Does The Uptick Rule Inflate Stock Prices?

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ABSTRACT

Does the uptick rule inflate stock prices? Miller (1977) hypothesizes that short sale constraints lead to stock overvaluation. In this paper I test this hypothesis in a power setting in which the Security and Exchange Commission (SEC) suspended the uptick rule for a pre-chosen set of stocks (pilot stocks) in 2005. The results suggest that on the NYSE the suspension of the uptick rule mitigates stock overvaluation and brings stock prices closer to their fundamental values. On the NASDAQ, however, lifting the uptick rule goes beyond correcting stock overvaluation; it leads to stock undervaluation. The results are robust after controlling for other factors, such as firm size, book-to-market ratio, stock return momentum, and availability of exchange-traded-options.

Keywords: The Uptick Rule; Short Sales; Stock Returns; Stock Overvaluation

1. INTRODUCTION

A short sale is the sale of a security by an investor who does not own it. Short sellers were blamed for the stock market crash of 1929. During the 1930s, the lawmakers in the U.S. introduced the uptick rule, which prohibit short sales on the down-tick basis, to prevent short sellers from manipulating stock prices downward¹. Miller (1977) hypothesizes that short sale constraints prevent pessimists from registering negative information and opinions in stock prices, resulting in overvaluation and low future returns. However, Miller's hypothesis does not explain why rational investors would buy overpriced stocks (Jones and Lamont, 2002). Diamond and Verrecchia (1987) argue that stocks may not be overpriced because the expected negative information may already be incorporated in stock prices even though the actual negative information are not when short sales are constrained. This assertion directly contradicts to Miller's overvaluation hypothesis.

Previous empirical studies have not generated convincing evidence on Miller's overpricing hypothesis. For example, Boehme, *et al.* (2006) show that the most short-sale constrained, high-dispersion stocks earn annualized abnormal returns of -14.8% to -20.7%, suggesting stocks subject to both short sale constraints and investors' disagreement are likely to be overvalued. In contrast, Doukas, *et al.* (2006) adopt an alternative proxy for investors' opinion dispersion and find that Boehme *et al.* (2006)'s results are not systematically significant. Previous studies have employed various measures for short sale constraints; such as monthly short interests (Dechow, *et al.*, 2001; and Desai, *et al.*, 2002), share lending costs and share lending supply (D'Avolio, 2002; Jones and Lamont, 2002; Ofek and Richardson, 2003; and Nagel, 2005), institutional ownership (Chen, *et al.*, 2002; Asquith, *et al.*, 2005), availability of exchange traded options (Danielson and Sorescu, 2001), and legal threats on short selling (Lamont, 2004). But each of these short sale constraints measures has limitations. For example, using of monthly short interest, one cannot distinguish short selling demand from short selling supply, therefore may either overestimate or underestimate the magnitude of stock overvaluation (Cohen, *et al.*, 2007; Chen, *et al.*, 2002). Institutional ownership as a proxy for short sale constraint has endogeneity problem, because institutional investors may have capability to identify stocks with high future stock returns.

¹ Rule 10a-1 of Securities Exchange Act of 1934 provides that an exchange-traded security may not be sold short at a price that is either lower or equal to the last trading price. This is so called the uptick rule on the NYSE. The National Association of Securities Dealers (NASD) introduced in 1994 a bid-test for NASDAQ listed stocks, the NASD Rule 3350, which provides that when the bid is a downtick from the previous bid, short sellers other than market dealers cannot short at prices lower than one penny above the bid. I refer to these short sale price test rules as the uptick rule in this paper.

The period surrounding the introduction of the pilot program in 2005 offers a powerful empirical setting for examining whether short sale constraints lead to stock overpricing². Adopting the uptick rule as the short sale constraints has several advantages. First, the suspension status of the uptick rule during the pilot program provides us with a setting that clearly separates short sale constrained stocks (control stocks) from less short sale constrained stocks (pilot stocks). Second, a firm-size and book-to-market ratio matched sample of control stocks that are subject to the price test and are trading in a common market environment during the same time period is available. Third, the uptick rule as a proxy of short sale constraints is free of the endogeneity concern. The SEC chose pilot stocks from the Russell 3000 membership list by ranking on average daily dollar trading volume for the previous year and then selecting every third stock as a pilot stock; the remaining stocks in the Russell 3000 are control stocks. This process should have eliminated any systematic difference between pilot and control stocks and avoided any endogeneity problem. For these reasons, the pilot program that suspended the uptick rule for pilot stocks in 2005 represents one of the most powerful settings available to date for testing Miller's overpricing hypothesis.

