UNSHACKLING SHORT SELLERS: THE REPEAL OF THE UPTICK RULE

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ABSTRACT

On July 6, 2007, the United States Securities and Exchange Commission eliminated the uptick rule and all other short-sale price tests. About 1,000 "pilot stocks" were already exempt from the uptick rule as a result of an SEC pilot program. There are no significant stock price effects when the SEC announces the repeal of the uptick rule. When repeal takes effect, shorting increases markedly in *both* pilot and non-pilot NYSE stocks, and short-sale orders on average become more aggressive in both affected and unaffected stocks. Repeal causes market liquidity to worsen slightly, and short sellers on average switch from being contrarian to being momentum traders. This switch in trading style by short-sellers could have contributed to the bout of volatility experienced by U.S. stocks in late July and early August 2007.

1. Introduction

While finance researchers generally consider short sellers to be important contributors to efficient prices, shorting is viewed with considerable skepticism in other corners. Even most stock market regulators tend to view shorting with at least some suspicion, and most jurisdictions have greater or lesser impediments to initiating a short position.[1] This is true even in the United States, where until recently one such regulatory impediment to shorting was the so-called "uptick rule." The uptick rule applied to all New York Stock Exchange stocks and required short sales to take place on an uptick (at a price higher than the last reported transaction price) or on a zero-plus tick (at the same price as the last reported transaction price if the most recent price change was positive).

In this paper, we study the July 2007 repeal of the uptick rule. Some NYSE stocks were already exempt from the uptick rule as a result of an SEC pilot program begun in 2005, so in some ways they act as a control group, and we study the effects of the repeal on the remaining stocks. We examine changes in stock prices, the rate of short sales, the aggressiveness of short sellers, various liquidity measures, the informativeness of short sales, and whether short sellers on average behave as momentum traders or as contrarians.

Shorting behavior after the repeal is of particular interest. About two weeks after the repeal takes effect, the U.S. stock market experiences a month-long bout of volatility, with broad market averages declining by about 10%. Perhaps the most important question addressed in the paper is whether these newly unshackled short sellers contribute in any way to this episode of stock market volatility.

Before proceeding, it is useful to understand the background and history behind the uptick rule. Tick tests to regulate short sales were first introduced during the 1930's bear market. The New York Stock Exchange prohibited short sales on downticks beginning on October 6, 1931, and other national stock exchanges soon followed. After another episode of falling share prices in late 1937, the SEC adopted a very strict uptick rule in February 1938. Rule 10a-1 required most short sales to take place at a price strictly higher than the last sale price. The minimum price increment was 1/8 of a dollar ($0.125) for most stocks, and the average share price was about $40 at the time, so this was non-trivial restriction on short sales. The rule was

[1] Bris, Goetzmann, and Zhu (2006) provide a summary of short sale regulations in approximately 50 different countries.

relaxed the following year to allow short sales to take place on zero-plus ticks (where the price is equal to the last sale price but the most recent price change is positive) as well as strict upticks. Jones (2008) evaluates the effects of these 1930's regulatory changes on price levels and market quality measures.

This uptick rule endured virtually unchanged on the NYSE and AMEX for almost 70 years.[2] As the minimum tick narrowed to a penny in 2001, the uptick rule became a much smaller impediment to shorting. Also, as trading volume exploded in the increasingly decentralized U.S. equity markets, it became more difficult for trading venues to ensure that a given short sale in fact took place on an uptick. On July 28, 2004, as part of Regulation SHO, which made a number of changes to short-sale regulations, the SEC announced a pilot program to suspend short sale price tests in 1,000 different stocks. The pilot program took effect in May 2005 and was expressly designed to allow the commission to study the effectiveness of the rule. Diether, Werner, and Lee (2009), Alexander and Peterson (2008), and the SEC's Office of Economic Analysis all conclude that suspending the uptick rule has only modest effects on market quality. In fact, the uptick rule sometimes forces short sellers to provide rather than demand liquidity, to use limit orders instead of market orders. This introduces an artificial asymmetry in liquidity provision which disappears in the pilot stocks.

On June 13, 2007, the SEC announced that it was eliminating all short sale price tests, effective July 6, 2007. In fact, trading venues were prohibited from introducing any type of short sale price test. Effective at the same time, the SEC ended the Regulation SHO requirement to make public short sale transaction data. This means that non-public data are required to study the time interval after July 6; this paper is possible because the NYSE generously provided shorting data to us up through the end of August 2007.

The paper is organized as follows. Related literature is discussed in the next section, and the data, especially the proprietary NYSE data, are discussed in section 3. Results start in section 4 with an analysis of changes in shorting activity. Section 5 discusses effects on share prices, such as they are. Section 6 examines the placement of short-sale orders relative to the existing bid and ask prices, while section 7 examines changes in effective spreads associated with the repeal of the uptick rule. Section 8 develops a measure of the information content of

[2] Short sale price tests were also present on Nasdaq during this time period but took a different form. Our shorting data are from the New York Stock Exchange, so we focus on the uptick rule as it applies to NYSE stocks.

short sales. Section 9 looks at whether short sellers are momentum or contrarian and whether the uptick rule affects this aspect of their trading behavior, while section 10 looks for evidence of manipulative shorting activity both before and after the uptick rule is repealed. Section 11 concludes.

2. Related literature

Theoretical models with differences in beliefs predict that constraints on short sales should cause stock prices to rise and become overvalued. In these models, shorting restrictions mean that pessimists are shut out of the market, and optimists do not take into account the absence of pessimists in setting prices. Prices thus become too high. Examples of such models include Miller (1977), Harrison and Kreps (1978), and Duffie, Garleanu and Pedersen (2002). In contrast, if all agents have rational expectations, as in Diamond and Verrecchia (1987), they do not agree to disagree, and shorting prohibitions do not cause stock prices to be biased on average (though shorting prohibitions slow down the adjustment of prices to negative news).

The empirical evidence in the literature provides uniform support for these models. Dechow et al. (2001), Desai, Krishnamurthy, and Venkataraman (2006), Cohen, Diether, and Malloy (2007), and Boehmer, Jones, and Zhang (2008) show that in aggregate short sellers appear to trade based on (and be well-informed about) fundamentals, and they earn excess returns. Generally, the evidence supports the models with differences in beliefs rather than the rational expectations alternative. When short sellers' information is not incorporated into prices because shorting is costly, difficult, or prohibited, the evidence indicates that stocks can get overvalued. For example, Lamont and Thaler (2003) and Mitchell, Pulvino, and Stafford (2002) show that during the late 1990's, spinoffs in the tech sector were so overpriced that arbitrage (or something very close to arbitrage) should have been possible, but short positions were very difficult to establish. Pontiff (1996) provides similar evidence for closed-end funds. Jones and Lamont (2002) show that in the 1920's and 1930's, stocks that were expensive to short had abnormally low future returns, even after accounting for shorting costs.

A number of researchers have also studied market structure changes that make it easier or harder to short. For example, Danielsen and Sorescu (2001) show that the introduction of listed options on a given stock eases shorting constraints and reduces share prices slightly. Ho (1996)

finds an increase in stock return volatility when short sales were restricted during the Pan Electric crisis in the Singapore market in 1985-1986. Chang, Cheng, and Yu (2007) find price effects in Hong Kong when specific stocks are designated as eligible for shorting. Rhee (2003) finds some evidence of price effects in Japan following imposition of an uptick rule there. In contrast, Diether, Werner, and Lee (2008) find that Regulation SHO's pilot program to suspend short sale price tests does not affect share prices.

Shorting restrictions also affect liquidity and the adjustment of prices to new information. Diamond and Verrecchia (1987) predict that if there are shorting constraints, prices will adjust more slowly to negative information. Reed (2002) finds an asymmetric price adjustment in response to information about earnings, and Bris, Goetzmann, and Zhu (2007) find that downward price moves are slower in markets where shorting is prohibited. Diamond and Verrecchia (1987) also point out that since short sellers do not have the use of the sale proceeds, shorting never takes place for liquidity reasons, and one might expect more information content in short sales. Aitken, Frino, McCorry, and Swan (1998) show that in Australia, where a short sale is publicly identified as such immediately on execution, short sales have a larger impact on price than regular-way sales, consistent with the theoretical predictions. Diether, Werner, and Lee (2009) find that the 2005 pilot program to suspend price tests in the U.S. slightly worsens some measures of market quality.

3. Data

The sample consists of all NYSE system order data records related to short sales from January through August 2007. We have data on all short-sale orders placed, not just executed short sales. Among other things, this means we can measure order aggressiveness based on the placement of short-sale orders relative to the existing bid and ask prices.

We match against CRSP and retain only common stocks, which means we exclude securities such as warrants, preferred shares, American Depositary Receipts, closed-end funds, and REITs. This leaves us a daily average of 1,334 NYSE-listed common stocks in the sample, of which 372 are pilot stocks and 962 are non-pilot stocks. Table 1 compares pilot and non-pilot stocks. The two groups are very similar, which is not surprising given the original assignment algorithm for the SEC pilot program. For example, average market capitalization is $10.0 billion

for pilot stocks and $9.4 billion for non-pilot stocks. Average daily volume is just over 1 million shares for pilot stocks vs. about 865,000 shares for non-pilot stocks.

