel B) the maximum bin. The return during the time just below the publication threshold is significantly lower relative to the time when the investor is not restricted by the publication threshold. These results suggest that the stock return predictability arising when a secretive investor is just below the publication threshold cannot be entirely explained by informed trading in this particular stock. The findings hold across all factor models and are in line with the hypothesis of a slower price discovery process due to avoidance of crossing the publication threshold.

What is the pattern within investor-stock pairs with other maxima? Is the predictability generally stronger inside the maximum bin phase relative to the phase outside the maximum? Interestingly, *none* of the other maximum reporting bins show a pattern similar to the interval just below the disclosure threshold. Namely, only for positions with a maximum of 0.4 we observe that the return in the maximum bin is negative *and* significantly lower than the return of the same positions below the maximum bin. For all

other bins, the average return below the maximum bin is even more negative than the return in the maximum bin.

Overall, we document negative risk-adjusted returns for secretive positions when the investor is just below the disclosure threshold. The negative return predictability is not present when we choose various hypothetical publication thresholds below and above the true one. Moreover, within investor-stock pairs, subsequent negative returns only occur when the position is just below the publication threshold and the constraint originating from it is binding. Altogether, these results suggest slower price discovery due to the evasive behavior of secretive investors just below the disclosure threshold.

6.3 Regression approach

In this section, we employ Fama and MacBeth (1973) cross-sectional predictive regressions to test whether the avoidance of short sellers to cross the publication threshold results in future negative abnormal returns. The regression approach allows us to control for additional variables that might capture a possibly confounding effect between the avoidance below the publication threshold and future returns. In particular, for each trading day, we perform a cross-sectional regression of the next day's return on the existence of a secretive investor being constrained by the publication threshold and various control variables related to the cross section of returns.

To isolate the effect of the publication rule on return predictability from the effect of general short selling, we control for the short interest ratio of the stock (e.g., Senchack and Starks, 1993; Desai, Ramesh, Thiagarajan and Balachandran, 2002; Asquith et al., 2005). Furthermore, we control for institutional ownership of the stock, which serves as a proxy for the supply of shares to borrow (D'Avolio, 2002; Asquith et al., 2005; Nagel, 2005). To account for systematic risk and the well-known size, value, short-term reversal, and momentum effects in returns (Banz, 1981; DeBondt and Thaler, 1985; Jegadeesh, 1990; Lehmann, 1990; Jegadeesh and Titman, 1993), we include the stocks' beta, log market

capitalization, log book-to-market ratio, and past return over different horizons as control variables. Lastly, we also include the Amihud (2002) illiquidity proxy, the bid-ask spread, and return volatility.

Table 9 displays the average coefficient estimates and t-statistics, following the procedure of Fama and MacBeth (1973). As evident from Column (1), stocks for which we observe that a secretive investor is just below the publication threshold yield negative future returns of -7.37 bps per day. This result is even more pronounced than the one from the calendar time portfolio approach (around 5 bps per day).[24]

The results in Section 5 suggest that avoidance to cross the publication threshold is particularly strong for investors who are generally perceived as secretive in the past. Moreover, we also find in Section 5.2 that especially secretive investors short stocks with significant abnormal negative returns. Therefore, to account for informed trading of secretive investors, we control for the presence of these investors in a particular stock in the specifications of Column (2) and (3). Consistent with our conjecture that secretive investors are informed traders, stocks shorted by an investor with generally no public filings are associated with lower future returns. Similar findings, though economically and statistically weaker, emerge when using investors with no public short positions in the past as proxy. Most importantly for our analysis, we find that the two proxies do not explain the return predictability resulting from the avoidance to cross the publication threshold.

Lastly, to ensure that the predictability in the bin just below the publication threshold is not entirely driven by the eventually superior performance of secretive positions, we control for the presence of a secretive position in a particular stock. We flag all position days to be one if there is at least one short position in this stock that has a maximum reporting bin of 0.4. This test is very close to the placebo portfolio test in Panel B and C

[24]The control variables exhibit the expected signs. The book-to-market coefficient is positive, whereas market capitalization is not a significant predictor of future stock returns in the recent period. At a daily frequency, short-term reversal effects are strong and the momentum effect (return from t-20 to t-249) is positive but insignificant. Also, using the bid-ask spread, we find a positive risk premium for illiquidity. Beta, short interest ratio, institutional ownership, and volatility are insignificant in our sample.

of Table 8. Namely, by controlling for the general return of secretive positions, we now seek to identify the additional return effect when a secretive position faces binding frictions just below the disclosure threshold. In line with our expectations, we find in Column (5) that the presence of a secretive position negatively though insignificantly predicts returns. Most importantly, our variable of main interest, the presence of a secretive investor *just below the threshold*, slightly decreases in its magnitude relative to the benchmark model in Column (1), but remains economically and statistically significant.

The results from Table 9 provide evidence that the additional control variables do not explain the negative returns of stocks in the presence of secretive investors just below the publication threshold. In particular, the effect of avoidance to publish short positions on stock prices is present even after controlling for a number of stock-specific (e.g., different risk factors) and investor-related (e.g., informed trading) variables.

7 Robustness Tests

In this section, we briefly summarize various robustness checks to our analysis. For a detailed description of all additional tests and their results, we refer the reader to the Internet Appendix.

First, we provide a more detailed description of the distributional pattern of reported short positions *including* the second digit after the decimal point. We offer an intuition as to why we collect the positions into one digit reporting bins. Second, we conduct different sensitivity analyses related to the existence of investors' avoidance to cross the disclosure threshold. In Section 4 we document that avoidance is particularly pronounced when investors approach the publication threshold from below *and* for the first time. Specifically, we rely on a sample split of positions at their record high vs. positions below their record high. In the Internet Appendix, we show that an alternative sample split, in which positions are simply divided into previously increased and previously decreased,

yields comparable results. This measure is much simpler but noisier given that it solely relies on investors last change of the position instead of the entire position history.