Using the Regulation SHO short selling data from 2005, I examine the impact of the suspension of the uptick rule on stocks returns. Comparing pilot and control stocks listed on the NYSE during the sample period from May to December 2005, I show that the suspension of the uptick rule on the NYSE mitigates stock overvaluation as much as 3% of the stock value over a one year period. This result is consistent with the notion that stock overvaluation is associated with the presence of investor opinion dispersion and short sale constraints. The overvaluation reduction effect varies depending on the types of stocks; it is mostly driven by stocks with no options, small stocks, and value stocks. For stocks with exchange-traded-options, it appears that the suspension of uptick rules cannot effectively help to reduce stock overvaluation since overvaluation in those stocks has already been mitigated by the introduction of options. This is consistent with Danielsen and Sorescu (2001) and highlights the role of stock option as an alternative of short selling vehicle in reducing stock overvaluation.

On the NASDAQ, however, the results show that lifting the uptick rule goes beyond correcting stock overvaluation. The prices of high-dispersion stocks tend to be distressed relative to low-dispersion stocks. When the uptick rule on the NASDAQ is suspended for pilot stocks, investors who hold the most pessimistic opinions can aggressively submit downtick short sale orders, pushing stock prices down to a level that may be lower than the true stock value. Further, the suspension of the uptick rule on the NASDAQ makes it easier for 'predatory' short sellers to aggressively submit short orders and manipulate stock price downwards. Therefore, the results here suggest that the SEC's recent decision to permanently remove the uptick rule in July 2007 may not be considered as an optimal policy, if such undervaluation is driven by "predatory" short sellers' price manipulation³.

This paper contributes to the ongoing research by investigating whether stock prices tend to be less overvalued when a certain short sale constraint is relaxed, using a study design that complements prior studies. First, I use Regulation SHO daily short selling data from 2005 that clearly separates stocks with short sale constraints (control stocks) from stocks with lower short sale constraints (pilot stocks). Using this method, I examine the impact of the removal of the uptick rule on stock returns. The suspension status of the uptick rule, based on the SEC's recently adopted Regulation SHO, provides us with a proxy for short sale constraints that is easy to identify and is not subject to an endogeneity criticism. Second, the use of high frequency short sale data in this paper improves upon the calendar time portfolio approach in the literature. Previous literature that uses monthly short interest as a proxy for short sale constraints is unable to capture the daily variation of short selling activities, overlooking the impact of short selling on short-term stock returns. Using daily short selling data facilitates the examination of the impact of relaxing a short sale constraint on stock returns and allows me to further explore the time dynamics of how the market corrects stock overvaluation.

² To facilitate the SEC and academics to study the effect of the uptick rule on market quality and trading processes, the SEC implemented a pilot program beginning on May 2, 2005 which suspended uptick rule restrictions for a set of pre-chosen "pilot stocks". The pilot program established by the Regulation SHO enables comparison between pilot and control stocks, thus providing us with a natural experiment to study the effect of removing uptick rules on stock returns in a controlled environment.

³ The SEC revoked the uptick rule for all exchanged listed securities in July 2007. Also see Brunnermeier and Pedersen (2005) for details of "predatory short selling".

Three recent studies are most closely related to this paper. Using Reg SHO short sale data during a 6-month period around the introduction of the Pilot program, Diether, *et al.* (2009) examine the effect of the uptick rule on a variety of market quality measures, such as trading volume, liquidity, and volatility. They find that the suspension of the uptick rule on the NYSE is associated with significant increase in short selling activities, a large reduction in the asymmetries of depth and order flows, and a slight increase in short-term volatility. Their testing results are confirmed by Alexander and Peterson (2008), who use an 8-month Reg SHO data around the introduction of the Pilot program. Both studies suggest that the uptick rule should be removed permanently. The Economic Analysis Office of the SEC (2007) compares pilot and control stocks along several dimensions. They show that the suspension of the uptick rule is associated with increased short selling activity, more orders executed on downticks, a decrease in quote depth, higher intraday volatility for small stocks, and lower intraday volatility. They suggest that removing the uptick rule has not had a deleterious impact on market quality or liquidity. While these studies examine general market quality measures such as bid-ask spread, bid and ask depth, liquidity, and volatility, this paper adds to the current literature by focusing on the impact of the uptick rule on stock returns.

Nevertheless, this study has several limitations. First, the sample period is short. I use only twelve months of short selling data in the analysis and this restricts the generalizability of the conclusions to other periods. Second, I rely on the mean scaled standard deviation of sell-side brokerage firms' earnings forecasts to measure the dispersion of investors' opinions. This may not be a perfect proxy for opinion dispersion, because aggregated sell-side brokers' earnings forecasts may be upwardly biased due to interest conflicts. Also, investors may form different evaluations on stock prices even when they have the same earnings forecast information. Thirdly, the causality relationship between "predatory" short selling and the undervaluation of high-dispersion stocks on the NASDAQ has not been established in this paper. It is important to justify the assertion that removing the bid-price test rule on the NASDAQ was not an optimal policy for the SEC. Future research that examines the impact of removing uptick rules on "predatory" short selling would be a fruitful extension of this study.