For parts of the analysis, we do not need order-level short-sale data, and in that case it is more convenient to work with daily shorting data for each stock. We measure daily shorting flow in three different ways. Our preferred measure is the fraction of volume executed in a given stock on a given day that involves a system short seller. This normalization ensures that our shorting activity measure is stationary during the sample period, at least until the tick test repeal. We also provide descriptive statistics on the number of short sale order executions and the total number of shares sold short on the NYSE in a given stock on a given day. Jones, Kaul, and Lipson (1994) find that the number of trades, rather than total volume, is most closely associated with the magnitude of price changes, and our use of the number of executed short sale orders is in the same spirit.

4. Effects on shorting activity

Figure 1 and Table 2 provide details on the prevalence of shorting in both pilot and non-pilot stocks, before and after the July 6, 2007 repeal of the tick test. The cross-sectional evidence indicates that the tick test inhibits a little more than one-fifth of shorting activity. Figure 1 shows that based on cross-sectional median fractions of trading volume, there is considerably less shorting in non-pilot stocks on every trading day. Table 2 Panel B computes equal-weighted cross-sectional averages and shows that before the repeal, short sales average 37.5% of NYSE trading volume for pilot stocks, compared to only 29.5% of trading volume for stocks where the tick test remains in effect. Non-normalized measures of shorting (the number of shares, or the number of executed short-sale orders) show similar differences between pilot and non-pilot stocks.

Once the tick test is repealed on July 6, the cross-sectional differences quickly disappear. It is interesting to note that the differences do not disappear overnight, indicating that it takes time for market participants to fully adjust their trading strategies and/or their trading technology to the new regulatory regime. In fact, Figure 1 shows that it takes almost two weeks for the pilot and non-pilot shorting prevalence lines to converge. However, once this adjustment period is past, the prevalence of shorting in the treated non-pilot stocks is indistinguishable from shorting

in the control pilot stocks. Table 2 considers the whole post-repeal period from July 6 through the end of August. Value-weighted averages are in Panel A. There short sales are virtually identical post-repeal, averaging 41.2% of volume for non-pilot stocks and 41.1% of volume for pilot stocks. Equal-weighted averages are in Panel B, and short sales average 43.5% of overall volume in pilot stocks, slightly higher than the corresponding 41.3% figure for non-pilot stocks.

Differences-in-differences tests confirm that the July 2007 repeal of the tick test leads to substantially more shorting in the affected non-pilot stocks. Based on the equal-weighted cross-sectional averages in Table 2 Panel B, the relative increase is 5.8% of trading volume, with a Newey-West t-statistic (used to account for the modest persistence in the amount of shorting from one day to the next) coming in strongly significant at t = 4.38. Value-weighting yields similar numbers, with a 7.0% diff-in-diff (t = 4.68).

Most surprising is that shorting increases after tick test repeal, even for the pilot stocks that were already exempt from the tick test and should have been unaffected by the regulatory change. The overall increase in shorting is apparent from Figure 1, and it is confirmed by the averages in Table 2. Based on the equal-weighted averages in Panel B, pilot stock shorting averages 37.5% of volume before the repeal, increasing to 43.5% of trading volume after repeal, for a statistically reliable increase of 6.0% (t = 5.40). Results for value-weighted averages in Panel A are even stronger.

Why would pilot stocks experience more shorting after July 6? There are at least two possible explanations. First, it could be that the amount of shorting activity depends on market conditions such as volatility, and perhaps market conditions were different post-repeal. To investigate this, we estimate a time-series regression model where the prevalence of shorting depends on stock price volatility and a post-repeal indicator variable. The estimated regression is:

$$\begin{array}{lll} S_t = & 0.370 + 0.066\, D_t - 38.2\, PVOL_t & (1) \\ & (0.014)\ (0.009) \quad (82.2) & \end{array}$$

where S_t is shorting's median fraction of overall trading volume on day t in pilot stocks, D_t is an indicator variable equal to one beginning when the tick test is repealed, and $PVOL_t$ is a range volatility measure, specifically the median proportional difference between the day's high and low transaction price. The coefficient on volatility is indistinguishable from zero and the repeal

dummy remains strongly significant, so market conditions do not seem to account for the increase in shorting in these control stocks.

An alternative explanation is that the tick test repeal made it easier to implement a shorting strategy that involves multiple stocks. For example, if futures are cheap relative to cash market prices, an index arbitrageur might buy futures and short the underlying stocks. If the uptick rule is in place for many of the underlying stocks, the arbitrageur could face considerable execution risk on the short portion of this trading strategy. The arbitrageur might require large price discrepancies before trading, or might not implement the strategy at all. Once the uptick rule is repealed, this source of execution risk is eliminated, and this arbitrageur is likely to short-sell more actively in all of the underlying stocks, including pilot stocks that were already exempt from the uptick rule.

There is some suggestive evidence that supports this story. Our data from the NYSE indicate whether or not a short sale order is part of a program trade, defined as the submission of simultaneous orders to trade 15 or more securities with an aggregate total value of at least $1 million. From January 1 through July 5, 2007, short sales that are part of program trades account for 5.5% of trading volume in pilot stocks. During the rest of July 2007, this number rises to an average of 7.8% of trading volume. This increase in program shorting accounts for about one-third of the increase in pilot stock shorting over the same interval. Of course, not all list-based activity is coded as program trading, so this explanation could in fact account for even more of the increase in control stock shorting activity. In any case, this evidence suggests that limiting the analysis to treatment vs. control groups in the regulatory experiment is likely to understate the overall effect of the tick test on shorting.

5. Effects on stock prices

As discussed earlier, shorting constraints can cause stocks to be overvalued relative to fundamentals. If the uptick rule imposes a binding constraint on fundamentals-based short sellers, we should see a price effect when the market learns that uptick rule is to be repealed. On June 13, 2007 the SEC announces the repeal of all short-sale price tests, effective on July 6, 2007. Figure 2 shows cumulative returns on the overall stock market over this time period as well as the differential return on pilot vs. non-pilot stocks.

The value-weighted index of NYSE stocks increases by 2.5% over the three days beginning June 13. This is actually reliably different from zero, with a t-statistic of 2.15 based on volatility from January 2007 up to that date. But the sign is wrong for the theoretical models with disagreement. According to these models, the repeal of shorting constraints should result in lower prices, not higher prices.

Of course, broad stock market returns on these days are affected by a much broader set of information. A more powerful test compares the return on pilot stocks to the return on non-pilot stocks. If the shorting constraints models are correct, non-pilot stocks should fall on the news of the uptick rule's repeal, at least relative to the control group of unaffected pilot stocks. The figure shows the cumulative return of pilot less non-pilot stocks. This return should be positive if the shorting constraints models are correct, the uptick rule actually restricts informed short sellers, and the announcement of the repeal is unanticipated. The confidence bounds are approximately two standard errors in either direction, using a daily standard deviation of the pilot vs. non-pilot value-weighted portfolio return difference of 0.15% based on returns up to that date in 2007. On announcement, the pilot vs. non-pilot return difference is virtually zero, and in fact non-pilot stocks slightly outperform over a longer holding period through the end of August 2007.

Similarly, little happens immediately around the effective date of July 6, 2007. Broad market indexes do not move unusually, and the pilot vs. non-pilot return difference is again virtually zero.

Why is there no immediate effect on prices? It could be that this action was not really news to the market. Most observers expected the repeal of the uptick rule at some point, though the exact timing remained uncertain. It could also be that while the uptick rule has an impact on liquidity providers, quant funds, and other short-term traders, it has little effect on long-term fundamentals-based shorting strategies. In fact, at a 2006 roundtable hosted by the SEC, one fundamentals-based hedge fund manager characterized the uptick rule as only a "minor nuisance" in taking short positions.

On July 20, two weeks after the repeal of short-sale price tests, the broad stock market (as measured by the value-weighted return on all NYSE common stocks) begins a fairly sharp decline and, measured from peak to trough, loses just over 10% of its value by August 16, approximately one month later. A few commentators in the financial press, including CNBC's

Jim Cramer, blamed the repeal of the uptick rule for this decline. While this seems unlikely given the observed time lags, in later sections we investigate the behavior of short sellers during this volatile time period to see if we can detect any changes that might be attributable to the less-constrained regulatory regime.

6. Short-sale order placement

Next we examine where short-sale orders are placed relative to the existing quote. We distinguish between passive and aggressive orders, based on the likelihood of execution. In particular, we define aggressive short sale orders as those that are marketable based on the existing bid price. These orders could be market orders. They could also be limit orders to sell short where the limit price is below the existing bid, making them marketable. These orders are virtually certain to be executed. Similarly, we define passive short-sale orders as limit orders where the limit price is greater than or equal to the existing ask price. These orders do not affect the displayed best bid and offer quote, and they are relatively unlikely to be executed.