Additionally, we explore two alternative hypotheses related to our avoidance finding. First, we investigate whether our documented effect comes from investors being hesitant and eventually cross the threshold with a delay ("hesitance") rather than an "absolute avoidance". Second, we examine whether investors immediately jump to very high positions after crossing the disclosure threshold. The results of our analyses support neither the "hesitance hypothesis" nor the "large jump hypothesis".

When studying determinants of both position increase and of avoidance in Section 5, we choose a linear probability model because of simplicity. In additional analyses, we show that the marginal effects of logit or probit models are very similar to those of the linear model. Moreover, we provide evidence that secretive investors predict negative news in company fundamentals and that their performance is largely generated on news days.

We also conduct a series of sensitivity analyses related to the return predictability from Section 6. We apply several modifications to our calendar-time portfolio approach. The effect is comparable when excluding penny stocks, requiring at least five trading days in the 0.4 bin, weighting the stocks by the number of possibly avoidant short sellers, and also when using European instead of German factor portfolios.

8 Conclusion

Using both public and confidential short-sale notifications, we study the effect of a disclosure threshold for short positions on investors' behavior and security prices. We document that a considerable fraction of short sellers are avoidant to cross the disclosure threshold, effectively representing a short-sale impediment for these investors. When the short-sale impediment imposed by the disclosure threshold is potentially binding, stocks subsequently exhibit a negative abnormal return, consistent with the notion of slower adjustment of prices to (private) information. These findings suggest that short sellers' evasive behavior in

response to the transparency regulation imposes a negative externality on the informational efficiency of stock prices.

The documented effect originates from investors' avoidance to cross the publication threshold. Additionally, in the spirit of Grossman and Stiglitz (1980), the short-sale disclosure rule may also diminish the incentive to collect and process information in the first place. As a consequence, the overall shorting activity may decrease, presumably resulting in an even greater reduction of stock price efficiency.

Our insights contribute to the ongoing policy debate on the requirement and design of short-sale disclosure rules. The EU short-sale transparency regulation is characterized by a public disclosure threshold of 0.5% of the stocks' market capitalization and a very timely publication delay period of one day. Regulators are also discussing different reporting regimes, with alternative thresholds, longer delay periods, or different regimes altogether. The strong evidence of investors' avoidance to reveal their short positions is of great importance for defining future transparency requirements. Thus, our findings advocate a better understanding of the incentives and consequences of disclosure requirements, both in theoretical and empirical work. To what degree modified disclosure rules help to attenuate the information-revealing effects of disclosure remains an open question for future research.

Appendix: Sample construction

We obtain public and confidential short-sale notifications from the German Federal Financial Supervisory Authority (BaFin). BaFin's notification data include the position holder's name, address, and country, the name and ISIN code of the stock shorted, the net short position in a number of equivalent shares and as a percentage of share issued capital, and the position and reporting date. To construct a panel of investors' short positions in different stocks we first account for the ISIN changes of the stocks. Next, we convert the original short-sale notifications into reporting intervals of 10 basis points by rounding down to the first decimal place, as we described in Section 2.1. We delete duplicate notifications (same information in all variables). For a few days, we find multiple short-sale positions for the same investor-stock pair. For these days, we keep the most recent one (identified by the reporting date), which is likely to represent corrections of the previous values. We omit some stale positions, which seem to occur disproportionately in the first days after the regulation was put in place. We define a stale position as a position which has been reported only once, has never changed, and is still open after 600 days.[25] From the notifications, we construct a large daily panel of investors' short positions in different stocks. Finally, we identify trading days from the official trading calendar of Frankfurt Stock Exchange.

We merge the BaFin panel of short positions with stock-level data (static characteristics and time-series data, such as price, return, and market value data) from *Thomson Reuters Datastream* using current ISIN codes. We only consider domestic common equity in the regulated market. Thus, we keep stocks categorized by *Datastream* as domiciled in Germany (variable GEOG = 30), equity (variable TYPE = EQ) and major issuance (variable MAJOR = Y). Moreover, we exclude preferred stocks, depositary receipts, real estate investment trusts, and stocks with other special features by screening the stocks' names. We filter out all stock day observations of delisted stocks, which are not trading

[25] Other cut-off points, such as 500 or 250 days, lead to similar results.

any more (variable $P\#T$ = missing value). We only keep shares admitted to trading on the German regulated market, using the information provided by the MiFID database of ESMA.[26]

Noting Ince and Porter's (2006) concerns about return data from *Datastream*, we apply the following filters for daily return data, as proposed by Karolyi et al. (2012) and Griffin et al. (2010): The return ($r_t = (RI_t/RI_{t-1}) - 1$, where RI is the dollar return index) is set to missing if the current or lagged total return index (RI) is below 0.01. If r_t or $r_{t-1} > 100\%$ and $(1 + r_{t-1})(1 + r_t) - 1 < 20\%$, then both r_t and r_{t-1} are set to missing. Moreover, any return greater than 200% is set to missing.

To gather additional information on the position holders, we manually research the corresponding unique investor identification number from *FactSet*, using the position holder's name, address, and country information from the BaFin notification data. For the identified investors, we then obtain investor characteristics such as the investor type.

We obtain the risk-free rate (RF), the market excess return (MKTRF), and the returns on the factor portfolios small-minus-big (SMB), high-minus-low (HML), and winner-minus-loser (WML) for the German stock market from Andrea Frazzini's data library, provided through AQR's website.[27]

The detailed computation and data sources of all variables used in the analysis are in Table A.1.