The rest of this paper proceeds as follows. Section 2 develops the testable hypotheses. Section 3 describes data and samples. Section 4 examines the impact of suspension of uptick rule on stock returns on both the NYSE and the NASDAQ. Several robustness tests are performed in Section 5. Section 6 provides conclusions.

2. HYPOTHESES DEVELOPMENT

The goal of this paper is to analyze the role of the uptick rule in shaping cross sectional future stock returns. The null hypothesis takes Miller's (1977) view that stock prices tend to be overvalued in the presence of short sale constraints and investor opinion dispersion. In this paper, I measure overvaluation in stocks as the return differential between low- and high- investor opinion dispersion portfolios (low-and high-dispersion portfolio, hereafter), and examine the role of the uptick rule as a short sale constraint. When the uptick rule is in effect, a significant proportion of investors who hold the most negative opinions on a certain stock are prohibited from short selling at a desired price. Reduced selling pressure on these stocks leads to an upwardly biased price and a subsequent low future return. When the uptick rule is suspended for pilot stocks, it would help short sellers to promptly register their negative opinions in stock prices on the down-ticks, thus mitigating the stock overvaluation. Therefore, the null hypothesis states that the return differential between low- and high-dispersion portfolios should be smaller for pilot stocks than for control stocks, and that the return differential between low- and high-dispersion portfolios should be positive for both pilot and control stocks. Specifically, the null hypothesis can be expressed as the following.

$$H_{null} : (D1 - D3)_{control} > (D1 - D3)_{pilot} > 0 \quad (1)$$

where D1 is the low-dispersion portfolio return and D3 is the high-dispersion portfolio return. The alternative hypothesis states that market prices will be unbiased and future returns will be independent of the uptick rule restriction. Diamond and Verrecchia (1987) model a rational market maker who sets bids and asks prices rationally. Even with heterogeneous expectation and short sale constraints, the equity price may be unbiased. Similarly, Hong and Stein (2000) introduce rational arbitrageurs who face no short sale constraints in a rational equilibrium model. The arbitrageurs observe the actions of overconfident investors with short sale constraints and formulate rational expected stock prices. Any upward biased stock price will be corrected by arbitrageurs. Thus, the alternative

hypothesis states that there is an ambiguous relation between the uptick rule and future stock returns, and the return differential between low- and high-dispersion portfolios will not be smaller for pilot stocks than those for control stocks.

$$H_{\text{alternative}} : (D1 - D3)_{\text{control}} = (D1 - D3)_{\text{pilot}} = 0 \quad (2)$$

3. DATA AND SAMPLES

To comply with the Regulation SHO, stock market dealers and brokers were required to report tick-by-tick short sales transactions to the SEC during the pilot program in 2005. The resulting data is Regulation SHO data. I obtain NYSE Regulation SHO data from NYSE TAQ dataset. The NASDAQ SHO data was provided by the NASD. Stock returns are from the Center for Research in Securities Price (CRSP) Daily Stocks Combined Files and firm Characteristic variable data are from the COMPUSTAT. The data on analysts' earnings estimates are obtained from the First Call Historical Estimates. Option availability data was obtained from CBOE (Chicago Board of Option Exchange). Following Danielsen and Sorescu (2001) and Diether et al. (2002), I measured investors' opinions dispersion as the standard deviation of analysts' earnings forecasts scaled by the mean estimations. Data for analyst quarterly earnings forecasts are obtained from the First Call dataset.