Figure 3 and Table 4 show the results. While the uptick rule is in place, there is a distinct cross-sectional difference in order placement. Short-sale orders are more aggressive for the pilot stocks, where there is no tick test, compared to the non-pilot stocks where the tick test remains in effect. When we time-series average the equal-weighted cross-sectional fraction of marketable short-sale orders for each day from January through July 5 (Table 4 Panel B), 35.4% of short-sale orders in pilot stocks are marketable, compared to 32.6% of short-sale orders in non-pilot stocks. This difference is statistically significant, and it also makes sense: some aggressive marketable orders to sell short run afoul of the uptick rule, so we should see fewer of them. Note that since the uptick rule is defined relative to the last transaction price, a marketable order to sell short will (may) satisfy the uptick rule if the current bid is above (equal to) the last transaction price, so aggressive short-sale orders are still present in the data, but are less prevalent.

Prior to the repeal of the uptick rule, there are similar cross-sectional results for passive orders to sell short placed above the existing ask price. For pilot stocks, 15.7% of short-sale orders are passive, compared to 18.2% for non-pilot stocks. Again, it makes sense that we should see more passive orders for stocks that are subject to the uptick rule: if the current ask

price is equal to the last transaction price, only orders at or above the ask price satisfy the uptick rule, and these are defined here as passive orders.

While these cross-sectional differences are somewhat mechanical and directly reflect the bite of the uptick rule, the interesting changes occur after July 6, when the uptick rule is repealed completely. First, within a week after repeal, the cross-sectional differences in order placement disappear. Pilot and non-pilot stocks exhibit similar rates for aggressive short-sale orders and passive short-sale orders.

Most intriguing is the change in short-sale order aggressiveness in pilot stocks. These stocks were exempt from the uptick rule both before and after repeal, so they are in some sense controls. But once the uptick rule is repealed, short-sellers are more aggressive in these stocks. Table 4 Panel B shows that from July 6 through August 31, the fraction of aggressive orders for pilot stocks rises to 37.3% (from 35.4% in the pre-period). This change is statistically significant, with a Newey-West t-statistic of 2.41. Similarly, the fraction of passive short-sale orders declines to 13.4% for these pilot stocks, compared to 15.7% before the repeal event. This is striking, as it indicates a fundamental change in short-sale order placement even in stocks which experienced no regulatory change.

Why do short-sellers become more aggressive once the uptick rule is repealed? There are at least two possible explanations. One is fairly benign; one is more troublesome. The benign explanation refers to list-based short sales, along the lines of the previous section. An index arbitrageur is the canonical example here. If futures are cheap relative to the underlying stocks, say, the arbitrageur would like to buy futures and immediately short all of the underlying stocks. The arbitrageur can observe the bid and ask prices for all stocks. If the trade is profitable at the existing quotes, the arbitrageur would like to hit all of the bids in the underlying stocks simultaneously, thereby locking in a profit. Thus, he will submit marketable short-sale orders in a list of stocks. This strategy is subject to considerable execution risk in the presence of the uptick rule, so the index arbitrageur may not be able to implement this strategy very often when the uptick rule is in place. Once the uptick rule is repealed, trading activity associated with this strategy may increase markedly. Similar arguments would apply for any list-based short-selling strategy where some of the stocks become free of the uptick rule.

The alternative explanation is of more concern. Increased aggressiveness in pilot stocks could be a sign of an increase in manipulative trading strategies by short-sellers who concluded

from the uptick repeal that the SEC was less concerned about such activity. Trade-based manipulation strategies require aggressive trading during one leg of the manipulation in an effort to move prices as far as possible, perhaps by encouraging others to trade in the same direction. Perhaps the increase in short-sale aggressiveness is a sign of the increased prevalence of this kind of trading behavior.

We do not have a direct way of definitively separating out these two explanations, but in the next few sections we will provide suggestive evidence that points away from manipulative trading by short sellers.

7. Liquidity measures

Diether, Lee, and Werner (2009) and Alexander and Peterson (2008) find that the pilot program suspending the uptick rule widens spreads slightly. As discussed in the previous section, depending on the current bid and ask prices relative to the last transaction price, short sellers subject to the uptick rule may be limited in their ability to demand liquidity. In this case, the uptick rule forces some short sellers to either not place a short-sale order or to supply liquidity instead via a limit order that complies with the uptick rule.

Here we briefly investigate market quality to see if the results from the end of the pilot and the complete repeal of the uptick rule in July 2007 match the results from the start of the pilot in 2005. For each NYSE common stock each day, we calculate average proportional effective spreads. The effective spread is defined as twice the distance between the trade price and the quote midpoint prevailing at the time of the trade. We use effective spreads because specialists and floor brokers are sometimes willing to trade at prices within the quoted bid and ask prices. The wider the effective spread, the less liquid is the stock. We consider pilot and non-pilot stocks separately. For each group of stocks, we calculate a cross-sectional average effective spread for each trading day.

While the uptick rule is in place, we would expect non-pilot stocks that are subject to the rule to have narrower effective spreads than pilot stocks, all else equal. Once the uptick rule is repealed, we would expect to see a widening of non-pilot stock effective spreads so as to match the pilot stock effective spreads. Spreads depend on various market conditions, notably

volatility, but if market conditions do not change after the repeal, we would expect to see no change in effective spreads on the control group pilot stocks.

The results are in Figure 4. Throughout the whole sample period, pilot stocks are slightly more liquid than non-pilot stocks, based on the effective spread measures. In the pre-event period, the average effective spread for pilot stocks is 7.1 basis points vs. 8.7 basis points for non-pilot stocks. Non-pilot stocks have wider spreads on every day of this period, so this difference is strongly statistically significant. As discussed earlier, stocks in the Russell 3000 in 2005 were essentially randomly assigned to either the pilot or non-pilot group, but no additional stocks were assigned to the pilot group after the start of the pilot. Stocks coming public since that date would automatically be in the non-pilot group, as would stocks that were too small for or otherwise excluded from the Russell 3000 at the time of assignment. Both of these effects work in the same direction and could account for the modest differences in the average proportional effective spreads of the two groups.

What happens once the uptick rule is repealed? Spreads widen sharply for both pilot and non-pilot stocks during the market turmoil of late July and early August. But a differences-in-differences approach can be used to compare the changes in the two groups. Starting on July 6, non-pilot stocks widen out to an effective spread of 11.6 basis points vs. 8.8 basis points for the pilot stocks. The non-pilot stocks widen out 1.3 basis points more, and this difference is statistically significant. Thus, we confirm the results from the earlier regulatory experiment. Repealing the uptick rule does lead to slightly worse market quality, as measured by effective spreads.

8. Informativeness

If short sellers are informed, the stocks they short heavily should underperform the stocks they avoid shorting. We adopt the portfolio approach used in Boehmer, Jones, and Zhang (2008) as a natural way to measure the information content of short sales. Portfolios have several advantages. First, the numbers are easy to interpret, because they are the returns to a potential trading strategy, assuming that one could observe all these shorting flow data in real time (such a strategy was actually possible during this time period, as the NYSE sells daily shorting flow data by stock). Second, compared to a regression approach, the aggregation into portfolios can

reduce the impact of outliers. Finally, portfolios are able to capture certain nonlinearities that might characterize the relationship between shorting activity and future returns.

Each day, we sort into quintiles based on normalized shorting activity (short sales as a fraction of overall trading volume) during the previous five trading days. We skip one day (to eliminate any possibility that prices for firms in a particular quintile are disproportionately at either the bid or the ask) and then hold a value-weighted portfolio for 20, 40, or 60 trading days. This process is repeated each trading day, so holding period returns from neighboring days have substantial overlap. To deal with this overlap, we use a calendar-time approach to calculate average daily returns and conduct inference (see, among many examples, Jegadeesh and Titman (1993), who apply this method to returns on momentum portfolios). For the 20-day holding period, each trading day's portfolio return is the simple average of 20 different daily portfolio returns, and 1/20 of the portfolio is rebalanced each day. To be precise, the daily return R_{pt} on portfolio p is given by

$$R_{pt} = \tfrac{1}{20}\sum_{k=1}^{20} Q^{ip}_{t-k-5,t-k-1} w^{ip}_{t-1} R_{it} \ , \tag{2}$$

where $Q^{ip}_{t-k-5,t-k-1}$ is an indicator variable set to one if and only if the i^{th} security is assigned to portfolio p based on short-selling activity during the time interval [t–k–5, t–k–1], w^{ip}_{t-1} are market-value weights at time t–1 (actually from the previous calendar month-end in this case) normalized such that

$$\sum_i Q^{ip}_{t-k-5,t-k-1} w^{ip}_{t-1} = 1 \tag{3}$$

for each portfolio p, date t, and portfolio formation lag k, and R_{it} is the return on stock i on date t.