[26] http://mifiddatabase.esma.europa.eu/Index.aspx?sectionlinks_id=14&language=0&pageName=MiFIDLiquidSearch

[27] See: www.aqr.com/library/data-sets/quality-minus-junk-factors-daily/data

Table A.1:
Definitions of variables

Variable:	Description:	Source:
Market capitalization	Market capitalization (in USD million) provided by the Datastream variable MV.	Datastream
Book-to-market ratio	Calculated as $PTBV^{-1}$, where PTBV is the price-to-book value provided by Datastream. The book-to-market ratio is set to missing if it is below 0.	Datastream
Bid-ask spread	$(PA - PB)/P$, expressed in percentage terms, where P is the stock's price, PA is the ask price, and PB is the bid price, all provided by Datastream. We winsorize the bid-ask spread at 1% at the upper tail and then average it over the last 60 trading days, requiring at least 10 valid observations.	Datastream
Amihud illiquidity	$\|r_t\|/(VO \times P) \times 10^6$, where r_t is the return, VO is the number of shares traded (in thousands), and P is the price (Amihud, 2002). We winsorize the Amihud illiquidity ratio at 1% at the upper tail and then average it over the last 60 trading days, requiring at least 10 valid observations.	Datastream
Return volatility	Standard deviation of return r_t computed over the last 60 trading days, requiring at least 10 valid observations.	Datastream
Institutional ownership	Percentage share of institutional investors from the previous quarter provided by Factset (Variable: OS_SEC_PCT_HLD_INST).	Factset
Futures or listed options	Dummy variable that equals 1 if futures or listed options exist for the underlying stock.	Datastream
Hedge fund	Dummy variable that equals 1 if investor is defined by Factset as a hedge fund.	BaFin, Factset
Bank	Dummy variable that equals 1 if investor is a bank.	Own research
European holder	Dummy variable which equals one if investor is domiciled in an European country.	BaFin
German holder	Dummy variable that equals 1 if investor is domiciled in Germany.	BaFin

Continued on next page

Table A.1 – *Continued from previous page*

Variable:	**Description:**	**Source:**
No public filings	Dummy variable that equals 1 if investor is not included in the Factset Ownership database. The ownership information of Factset originates from public filings, so a non-appearance is indicative of no public record.	BaFin, Factset
No previous short position disclosure	Dummy variable that equals 1 if an investor has never had a public short position in the past.	BaFin
Short interest ratio	We aggregate the short positions of all investors for each stock per day relative to the stock's shares outstanding to obtain a proxy for the short interest ratio.	BaFin
Disclosure by others	Dummy variable that equals 1 if at least one other investor has a public short position disclosure.	BaFin
Market beta	Slope coefficient of the time series regression of the stock's return the market excess return (MKTRF), with a rolling window of 300 trading days.	Datastream, Frazzini
Secretive position just below threshold	Dummy variable that equals 1 if the position's maximum bin is 0.4 *and* the investor is at the maximum	BaFin
Secretive position	Dummy variable that equals 1 if the position's maximum bin is 0.4	BaFin

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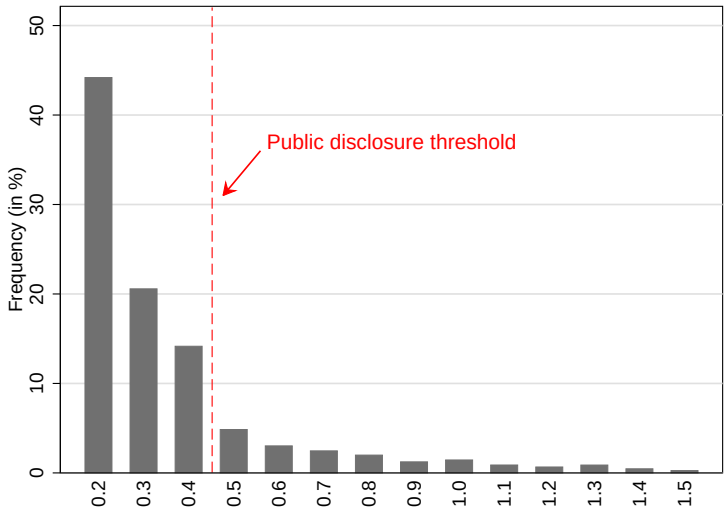
(a) Overall sample



(b) Sample split

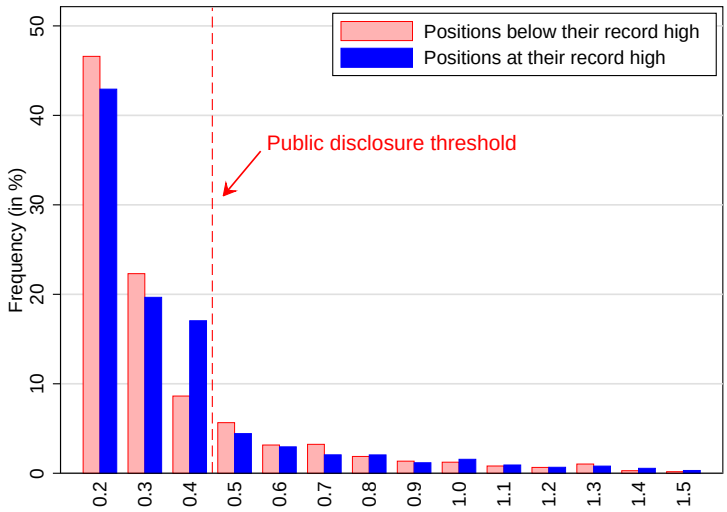


Figure 1:
Distribution of open short positions

This figure displays the distribution of days with open short positions across reporting intervals. Reporting intervals are in 10 bps steps, starting from 0.2%. Positions above 0.2% but below 0.5% are reported to the regulator but not disclosed to the public; positions of 0.5% and higher are disclosed to the public. Figure 1(a) shows the relative frequency of days with an open position for each interval for the overall sample. Figure 1(b) reports the relative frequency separately for short positions at their record high and for positions below their record high. Reporting intervals greater than 1.5% are truncated for readability. The sample contains all German domestic equity in the regulated market from November 5, 2012, to March 31, 2015.

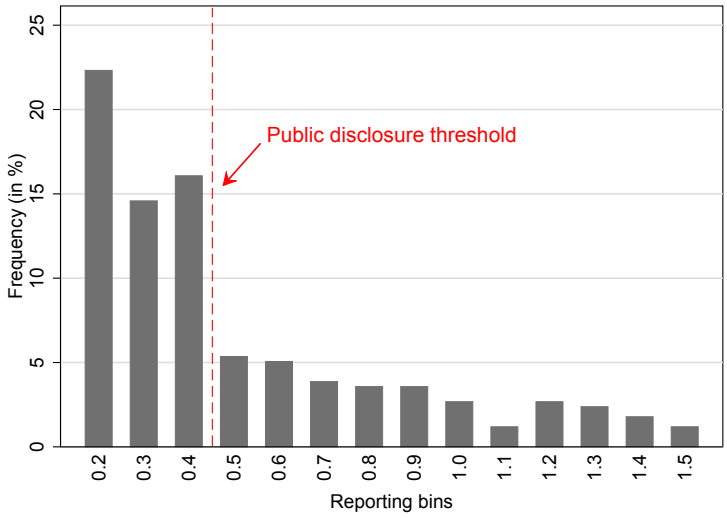


Figure 2:
Distribution of short sellers according to their maximum bin reached

This figure displays the distribution of short sellers according to their maximum bin reached. For example, the bar just below the disclosure threshold indicates that 16.1% of all short sellers had at least one position in the 0.4 reporting bin but no positions higher than the 0.4 reporting bin. For comparison, 14.6% of investors' short positions had 0.3 bin position but did not exceed the 0.3 bin, and 5.4% had at least one 0.5 bin position but did not exceed the 0.5 bin. Reporting intervals are in 10 bps steps, starting from 0.2%. Positions above 0.2% but below 0.5% are reported to the regulator but not disclosed to the public; positions of 0.5% and higher are disclosed to the public. Reporting intervals greater than 1.5% are truncated for readability. The sample contains all investors with short position notifications in German domestic equity in the regulated market from November 5, 2012, to March 31, 2015.

Table 1:
Summary statistics:
Stocks with short position notifications/disclosures vs. all stocks

This table shows summary statistics for the various stock characteristics of stocks with at least one short position notification and for all stocks in the regulated market. Short positions must be reported to the regulator if the position is greater than or equal to 0.2% of the issued share capital of the company shorted and publicly disclosed if the position is greater than or equal to 0.5%. Column (1) contains the summary statistics for the entire population of stocks in the German regulated market, Column (2) reports stocks that have at least one public or confidential short postilion notification, Column (3) includes stocks with at least one public short position, and Column (4) refers to stocks with at least one confidential short position notification. The table reports time-series averages of cross-sectional medians. The sample consists of common equity in the German regulated stock market from November 5, 2012, until March 31, 2015. For details on the calculation of the stock characteristics, see Table A.1.

	(1)	(2)	(3)	(4)
	All stocks	Stocks with short position notifications/disclosures		
		All	Public	Confidential
Share of stocks		19.9%	8.3%	11.6%
Median values:				
Market capitalization (in USD million)	102.1	2225.3	1986.6	2401.2
Book-to-market ratio	0.65	0.53	0.55	0.52
Institutional ownership (in %)	3.9	29.2	29.8	29.0
Relative bid-ask spread (in %)	3.11	0.65	0.66	0.63
Amihud illiquidity ($\times 10^6$)	2082.7	223.3	223.9	229.4
Return volatility (in %)	2.28	1.81	2.00	1.71

Table 2:
Summary statistics

This table contains summary statistics for the investor-stock panel with open short position notifications above 0.2% of the issued share capital. The summary statistics include the number of observations (N), mean, standard deviation (SD), and the 10th, 25th, 50th, 75th and 90th percentiles. The sample consists of common equity in the German regulated stock market from November 5, 2012, until March 31, 2015. For details on the calculation of the variables, see Table A.1.

				Percentiles:				
Variable	N	Mean	SD	10th	25th	50th	75th	90th
ln(Return volatility)	278,648	0.70	0.38	0.25	0.44	0.68	0.92	1.16
ln(Market capitalization)	278,649	7.63	1.41	5.78	6.74	7.66	8.58	9.26
ln(Amihud illiquidity)	278,624	5.08	1.31	3.23	4.29	5.19	5.94	6.66
ln(Bid-ask spread)	278,648	-0.43	0.53	-1.05	-0.86	-0.40	-0.08	0.21
Institutional ownership	278,475	34.37	17.50	13.08	21.93	31.50	45.81	61.21
Futures or listed options	278,649	0.38						
Hedge fund	278,649	0.66						
Bank	278,649	0.02						
European holder	278,649	0.47						
German holder	278,649	0.02						
No public filings	278,649	0.10						
No previous short position disclosure	278,649	0.23						
Short interest ratio	278,649	4.07	3.70	0.57	1.37	2.90	5.75	9.41
Disclosure by others	278,649	0.61						

Table 3:
Probability of a short position increase

This table shows the estimated probability of increasing a short position, conditional on currently having a position in a specific reporting bin. Short positions are reported in bins of 10 bps, starting from 0.2% of issued share capital of the company shorted. Positions above 0.2% but below 0.5% are reported to the regulator but not disclosed to the public; positions of 0.5% and higher are disclosed to the public. The 0.2 bin denotes the bin ranging from 0.20% to 0.29%, the 0.3 bin from 0.30% to 0.39%, the 0.4 bin from 0.40% to 0.49%, and so forth. Reporting bins greater than or equal to 1.0% are summarized in one group. The table reports the probability of increasing a short position (i.e., changing to a higher reporting bin), given that an investor currently has a position in a specific bin. In addition, it displays the difference in probability of row (3) relative to row (j), the 0.4 reporting bin just below the publication threshold (shaded in gray), and the *p*-value for the differences in means. The table displays probabilities for the overall sample and for two subsamples, in which we split the sample into short positions at their record high and into positions below their record high. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