Average daily calendar-time returns are reported in percent multiplied by 20 (to correspond to the holding period and also so that the returns cover approximately one calendar month), with t-statistics based on an i.i.d. daily time series. We also calculate the Fama-French (1993) alpha on this return difference. Specifically, the alpha for portfolio p is the intercept (scaled up by 20) in the following daily time-series regression:

$$R_{pt} - R_{ft} = \alpha_p + \beta_{p1}RMRF_t + \beta_{p2}SMB_t + \beta_{p3}HML_t + \varepsilon_{pt}. \tag{4}$$

The results are in Table 5 and Figure 5. We focus on results at the 20-day horizon and sometimes refer to this time interval as one month, even though the typical calendar month has

21 or 22 trading days. Results at long horizons are qualitatively similar. The basic result is identical to the result in Boehmer, Jones, and Zhang (2008): short sellers are well-informed. A value-weighted portfolio of heavily shorted stocks (quintile 5) significantly underperforms a portfolio of lightly shorted stocks (quintile 1) over the next month. Subsequent *raw* returns are actually negative on the quintile of most heavily shorted stocks, averaging -0.70% per month for pilot stocks and -0.50% per month for non-pilot stocks, though these are statistically indistinguishable from zero given the short eight-month sample period.

We look at return differences on pilot stocks and non-pilot stocks separately. However, it is not clear whether there should be a cross-sectional difference, and if so, what the sign should be. If informed shorting is sharply constrained by the uptick rule, sorting by shorting flow might not explain much at all, and we would expect no return difference for heavily shorted vs. lightly shorted non-pilot stocks. On the other hand, if informed shorting is limited but not eliminated by the uptick rule, it could be that prices are less efficient, with a very low subsequent return on heavily shorted stocks as the short-seller's information becomes known to the market over time. And if the uptick rule does not have much bite, we would expect no difference between pilot and non-pilot stocks with respect to the information content of short sales.

For pilot stocks over the whole eight-month sample period (Table 5 Panel A), the heavily shorted quintile underperforms the lightly shorted quintile by 0.78% over the next month (t = 1.38). For non-pilot stocks, the corresponding number is 1.15%, with a t-statistic of 3.43. Interestingly, prior to the elimination of the uptick rule, pilot stock short sellers either received a bad draw or are not very informed. During this period, Table 5 Panel B shows that heavily shorted pilot stocks underperform lightly shorted pilot stocks by only 0.15% over the next month, and this is not statistically distinguishable from zero. In contrast, shorting in non-pilot stocks is very informed. Heavily shorted non-pilot stocks underperform lightly shorted non-pilot stocks by a statistically significant 1.33% over the next 20 trading days.

Why the difference between pilot and non-pilot stocks? We conjecture that the uptick rule affects the price adjustment process. When there is no uptick rule, short sellers can trade more aggressively on their information, and their trading would tend to drive prices down toward fundamental value. If there is an uptick rule, short sellers are less able to move prices toward fundamental value. But that means that when prices eventually do find their way back to fundamental value, the short sellers could actually earn larger profits. In the context of the

Diamond and Verrecchia (1987) model, the uptick rule could slow down adjustment to negative information, and that manifests itself in greater underperformance in these non-pilot stocks that have been heavily shorted.

Next we look at the six-week period after repeal. This is an extremely short time interval, and we have little statistical power, but Figure 5 and Table 5 Panel B both show that the ordering is now reversed. From July 6 through August 31, 2007, pilot stocks that are heavily shorted proceed to underperform badly (an average of 2.65%) over the next 20 trading days. The return difference reaches double digits in mid August, during the heart of the volatility. Shorts seem to have much less information about non-pilot stocks once the uptick rule ends. These two groups now have the same regulatory treatment, so we have no good explanation for this difference beyond statistical noise. Perhaps we should simply focus on the fact that short sellers as a group seem to do very well during the bout of volatility in late July and early August.

9. Momentum vs. contrarian shorting

Diether, Lee, and Werner (2008) show that short-sellers are contrarian at a daily horizon. If a stock goes up one day, there is more shorting activity in that stock the following day. Short sales are thus in some sense stabilizing trades. Of course, this contrarian trading may simply be an artifact of the uptick rule. In declining markets, short sellers may have a more difficult time initiating a trade, and this could lead mechanically to trading behavior that looks contrarian. In this section, we examine differences in contrarian shorting between pilot stocks and non-pilot stocks, both before and after repeal of the uptick rule. In the cross-section, the discussion above suggests that we should expect stronger contrarian shorting in stocks where the uptick rule is in effect. In terms of time-series changes, we do not expect any change in the nature of shorting for pilot stocks when the uptick rule is repealed.

Our methodology is straightforward. For each individual stock, we estimate a time-series regression of shorting (measured as a fraction of trading volume) on lagged returns and a variety of control variables, including lagged shorting, lagged volatility measures, and lagged trading volume. All of the explanatory variables are aggregated over the past five trading days. Each of these variables is interacted with a dummy variable set to one once the uptick rule is repealed, so we should be able to see any changes in the determinants of shorting activity that are associated

with the new regulatory regime. We report cross-sectional averages of the individual-firm regression coefficients, along with their associated t-statistics.

The results are in Table 3 and indicate that most of the time, short sellers are contrarian on average. Panel A reports results for pilot stocks. For example, the first row of Panel A omits all controls and shows a slope coefficient of 0.906, which means that if the past week's return is 1% above its average for the sample, shorting activity is higher by 0.906% of total trading volume in that stock. The results for non-pilot stocks are in Panel B and are quite similar, with a corresponding slope coefficient of 0.812. Panel C shows that the difference between these two coefficients is not statistically significant. The results are qualitatively similar when we add various combinations of control variables. Note that the coefficient on lagged returns is always lower for non-pilot stocks vs. pilot stocks, and in some of the specifications, this difference is actually statistically significant. At first glance, this does not seem to match our priors. However, this result makes intuitive sense, because the uptick rule binds in a declining market, and if shorting activity is simply delayed rather than cancelled by the uptick rule, we might see a bit more shorting activity following a daily share price decline in such stocks.

Again, the most interesting numbers involve the time-series changes. After the uptick rule is repealed, short sellers become momentum traders. For non-pilot stocks using the simplest specification without controls, the post-repeal coefficient becomes 0.812 – 1.041 = -0.229, implying that if the past week's return is 1% *below* average, shorting activity is *higher* by 0.229% of total trading volume during July and August 2007. If anything, the effect on pilot stocks is even more dramatic. Before repeal, the coefficient on lagged returns is 0.906 (based on the specification without controls). After the uptick rule is repealed, the coefficient on lagged returns is about the same magnitude (0.906 – 1.793 = –0.887) but of opposite sign, indicating strong momentum trading among short sellers.

It is worth noting that this result is somewhat fragile. Adding control variables often eliminates the momentum effect. Adding lagged shorting activity has a particularly strong effect on the lagged return coefficient. While we are not sure what is going on here, recall from Figure 1 that there were very sharp spikes in both directions in NYSE shorting activity during the second week of August. It could be that the unusual market conditions changed everything at once: the amount of shorting, volatility, trading volume, and the dependence of shorting on past returns.

Taking the momentum shorting result as given, we might ask why short sellers might suddenly have become momentum traders in late July and August. Again, there are various answers, some benign and some less so. It is known, for example, that a considerable amount of shorting is extremely short-term, because shorting flow is a very large fraction of trading volume, while short interest is only about 4% of shares outstanding on average (see the discussion in Boehmer, Jones, and Zhang, 2008). While there are no hard figures, most market participants believe that this short-term shorting activity is coming from quant hedge funds and other short-term liquidity providers, including various market-makers. Khandani and Lo (2007) show that any hedge fund following such a short-term contrarian strategy probably posted large losses on several days in early August 2007. It is possible that these participants are responsible for most of the contrarian shorting, and after getting hit with these negative shocks, they may have retreated from the market for a while. This would have made short sellers in aggregate less contrarian until after the immediate storm blows over.

Another possibility is that the unusual market conditions and the changed regulatory backdrop made it possible for manipulative short sellers to trade aggressively in a momentum fashion to drive down prices. While we can not provide a definitive test of this "bear-raid" hypothesis, if the manipulative trading is short-lived, we would expect to see reversals in share prices, and we investigate this in the next subsection.

10. Reversals

Suppose that the repeal of the uptick rule does in fact open the floodgates to manipulative short sellers conducting bear raids. Short sellers would target a stock or stocks, short them heavily, and try to encourage others to piggyback on this selling, perhaps by making negative public statements about the prospects for the targeted stock or stocks. After the price drops, with prices at a temporary low, the manipulators would cover their positions at a profit, and the share price would eventually rebound to fundamental value.

Thus, if manipulative shorting activity is present, we could expect to see a temporary decline in the share prices of heavily shorted stocks, followed by a later rise. If the repeal of the uptick rule makes it easier for short sellers to follow such a strategy, we might see these price reversals only when there is no uptick rule in place.

The empirical approach is similar to that used to assess the informativeness of short sale orders in section 8 above. Each day, we short stocks into quintiles based on the prevalence of short sales in the past week (short sales normalized by trading volume). We look at the cumulative return on the most heavily shorted quintile less the return on the most lightly shorted quintile over various horizons out to three months (60 trading days), averaged over all the portfolios formed each trading day. We do this exercise separately for pilot and non-pilot stocks, and we consider portfolios formed both before and after the uptick rule is repealed on July 6, 2007.