				Overall			Positions at their record high			Positions below their record high		
			Bin	Probability of increase	Difference row (3) - (j)	*p*-value	Probability of increase	Difference row (3) - (j)	*p*-value	Probability of increase	Difference row (3) - (j)	*p*-value
undis-	closed	(1)	0.2	0.364	−0.010	(0.469)	0.347	−0.010	(0.581)	0.380	−0.001	(0.947)
		(2)	0.3	0.391	−0.037**	(0.014)	0.423	−0.085***	(0.000)	0.360	0.018	(0.416)
		(3)	0.4	0.354			0.338			0.379		
	disclosed	(4)	0.5	0.408	−0.054***	(0.007)	0.514	−0.176***	(0.000)	0.302	0.076***	(0.009)
		(5)	0.6	0.476	−0.122***	(0.000)	0.562	−0.225***	(0.000)	0.395	−0.017	(0.624)
		(6)	0.7	0.440	−0.086***	(0.001)	0.604	−0.266***	(0.000)	0.308	0.071**	(0.048)
		(7)	0.8	0.449	−0.095***	(0.001)	0.648	−0.310***	(0.000)	0.266	0.113***	(0.006)
		(8)	0.9	0.477	−0.123***	(0.000)	0.702	−0.364***	(0.000)	0.279	0.100**	(0.032)
		(9)	≥1.0	0.474	−0.120***	(0.000)	0.682	−0.345***	(0.000)	0.275	0.103***	(0.000)

Table 4:
Duration in reporting bins

This table shows the average duration spent in each reporting bin. Short positions are reported in bins of 10 bps, starting from 0.2% of issued share capital of the company shorted. Positions above 0.2% but below 0.5% are reported to the regulator but not disclosed to the public; positions of 0.5% and higher are disclosed to the public. The 0.2 bin denotes the bin ranging from 0.20% to 0.29%, the 0.3 bin from 0.30% to 0.39%, the 0.4 bin from 0.40% to 0.49%, and so forth. Reporting bins greater than or equal to 1.0% are summarized in one group. The table reports the mean and median number of trading days spent in each reporting bin (Panels A and B, respectively). In addition, it displays the difference in mean (median) duration of row (3) relative to row (j), the 0.4 reporting bin just below the publication threshold (shaded in gray), and the p-value for differences in means (medians). Each panel displays probabilities for the overall sample and for two subsamples, in which we split the sample into short positions at their record high and into positions below their record high. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Mean duration within reporting bin in trading days

			Overall			Positions at their record high			Positions below their record high		
		Bin	Mean duration	Difference row (3) - (j)	p-value	Mean duration	Difference row (3) - (j)	p-value	Mean duration	Difference row (3) - (j)	p-value
undisclosed	(1)	0.2	18.3	2.2**	(0.019)	22.3	3.6**	(0.012)	14.0	−2.4**	(0.039)
	(2)	0.3	17.0	3.6***	(0.000)	21.3	4.6***	(0.002)	12.6	−1.0	(0.376)
	(3)	0.4	20.6			26.0			11.7		
disclosed	(4)	0.5	14.3	6.2***	(0.000)	16.7	9.3***	(0.000)	11.8	−0.1	(0.919)
	(5)	0.6	13.7	6.8***	(0.000)	17.4	8.5***	(0.001)	9.9	1.8	(0.238)
	(6)	0.7	13.3	7.3***	(0.000)	15.8	10.1***	(0.001)	11.2	0.5	(0.772)
	(7)	0.8	13.6	7.0***	(0.001)	17.2	8.8***	(0.008)	10.0	1.6	(0.379)
	(8)	0.9	11.9	8.7***	(0.000)	14.1	11.8***	(0.002)	9.7	2.0	(0.355)
	(9)	≥1.0	12.6	8.0***	(0.000)	16.6	9.4***	(0.000)	8.6	3.1***	(0.004)

Table 4 – Continued

Panel B: Median duration within reporting bin in trading days

		Bin	Overall			Positions at their record high			Positions below their record high		
			Median duration	Difference row (3) - (j)	p-value	Median duration	Difference row (3) - (j)	p-value	Median duration	Difference row (3) - (j)	p-value
undis-	closed (1)	0.2	6	1***	(0.004)	7	3***	(0.000)	5	0	(0.182)
	closed (2)	0.3	6	1***	(0.003)	8	2***	(0.007)	5	0	(0.824)
	closed (3)	0.4	7			10			5		
	disclosed (4)	0.5	5	2***	(0.000)	7	3***	(0.004)	4	1	(0.364)
	disclosed (5)	0.6	5	2***	(0.000)	6	4***	(0.000)	4	1	(0.331)
	disclosed (6)	0.7	4	3***	(0.000)	4	6***	(0.000)	4	1	(0.278)
	disclosed (7)	0.8	4	3***	(0.000)	5	5***	(0.000)	3	2***	(0.009)
	disclosed (8)	0.9	4	3***	(0.000)	5	5***	(0.000)	3	2*	(0.053)
	disclosed (9)	≥1.0	4	3***	(0.000)	5	5***	(0.000)	3	2***	(0.000)

Table 5:
Probability of increase: Regression approach with fixed effects

This table shows estimates from the linear probability model

$$y_{i,j,t} = \beta_0 + \beta_1 \; \textit{Just below threshold}_{i,j,t} + \sum_k \beta_k \; k \; bin_{i,j,t} + u_{i,j,t},$$

with $y_{i,j,t} = \mathbb{1}\left(bin_{i,j,t} > bin_{i,j,t-1}\right)$, and $u_{i,j,t}$ models various fixed effects and an error term. $k \; bin_{i,j,t}$ is equal to 1 if investor j has a short position in stock i in the bin k at day t, with $k \in \{0.2, 0.5, 0.6, \ldots, 1.0\}$. The unconditional probability of increasing a short position to enter the next bin (estimated by the sample average of $y_{i,j,t}$) is 2.0%. Panel A shows coefficient estimates using the 0.3 bin as omitted reference category. Panel B tests for differences in the probability of increase between the bin just below the threshold and all other bins. The estimated coefficients are scaled to reflect changes in percentage points. Standard errors are clustered at the investor-stock and time level. The t-statistics are given in parentheses, and *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Panel A: Regression with reporting bin dummies					
0.2 bin	-0.43***	-0.16	-0.63***	-0.29**	-0.41***
	(-3.41)	(-1.30)	(-4.72)	(-2.20)	(-2.76)
0.3 bin	–	–	–	–	–
0.4 bin (Just below threshold)	-0.54***	-0.92***	-0.68***	-0.61***	-1.08***
	(-3.66)	(-5.72)	(-4.23)	(-3.55)	(-5.40)
0.5 bin	0.64***	-0.20	0.45*	0.27	-0.16
	(2.74)	(-0.87)	(1.85)	(1.10)	(-0.53)
0.6 bin	1.26***	0.65**	1.37***	0.99***	0.68*
	(3.70)	(2.03)	(4.05)	(2.61)	(1.85)
0.7 bin	0.92**	0.61*	0.97***	0.91**	0.37
	(2.18)	(1.87)	(2.73)	(2.52)	(1.02)
0.8 bin	0.69	0.78*	0.69	1.65***	1.07**
	(1.35)	(1.79)	(1.58)	(3.57)	(2.22)
0.9 bin	1.36*	0.91*	0.93	1.68***	0.94*
	(1.90)	(1.92)	(1.39)	(3.76)	(1.87)
$\geq$ 1.0 bin	1.42***	0.74**	1.44***	2.40***	1.61***
	(3.90)	(2.20)	(4.59)	(6.11)	(4.46)
Fixed effects:					
Time	Yes	Yes	No	No	No
Stock	No	Yes	No	No	No
Investor	No	Yes	No	No	No
Stock $\times$ time	No	No	Yes	No	Yes
Investor $\times$ time	No	No	No	Yes	Yes
R^2 (in %)	0.61	2.56	15.71	19.58	38.09
Within R^2 (in %)	0.20	0.08	0.22	0.22	0.15
Number of observations	278,003	277,999	255,274	228,358	202,057

Continued on next page

Table 5 – Continued from previous page

	(1)	(2)	(3)	(4)	(5)
Panel B: Differences in the probability of increase					
Just below threshold – 0.2 bin	-0.11	-0.76***	-0.05	-0.31**	-0.66***
	(-0.85)	(-4.70)	(-0.31)	(-1.99)	(-3.34)
Just below threshold – 0.3 bin	-0.54***	-0.92***	-0.68***	-0.61***	-1.08***
	(-3.66)	(-5.72)	(-4.23)	(-3.55)	(-5.40)
Just below threshold – 0.5 bin	-1.18***	-0.72***	-1.13***	-0.88***	-0.92***
	(-5.04)	(-2.92)	(-4.49)	(-3.38)	(-2.89)
Just below threshold – 0.6 bin	-1.81***	-1.57***	-2.05***	-1.60***	-1.76***
	(-5.43)	(-4.85)	(-6.10)	(-4.22)	(-4.69)
Just below threshold – 0.7 bin	-1.47***	-1.53***	-1.65***	-1.52***	-1.45***
	(-3.52)	(-4.60)	(-4.77)	(-4.25)	(-3.98)
Just below threshold – 0.8 bin	-1.23**	-1.70***	-1.37***	-2.26***	-2.15***
	(-2.44)	(-3.86)	(-3.09)	(-4.79)	(-4.30)
Just below threshold – 0.9 bin	-1.91***	-1.83***	-1.61**	-2.28***	-2.02***
	(-2.68)	(-3.90)	(-2.43)	(-5.24)	(-4.18)
Just below threshold – ($\geq$ 1.0 bin)	-1.96***	-1.66***	-2.12***	-3.01***	-2.68***
	(-5.53)	(-5.03)	(-6.75)	(-7.64)	(-7.40)

Table 6:
Characteristics influencing the probability of passing the disclosure threshold

This table shows estimates from the linear probability model

$$\begin{aligned} y_{i,j,t} \quad = \quad & \beta_0 + \beta_1 \, \textit{Just below threshold}_{i,j,t} + \boldsymbol{\beta}_2' \mathbf{x}_{i,j,t} + \boldsymbol{\beta}_3' \, \textit{Just below threshold}_{i,j,t} \times \mathbf{x}_{i,j,t} \\ & + \beta_4 \, \textit{0.2 bin}_{i,j,t} + \beta_5 \, \textit{Public short position}_{i,j,t} \\ & + \boldsymbol{\beta}_6' \, \textit{0.2 bin}_{i,j,t} \times \mathbf{x}_{i,j,t} + \boldsymbol{\beta}_7' \, \textit{Public short position}_{i,j,t} \times \mathbf{x}_{i,j,t} + \alpha_t + \varepsilon_{i,j,t}, \end{aligned}$$