The results are graphed in Figure 6. All of the return differences exhibit a gradual downward slope. Similar results are presented in Boehmer, Jones, and Zhang (2008) over a much longer sample period. The evidence is consistent with the gradual incorporation of short sellers' information into prices over fairly long time intervals, suggesting that at least some of the information used by short sellers is long-lived information about fundamentals, such as information about future earnings shortfalls. There is no evidence of reversals. None of the curves even flatten out at the 3-month mark, much less begin to head back up. Overall, there is no evidence of this kind of manipulative trading strategy, or to put it more precisely, if there are isolated cases of temporary price moves, they are dominated by the gradual incorporation of short sellers' information into prices.

11. Conclusions

In this paper, we study the July 6, 2007 elimination of the uptick rule that had limited short sales on the New York Stock Exchange. Some stocks were already exempt from the uptick rule due to an SEC pilot program begun in 2005, and we use these pilot stocks as a control group ostensibly unaffected by the regulatory change. The remaining stocks were affected by the repeal, and we use these non-pilot stocks as the treatment group. We find no significant stock price effects when the repeal is announced in June. When repeal takes effect, shorting increases markedly in both pilot and non-pilot NYSE stocks, and short-sale orders on average become more aggressive in both affected and unaffected stocks. Repeal causes market liquidity to worsen slightly, and short sellers on average switch from being contrarian to being momentum traders. One might worry that this switch in trading style by short-sellers could have contributed

to the bout of volatility experienced by U.S. stocks in late July and early August 2007. But we do not find any evidence that this momentum trading destabilizes stock prices in any way, and in fact short sellers seem to be even more important contributors to efficient share prices after the uptick rule is removed.

The repeal of the uptick rule in the summer of 2007 is the only recent regulatory move in the United States that makes life easier for short sellers. As stock prices have continued to fall through 2008, restrictions on short sales have tightened in the United States and across the world. In fact, recent regulatory changes have been nothing short of breathtaking. In July, the Securities and Exchange Commission (SEC) issued an emergency order restricting naked shorting (where the short seller fails to borrow shares and deliver them to the buyer on the settlement date) in 19 financial stocks.[3] After the emergency order expired in mid-August, the SEC returned on September 17 with a total ban on naked shorting in all U.S. stocks. One day later, following on the heels of a similar announcement from the U.K.'s Financial Services Authority, the SEC surprised the market with a temporary emergency ban on all short sales in approximately 800 financial stocks. On the same day, the Commission announced that all institutional short sellers would have to report their daily shorting activity, and the Commission announced aggressive investigations into possible manipulation by short sellers.

Among all this regulatory activity, the SEC has up to now maintained its ban on short sale price tests. However, it would not be surprising to see some sort of price test re-emerge. For example, Erik Sirri, director of the SEC's Division of Trading and Markets, said on Oct 6, 2008 that the SEC is considering bringing back the uptick rule, stating, "It's something we have talked about and it may be something that we in fact do." Based on the evidence presented here, there are worse restrictions to impose: the evidence here indicates that the uptick rule has only modest effects on short selling activity, and in fact may improve liquidity and other market quality measures.

[3] See Boni (2006) for some early data on naked shorting and Evans et al. (2008) for a discussion of strategic naked shorting by options market-makers.

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Table 1. Summary statistics

Pilot stocks are part of an SEC pilot program to suspend the NYSE's short-sale uptick rule. The statistics are first averaged over the cross section each day, and then averaged over days. The sample period includes all NYSE common stocks and extends from January through August 2007.

	Non-pilot	Pilot
Market cap ($billions)	9.401	10.000
Book-to-market	0.52	0.50
Daily share volume (millions)	0.865	1.004
n(firms)	962	372

Table 2. NYSE short sales before and after the repeal of the uptick rule

The pre-repeal period extends from January 3, 2007 through July 5, 2007. The post-repeal period extends from July 6, 2007 through August 31, 2007. Statistics are first averaged over the relevant cross section of stocks each day, and then averaged over days. Value-weighting uses the past month's market cap. T-stats are based on Newey-West standard errors.

Panel A. Value weighting

	Non-pilot				Pilot					
	pre	post	diff	t(diff)	pre	post	diff	t(diff)	Dif-in-dif	T-stat
Shares Shorted (millions)	1.016	2.049	1.033	5.15	1.156	1.657	0.501	4.23	0.533	2.28
Number of shorting trades	3,456	6,571	3,115	4.82	3,558	5,107	1,549	3.82	1,566	2.04
Short sales fraction of total volume	0.263	0.412	0.149	13.66	0.332	0.411	0.079	6.97	0.070	4.68
Average trade size of short sales (in shares)	251.9	262.9	11.0	3.70	272.4	271.6	-0.8	-0.36	11.7	3.18
Trading volume (millions of shares)	4.109	4.837	0.728	1.82	3.655	4.102	0.447	1.75	0.281	0.62
Short interest (thousands of shares)	601.4	556.3	-45.0	-0.11	561.3	467.6	-93.7	-0.26	48.6	0.09

Panel B. equal weighting

	Non-pilot				Pilot					
	pre	post	diff	t(diff)	pre	post	diff	t(diff)	Dif-in-dif	T-stat
Shares Shorted (millions)	0.238	0.402	0.164	3.97	0.344	0.473	0.129	3.01	0.034	0.58
Number of shorting trades	973	1,661	688	4.15	1,348	1,923	575	3.18	113	0.46
Short sales fraction of total volume	0.295	0.413	0.118	14.28	0.375	0.435	0.060	5.40	0.058	4.38
Average trade size of short sales (in shares)	191.1	193.8	2.7	1.16	201.9	196.9	-5.0	-3.14	7.7	2.73
Trading volume (millions of shares)	0.830	0.972	0.142	1.60	0.965	1.122	0.157	1.66	-0.015	-0.12
Short interest (thousands of shares)	197.7	174.2	-23.5	-0.18	223.3	192.1	-31.2	-0.21	7.7	0.04

Table 3. Are short sellers momentum or contrarian?

Cross-sectional averages of coefficients in individual firm daily time-series regressions. The dependent variable is shorting as a fraction of total trading volume in that stock on a given day. Explanatory variables include the return over the past five days (*lret*5), the average value of the dependent variable over the past five days (*lvall*5), the average daily price range over the past five days (*lpvol*5), the average trading volume over the past five days in millions of shares (*lvolu*5), and the average value of the VIX volatility index over the past five days (*lvix*5). All explanatory variables are also interacted with a post-repeal dummy variable; interacted variables are indicated by the suffix *d*.

Panel A. pilot stocks

	intercept	lret5	lret5d	lvall5	lvall5d	lpvol5	lpvol5d	lvolu5	lvolu5d	lvix5	lvix5d
coef.	0.328	0.906	-1.793								
tstat	138.23	9.41	-10.09								
coef.	0.169	0.770	-0.272	0.432	0.165						
tstat	74.95	10.34	-2.29	70.51	43.54						
coef.	0.339	1.199	-0.921			-1.791	3.987				
tstat	105.68	12.56	-6.22			-16.88	37.91				
coef.	0.325	1.463	-1.146					-0.189	0.514		
tstat	115.64	15.17	-7.30					-6.58	10.01		
coef.	0.336	1.316	-1.560							-0.003	0.006
tstat	87.42	14.08	-10.59							-11.79	44.59
coef.	0.210	0.851	-0.423	0.385	-0.029	-0.266	-1.036	0.011	0.288	-0.002	0.004
tstat	54.43	10.41	-2.90	52.39	-2.51	-2.23	-4.66	0.27	2.80	-7.55	12.86
coef.	0.322	1.444	-1.507			0.085	-1.239	-0.033	0.337	-0.002	0.005
tstat	74.17	14.70	-9.49			0.54	-4.85	-0.91	3.58	-5.57	18.82

Panel B. non-pilot stocks

	intercept	lret5	lret5d	lvall5	lvall5d	lpvol5	lpvol5d	Lvolu5	lvolu5d	lvix5	lvix5d
coef.	0.395	0.812	-1.041								
tstat	102.90	5.20	-3.62								
coef.	0.202	0.520	-0.137	0.474	0.059						
tstat	55.03	4.31	-0.71	47.79	9.66						
coef.	0.394	0.887	-0.598			-0.731	1.978				
tstat	75.85	5.74	-2.50			-4.26	11.61				
coef.	0.392	1.091	-0.849					0.030	0.252		
tstat	86.17	6.98	-3.34					0.64	3.03		
coef.	0.368	0.886	-0.979							0.001	0.002
tstat	59.11	5.85	-4.11							2.98	8.26
coef.	0.230	0.492	-0.029	0.401	-0.064	-0.169	-1.096	0.125	0.370	0.000	0.002
tstat	36.82	3.72	-0.12	33.68	-3.41	-0.87	-3.04	1.90	2.22	-0.09	4.33
coef.	0.355	0.966	-0.924			0.420	-1.712	0.115	0.387	0.002	0.001
tstat	50.45	6.07	-3.59			1.65	-4.14	1.97	2.54	4.18	2.65

Panel C. pilot minus non-pilot

	intercept	lret5	lret5d	lvall5	lvall5d	lpvol5	lpvol5d	lvolu5	lvolu5d	lvix5	lvix5d
coef.	0.067	-0.094	0.752								
tstat	14.94	-0.52	2.22								
coef.	0.032	-0.250	0.135	0.042	-0.106						
tstat	7.45	-1.77	0.60	3.62	-14.66						
coef.	0.055	-0.312	0.323			1.060	-2.009				
tstat	9.02	-1.72	1.15			5.25	-10.04				
coef.	0.067	-0.372	0.297					0.219	-0.262		
tstat	12.57	-2.03	0.99					4.01	-2.68		
coef.	0.032	-0.430	0.580							0.004	-0.004
tstat	4.37	-2.42	2.07							8.73	-16.40
coef.	0.020	-0.359	0.394	0.016	-0.035	0.097	-0.059	0.114	0.081	0.002	-0.002
tstat	2.74	-2.31	1.42	1.14	-1.58	0.43	-0.14	1.48	0.42	3.88	-3.07
coef.	0.033	-0.478	0.583			0.335	-0.473	0.148	0.050	0.003	-0.004
tstat	3.96	-2.56	1.93			1.12	-0.97	2.15	0.28	6.48	-7.63

Table 4. The aggressiveness of short sale orders

The fraction of short sale orders that are marketable at the time of submission (market order or marketable limit order) and is thus executed immediately, the fraction of passive short sale orders placed at or above the prevailing ask price, and the average effective spread earned by short sellers in cents.