in which $y_{i,j,t}$ equals one on day t if $bin_{i,j,t+1} > bin_{i,j,t}$ and is zero otherwise, where $bin_{i,j,t}$ denotes the short position bin of investor i in a given stock j on trading day t. Here, *Just below threshold* is a dummy variable, indicating the reporting bin just below the publication threshold ($bin = 0.4$) and $\mathbf{x}_{i,j,t}$ is a vector of stock- and investor-specific variables. For details on the calculation of these variables, see Table A.1. In addition, two bin indicators are included, one for the 0.2 bin, $\mathbb{1}(bin_{i,j,t} = 0.2)$, where $\mathbb{1}(\cdot)$ is the indicator function, and an analogous indicator for all public short positions ($bin \geq 0.5$), which are referred to as the 0.2 bin and the ≥ 0.5 bin in the table below. In Model 3, all bin indicators are interacted with the variables $\mathbf{x}_{i,j,t}$, but only the interactions with the 0.4 bin (Just below threshold) are reported. All specifications include daily time fixed effects, employing the method described in Correia (2016). The unconditional probability of increasing a short position to enter the next bin (estimated by the sample average of $y_{i,j,t}$) is 2.00% overall and 2.04% in the 0.3 bin. The estimated coefficients are scaled to reflect changes in percentage points. A constant is included in the regression but estimates are not reported. Standard errors are clustered at the investor-stock and time level, (see Petersen (2009); Thompson (2011)). The t-statistics are given in parentheses, and *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Model 1		Model 2		Model 3	
0.2 bin	-0.43***	(-3.42)	-0.34***	(-2.60)	-0.41	(-0.24)
0.3 bin	–	–	–	–	–	–
0.4 bin (Just below threshold)	-0.55***	(-3.67)	-0.57***	(-3.83)	0.88	(0.44)
≥ 0.5 bin (Public short position)	1.08***	(5.00)	0.54***	(2.66)	2.53	(0.96)
ln(Market capitalization)			-0.40***	(-5.03)	-0.43***	(-2.98)
ln(Return volatility)			0.28	(1.38)	0.70**	(2.04)
ln(Amihud Illiquidity)			-0.51***	(-6.80)	-0.39***	(-3.15)
ln(Bid-ask spread)			-0.10	(-0.55)	-0.48	(-1.50)
Institutional Ownership			0.01***	(3.56)	0.01**	(2.30)
Futures or listed options			0.56***	(4.08)	0.44**	(2.06)
Hedge Fund			0.33**	(2.36)	0.33	(1.36)
Bank			-0.15	(-0.36)	-0.18	(-0.33)
European holder			0.30**	(2.01)	0.34	(1.36)
German holder			-0.29	(-0.64)	-1.71***	(-3.70)
No public filings			0.78***	(2.89)	1.48***	(2.68)
No previous short position disclosure			-0.87***	(-7.25)	-0.68***	(-3.12)
Short interest ratio			0.08***	(2.65)	0.07*	(1.67)
Disclosure by others			-0.02	(-0.18)	0.06	(0.26)

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Table 6 – *Continued from previous page*

	Model 1	Model 2	Model 3	
Just below threshold × ln(Market capitalization)			0.04	(0.24)
Just below threshold × ln(Return volatility)			-0.79*	(-1.67)
Just below threshold × ln(Amihud Illiquidity)			-0.10	(-0.67)
Just below threshold × ln(Bid-ask spread)			0.39	(0.95)
Just below threshold × Institutional Ownership			-0.00	(-0.40)
Just below threshold × Futures or listed options			0.06	(0.21)
Just below threshold × Hedge Fund			-0.19	(-0.55)
Just below threshold × Bank			-0.32	(-0.34)
Just below threshold × European holder			0.27	(0.85)
Just below threshold × German holder			1.20	(1.20)
Just below threshold × No public filings			-1.61**	(-2.57)
Just below threshold × No previous short position disclosure			-0.91***	(-3.35)
Just below threshold × Short interest ratio			-0.01	(-0.12)
Just below threshold × Disclosure by others			0.11	(0.35)
0.2 bin × $\mathbf{x}_{i,j,t}$	No	No	Yes	
Public short position × $\mathbf{x}_{i,j,t}$	No	No	Yes	
Daily time fixed effects	Yes	Yes	Yes	
Adjusted R^2 (in %)	0.38	0.74	0.86	
Number of observations	278,003	277,722	277,722	

Table 7:
Performance comparison: Secretive vs. non-secretive investors

In this table we compare the performance of secretive with that of non-secretive investors. We define secretive investors as investors, which never had a public short position in our sample, but at least once reached the 0.4 bin. Investors are defined as non-secretive, if they at least once had a public short position. In Panel A, we compare the two investor groups' performance in all non-public positions, i.e. positions with a maximum value of 0.2, 0.3, or 0.4. In Panel B we exclude positions with a maximum bin value of 0.4. To measure performance, we form equal-weighted portfolios of stocks originating from the respective investor groups and regress the portfolio returns on market excess return (MKTRF), the size (SMB) and value (HML) factors, and the momentum factor (WML) depending on the factor model. The table reports alphas (in bps per day) of the time-series regression, omitting the factor loadings for the sake of brevity. The *t*-statistics are computed with Newey-West standard errors and are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)
	Secretive investors	Non-secretive investors	Difference: (1) - (2)
Panel A: Performance of positions with a maximum below the publication threshold			
CAPM	-4.77*	-1.16	-3.61**
	(-1.74)	(-0.63)	(-2.14)
Fama-French	-5.50***	-1.62	-3.88**
	(-2.59)	(-1.18)	(-2.48)
Carhart	-4.72**	-1.63	-3.08**
	(-2.26)	(-1.13)	(-2.24)
Panel B: Performance of positions with a maximum bin of 0.2 and 0.3			
CAPM	-4.61	0.28	-4.89***
	(-1.51)	(0.16)	(-2.58)
Fama-French	-5.26**	-0.19	-5.07**
	(-2.17)	(-0.14)	(-2.57)
Carhart	-4.37*	-0.47	-3.90**
	(-1.83)	(-0.32)	(-2.20)