Panel A. value weighting

	Non-pilot				Pilot					
	pre	post	diff	t(diff)	pre	post	diff	t(diff)	Dif-in-dif	T-statistic
Fraction Marketable	0.290	0.406	0.116	15.43	0.333	0.399	0.066	11.10	0.050	5.34
Fraction Passive	0.217	0.160	-0.057	-16.02	0.186	0.157	-0.029	-9.93	-0.028	-6.43
Effective Half-spread On Shorts	0.010	0.005	-0.005	-32.93	0.006	0.006	0.000	-1.12	-0.005	-10.87

Panel B. equal weighting

	Non-pilot				Pilot					
	pre	post	diff	t(diff)	pre	post	diff	t(diff)	Dif-in-dif	T-statistic
Fraction Marketable	0.326	0.365	0.039	5.29	0.354	0.373	0.019	2.41	0.020	1.88
Fraction Passive	0.182	0.138	-0.044	-11.08	0.157	0.134	-0.023	-7.94	-0.021	-4.29
Effective Half-spread On Shorts	0.011	0.005	-0.006	-13.95	0.006	0.007	0.001	1.50	-0.007	-8.29

Table 5. The informativeness of short sales

Each day pilot or non-pilot NYSE common stocks are sorted into quintiles based on the shorting's fraction of the day's trading volume over the past five days. Heavily shorted (lightly shorted) stocks are in quintile 5 (quintile 1). The quintile portfolio is held for the next 20, 40, or 60 trading days, and the mean portfolio return or Fama-French (1993) alpha is reported in the table, expressed in percent. T-statistics are based on Newey-West standard errors with the appropriate number of lags to account for the overlap in holding period returns.

Panel A. Full sample, Jan 2007 – August 2007

Holding period in days	Portfolio	nonpilot mean	nonpilot t-stat	nonpilot alpha	nonpilot t-stat	pilot mean	pilot t-stat	pilot alpha	Pilot t-stat
20	q1	0.6441	0.79	0.3876	3.32	0.0808	0.09	-0.1729	-0.82
20	q2	0.5574	0.67	0.0583	0.26	0.6490	0.76	0.3895	3.84
20	q3	0.5217	0.54	0.0567	0.49	0.6153	0.52	0.4230	1.54
20	q4	0.1398	0.15	-0.2769	-1.34	0.1664	0.16	0.0390	0.16
20	q5	-0.5019	-0.59	-0.6230	-2.66	-0.6969	-0.61	-0.4431	-1.23
20	q5-q1	-1.1460	-3.43	-1.0106	-5.96	-0.7777	-1.38	-0.2703	-0.51
40	q1	1.4181	1.07	0.3392	3.52	0.5612	0.43	-0.7963	-2.68
40	q2	1.2273	0.88	-0.3502	-1.99	1.4861	0.97	1.1113	10.73
40	q3	1.3928	0.90	0.1133	0.60	1.4149	0.72	0.8419	2.95
40	q4	0.8458	0.56	-0.2702	-0.77	0.6518	0.32	0.1672	0.64
40	q5	-0.7775	-0.52	-1.1058	-5.15	-1.2951	-0.55	-0.0903	-0.28
40	q5-q1	-2.1956	-5.75	-1.4450	-5.78	-1.8563	-1.35	0.7060	2.34
60	q1	2.0907	1.64	0.0848	0.66	0.7973	0.60	-0.2815	-1.61
60	q2	1.5878	1.09	-0.9169	-2.77	1.7908	0.99	0.9867	1.35
60	q3	1.6392	0.97	0.2021	0.49	2.1632	1.05	1.9889	6.96
60	q4	0.3572	0.22	0.1355	0.26	0.7456	0.29	-0.0286	-0.06
60	q5	-1.8887	-0.94	-0.5314	-1.36	-2.9349	-0.86	0.6938	1.63
60	q5-q1	-3.9794	-3.77	-0.6162	-1.28	-3.7322	-1.60	0.9753	1.96

Panel B. Difference in difference, pre- vs. post-repeal

Holding period in days	Pilot pre	post	diff	t(diff)	Nonpilot pre	post	diff	t(diff)	dif-in-dif	t-statistic
20	-0.150	-2.647	-2.497	-3.547	-1.333	-0.591	0.741	1.467	-3.239	-3.701
40	-0.928	-4.618	-3.690	-3.021	-2.180	-2.243	-0.063	-0.069	-3.627	-2.576
60	-2.360	-7.816	-5.457	-2.198	-3.251	-6.146	-2.895	-1.617	-2.561	-0.915

Figure 1. Shorting rises after tick test repeal. Shorting is measured each day Jan-Aug 2007 for each NYSE stock as the fraction of NYSE/Arca daily share volume. Cross-sectional medians are reported for both pilot and non-pilot stocks.

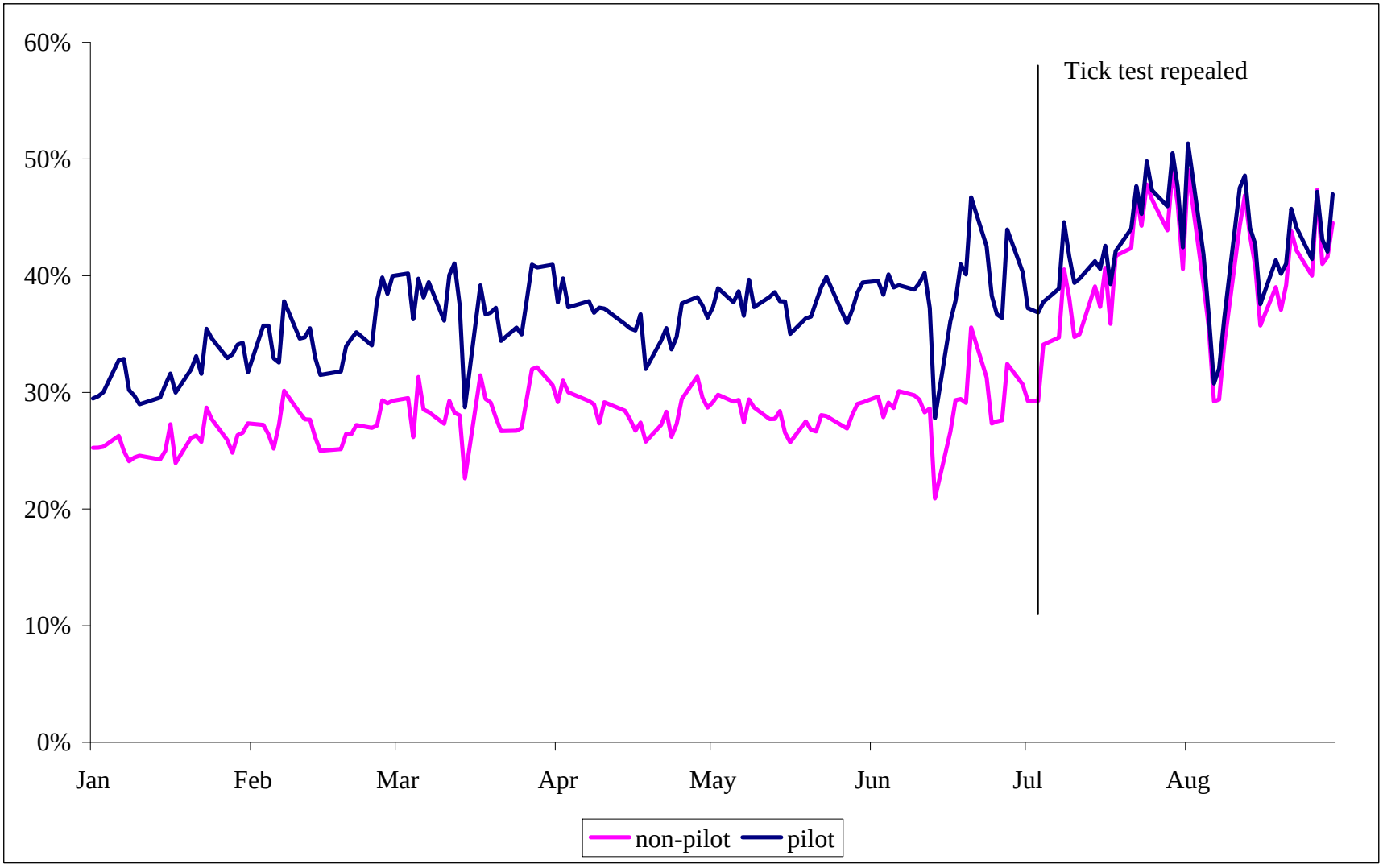

Figure 2. Stock returns around tick test repeal. Cumulative returns around June 13, 2007 announcement and July 6, 2007 effective date of tick test repeal. Value-weighted market returns are on all NYSE stocks; pilot less non-pilot returns are the cumulative difference in average daily returns. Quantile lines are based on 2007 pre-announcement distributions and can be used to test the null hypothesis at the 5% level of equal means for cumulative post-announcement returns on pilot and non-pilot stocks.

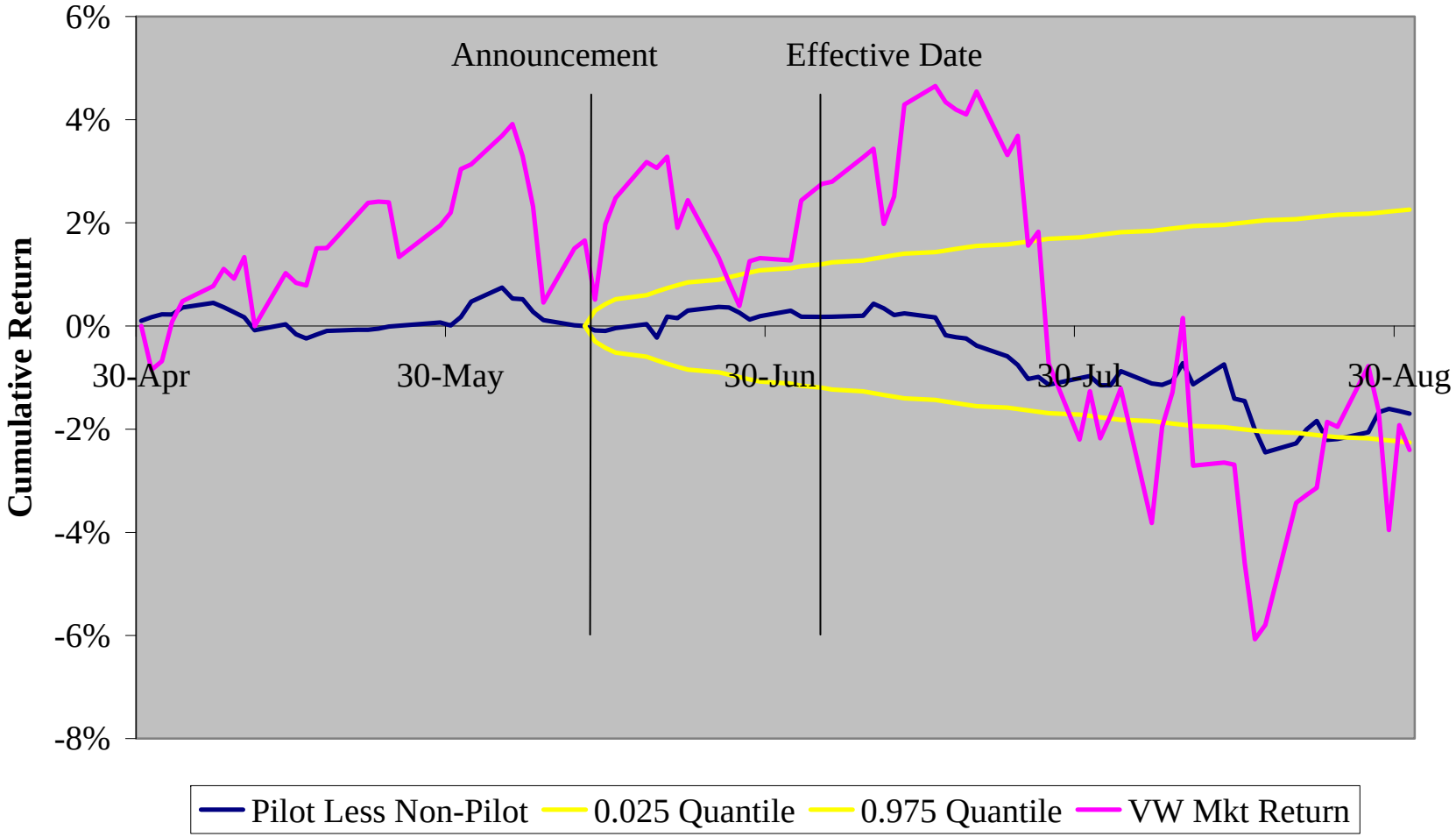

Figure 3. Short-sale orders become more aggressive after tick test repeal. The fraction of short sale orders that are marketable (market orders or marketable limit orders) and the fraction of short sale orders that are passive (placed above the existing ask price). Fractions are calculated each day for each stock during Jan-Aug 2007, and daily cross-sectional means are reported for pilot and non-pilot stocks.

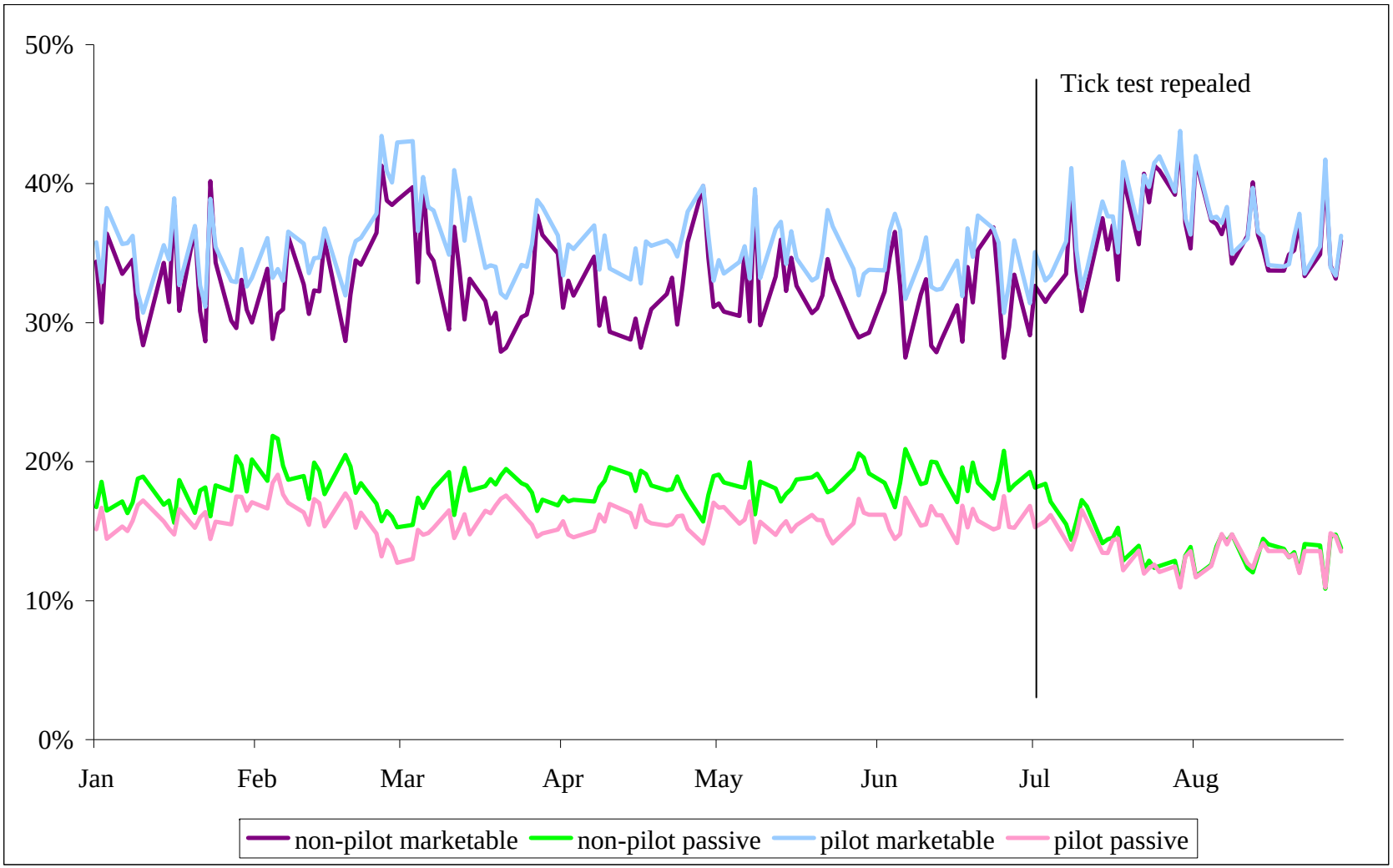

Figure 4. Effective spreads before and after repeal of the uptick rule. Cross-sectional average proportional effective spreads on the indicated NYSE common stocks during each trading day from January through August 2007.