Table 8:
Calendar time portfolio approach

This table shows the average risk-adjsuted returns of different portfolios constructed according to different maximum reporting bins (Column 1 to 5). For each investor-stock pair, we determine the maximum reporting interval reached during the sample period. In Panel A, for each maximum bin, we report the average risk-adjusted return of portfolios that include all stocks with at least one short seller, holding a position at its maximum reporting bin. In Panel B, for each maximum bin interval, we report the average risk-adjusted return of portfolios that include all stocks with at least one short seller holding a position that is *outside* the maximum reporting bin. In other words, it is the average return of the stocks not generated in the maximum bin phase. Panel C reports the differences between the two portfolios for each maximum bin definition and factor model. We form an equal-weighted portfolio of stocks for each test. Then, we regress the portfolio returns on market excess return (MKTRF), the size (SMB) and value (HML) factors, and the momentum factor (WML) depending on the factor model. The table reports alphas (in bps per day) of the time-series regression, omitting the factor loadings for the sake of brevity. The t-statistics are computed with Newey-West standard errors and are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Panel A: Performance during the maximum bin phase					
	Maximum reporting bin reached				
	0.2	0.3	0.4	0.5	0.6
CAPM	0.46	-1.24	-4.82**	6.27	0.32
	(0.22)	(-0.77)	(-1.98)	(1.64)	(0.09)
Fama-French	-0.13	-1.68	-5.42***	6.17*	-0.70
	(-0.09)	(-1.27)	(-3.02)	(1.70)	(-0.18)
Carhart	-0.00	-1.76	-5.17***	5.85	-1.84
	(-0.00)	(-1.30)	(-3.01)	(1.56)	(-0.48)
Panel B: Performance outside the maximum bin phase					
	Maximum reporting bin reached				
	0.2	0.3	0.4	0.5	0.6
CAPM	–	-5.07*	-1.51	0.02	-5.46
		(-1.89)	(-0.64)	(0.01)	(-1.60)
Fama-French	–	-5.55***	-1.76	-0.66	-6.30**
		(-2.58)	(-1.04)	(-0.38)	(-2.33)
Carhart	–	-5.12**	-1.40	-0.59	-6.00**
		(-2.30)	(-0.78)	(-0.31)	(-2.19)
Panel C: Difference in return (Panel A - B)					
	Maximum reporting bin reached				
	0.2	0.3	0.4	0.5	0.6
CAPM	–	3.84*	-3.30*	6.25	5.78
		(1.74)	(-1.67)	(1.46)	(1.04)
Fama-French	–	3.86	-3.67*	6.83*	5.60
		(1.52)	(-1.95)	(1.92)	(0.98)
Carhart	–	3.36	-3.77**	6.44	4.16
		(1.51)	(-2.14)	(1.51)	(0.76)

Table 9:
Cross-sectional predictive regressions

This table shows the average coefficients and t-statistics from daily cross-sectional regressions to predict stock returns (in bps per day) using the Fama and MacBeth (1973) procedure. Each day, we run a cross-sectional regression of future returns $t+1$ on the dummy variable *Secretive position just below threshold* and several control variables, which are observed at time t. Control variables for secretive and possibly informed investors are variables indicating if the stock is shorted by investors with no public filings (Column 2) or no previous short position disclosure (Column 3). In Column 4 we control for the presence of a secretive position, i.e. a position that has a maximum reporting bin of 0.4. Additional control variables are: short interest ratio, institutional ownership, market beta, market capitalization, the book-to-market ratio, past returns, illiquidity, and return volatility. Skewed variables are logarithmized and named accordingly. The table reports the time-series average of the cross-sectional regression coefficients, along with their t-statistics and R^2s . The t-statistics are based on the time-series standard deviations of the cross-sectional coefficients using the Newey and West (1987) procedure. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Secretive position just below threshold	-7.37***	-7.70***	-7.32***	-5.86**
	(-2.62)	(-2.74)	(-2.64)	(-2.28)
No public filings		-6.40*		
		(-1.82)		
No previous short position disclosure			-0.95	
			(-0.32)	
Secretive position				-2.65
				(-0.91)
ln(Short interest ratio)	0.38	0.85	0.45	0.59
	(0.69)	(1.42)	(0.70)	(0.94)
ln(Institutional ownership)	1.01	1.01	1.00	1.01
	(1.61)	(1.62)	(1.60)	(1.61)
Market beta	11.87**	12.15**	11.88**	11.91**
	(2.13)	(2.17)	(2.12)	(2.13)
ln(Market capitalization)	1.59	1.53	1.62	1.60
	(1.35)	(1.29)	(1.38)	(1.36)
ln(Book-to-market ratio)	4.83***	4.79***	4.80***	4.80***
	(2.98)	(2.94)	(2.95)	(2.95)
Return_t	-0.24***	-0.24***	-0.24***	-0.24***
	(-30.32)	(-30.33)	(-30.33)	(-30.34)
$\text{Return}_{t-1,t-4}$	-0.05***	-0.05***	-0.05***	-0.05***
	(-11.49)	(-11.50)	(-11.50)	(-11.49)
$\text{Return}_{t-5,t-19}$	-0.01***	-0.01***	-0.01***	-0.01***
	(-3.46)	(-3.48)	(-3.49)	(-3.46)
$\text{Return}_{t-20,t-249}$	2.23	2.10	2.09	2.21
	(0.47)	(0.45)	(0.44)	(0.47)
ln(Return volatility)	4.70	4.68	4.68	4.74
	(1.11)	(1.11)	(1.10)	(1.12)
ln(Bid-ask spread)	11.42***	11.72***	11.62***	11.41***
	(3.76)	(3.85)	(3.83)	(3.76)
ln(Amihud illiquidity)	0.39	0.25	0.33	0.41
	(0.26)	(0.17)	(0.22)	(0.28)
Constant	-15.94	-12.90	-15.45	-15.22
	(-0.91)	(-0.73)	(-0.88)	(-0.87)
Average adjusted R^2 (in%)	14.53	14.40	14.38	14.25
Number of observations	253,933	253,933	253,933	253,933