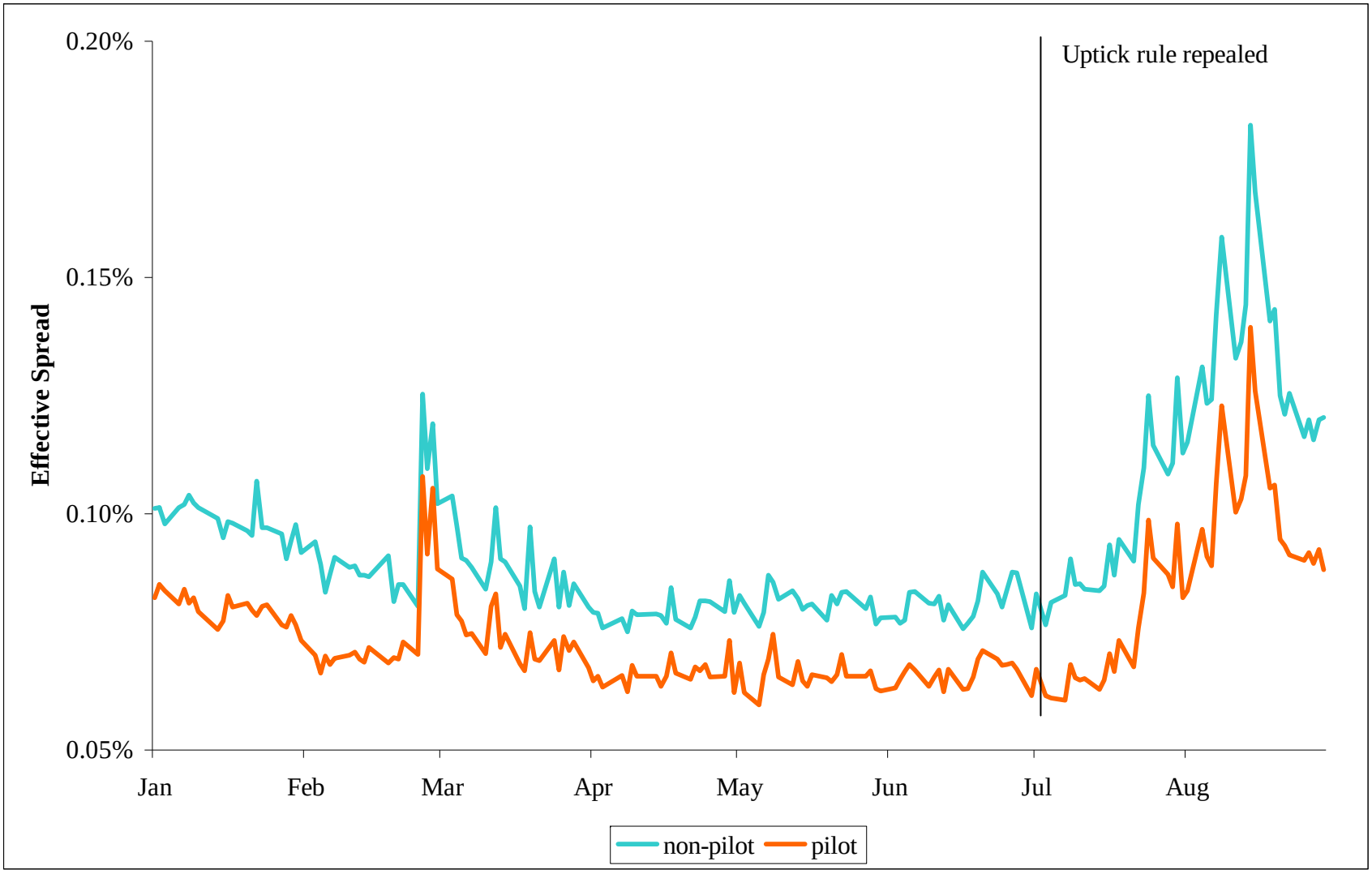

Figure 5. Informativeness of pilot vs. non-pilot short sales. NYSE common stocks are sorted into quintiles based on short selling (shares sold short as a percentage of NYSEArca trading volume) over the past five days. We show return differences for holding periods of 20 trading days beginning on the indicated day. Return differences are for the heaviest shorting quintile (q5) less the lightest shorting quintile (q1) and are expressed in percent; negative numbers indicate that heavily shorted stocks underperform over the next 20 trading days.

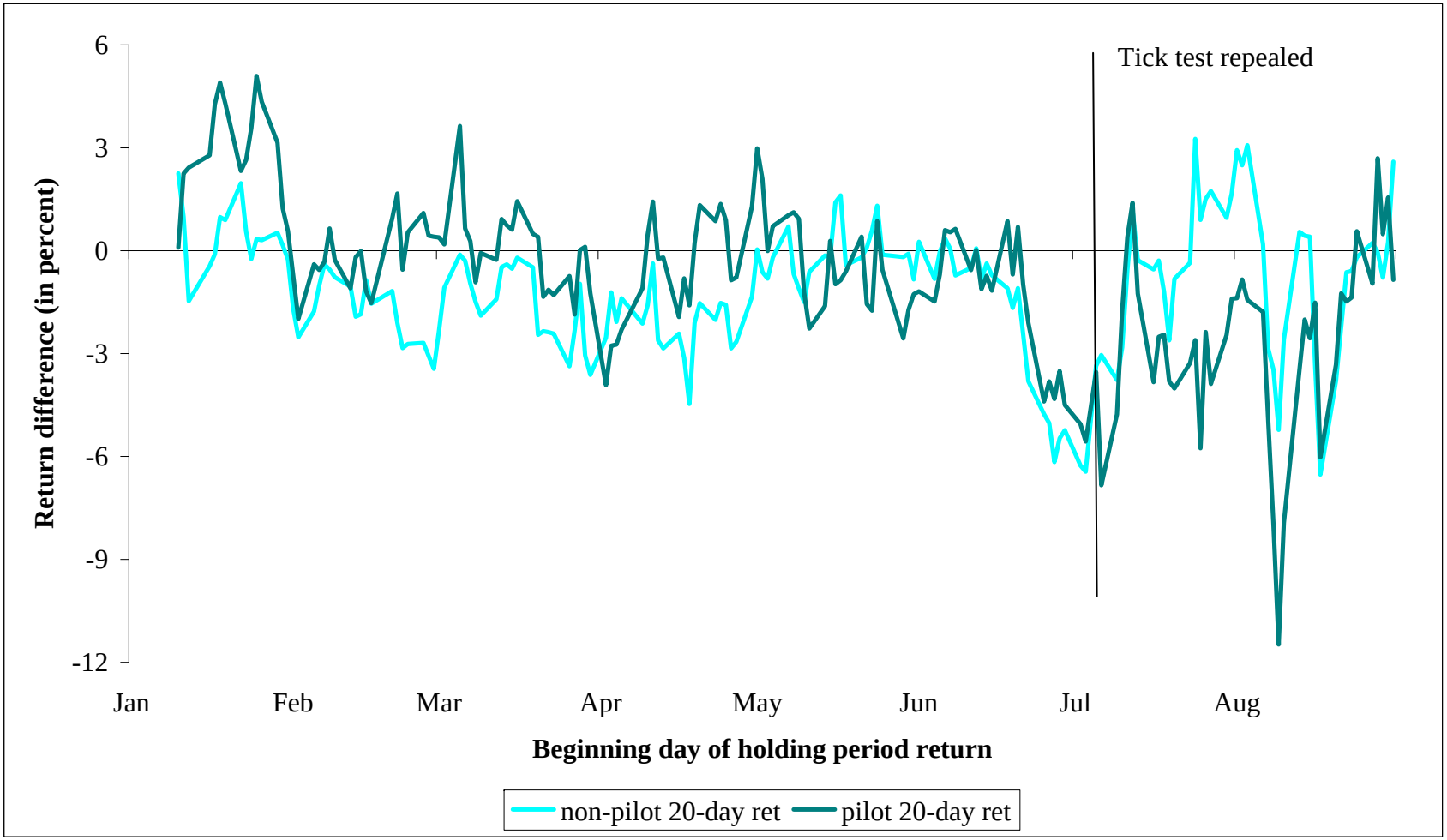

Figure 6. Average informativeness of pilot vs. non-pilot short sales at various horizons pre- and post-repeal. For each day from January 1, 2007 through August 31, 2007, NYSE common stocks are sorted into quintiles based on short selling prevalence (shares sold short as a percentage of NYSEArca trading volume) over the past five days. We show average return differences for holding periods between 1 and 60 trading days thereafter. Return differences are for the heaviest shorting quintile less the lightest shorting quintile and are expressed in percent; negative numbers indicate that heavily shorted stocks underperform on average over that length holding period.