To facilitate the comparison between uptick rule unrestricted (pilot) stocks and the uptick rule restricted (control) stocks, I construct pilot and control samples for a post-SHO period from May to December 2005 for both NYSE- and NASDAQ-listed stocks⁴. The SEC chose pilot stocks from the Russell 3000 membership list by ranking on average daily dollar trading volume for the previous year and then selecting every third stock as a pilot stock; the remaining stocks in the Russell 3000 are control stocks. Russell 3000 membership lists are obtained from the Russell Company. I then obtain NYSE pilot stocks lists from the NYSE. On May 2, 2005, there were 486 NYSE-listed pilot stocks. To eliminate the potential effect of index inclusion or index exclusion on stock returns, I require that sample stocks were members of the Russell 3000 index after the June 2004 reconstitution, and remained in the Russell 3000 member list after the June 2005 reconstitution. Thus, I exclude stocks that were added to the index due to IPOs during the period June 2004 through the end of 2005, as well as stocks that were eliminated during the same period due to mergers, bankruptcies, and ticker changes. Then the CRSP and COMPUSTAT databases are checked to see if the stocks have positive book-to-market ratios. Stocks with negative book-to-market ratios are excluded from the analysis to reduce the effect of outliers. The resulting NYSE-pilot sample has 418 stocks. To construct the NYSE-control stock sample, I first include the Russell 3000 stocks that are listed on the NYSE. Then I exclude stocks that were added to or eliminated from the index. Excluding stocks on the pilot stock list as of May 2, 2005 results in 937 NYSE-control stocks. Next, NYSE-control stocks are matched with NYSE-pilot stocks by year-end 2004 market capitalization and year-end 2004 book-to-market ratios, resulting in 418 pairs of stocks in both NYSE-pilot and -control samples. Following the same procedure, I construct NASDAQ-pilot and -control samples consisting of 358 pair of stocks.

The summary statistics based on various firm-specific characteristics for both the pilot and control samples during the post-SHO period from May to December 2005 are detailed in Table 1. Short sale ratio is defined as average daily shorting volume divided by the trading volume. Firm size is measured as the market capitalization of individual stocks, which equals to the product of shares outstanding and the daily closing price. Book value is equal to shareholders' equity plus deferred taxes and investment tax credit, and minus book value of preferred stock. Daily share turnover is the ratio of daily trading volume to shares outstanding. Risk adjusted (beta excess) returns are calculated as the excess return of a specific stock less the average return of all stocks in its beta portfolio based on previous year beta ranking.

⁴ Previous literature reveals that the impact of uptick rule suspension on market quality is different for NYSE-listed stocks and for NASDAQ-listed stocks. Diether, et al. (2006) and the Office of Economic Analysis of the SEC (2007) argue that the NYSE's uptick rule is a more binding rule for short sellers. Furthermore, Diether, et al. (2006) argue that NASDAQ's bid-test rule has a much more limited effect on the trading strategies of short sellers than the tick-test rule on the NYSE, because short sellers of NASDAQ-listed stocks can use a more natural mixture of aggressive marketable limited orders and passive limit orders to execute their short sales. Therefore, I perform separate analyses for NYSE-listed and NASDAQ-listed stock to accommodate different natures of uptick rule constraints on the NYSE and NASDAQ-listed stocks.

Table 1. Descriptive Summary for the Pilot and Control Samples during the post-SHO period from May to December 2005

Panel A: NYSE-listed Stocks				
	Pilot	Control	(Pilot-Control)	t-stat
Short Sale Ratio	23.10% (0.25%)	20.94% (0.27%)	2.16% ***	5.83
Investor Opinion Dispersion	0.37 (0.03)	0.365 (0.021)	0.005	0.14
Firm Size (in million dollars)	7,968 (879)	8,074 (910)	-106	-0.08
Book-to-Market	0.558 (0.0175)	0.569 (0.0226)	-0.011	-0.38
Daily Share Turnover	0.70% (0.02%)	0.74% (0.02%)	-0.04%	-1.52
Daily Stock Return	0.08% (0.01%)	0.04% (0.00%)	0.04% ***	6.25
Risk Adjusted (Beta Excess) Daily Return	-0.02% (0.01%)	-0.01% (0.00%)	-0.01%	-1.49
# of Stocks with Options	46.14%	50.70%	-4.57%	n/a
Panel B: NASDAQ-listed Stocks				
	Pilot	Control	(Pilot-Control)	t-stat
Short Selling Ratio	19.99% (0.0015)	18.60% (0.0010)	1.39% ***	7.63
Investor Opinion Dispersion	0.42 (0.038)	0.45 (0.033)	-0.03	-0.59
Firm Size (in million dollars)	2,467 (485)	2,526 (473)	-59	-0.08
Book-to-Market	0.467 (0.0167)	0.454 (0.0206)	0.013	0.49
Daily Share Turnover	0.97% (0.0004)	0.95% (0.0003)	0.02%	0.42
Daily Stock Return	0.11% (0.009%)	0.12% (0.006%)	-0.01%	-0.48
Risk Adjusted (Beta Excess) Daily Return	-0.03% (0.009%)	-0.02% (0.006%)	-0.01%	-0.9
#of Stocks with Options	46%	43%	3%	n/a

Standard errors for mean estimates are in parentheses. The differentials between pilot and control stocks are shown as (pilot-control), followed by the t-statistics. *** is significant at 1% level.

Table 1 shows that during a period from May to December 2005 on the NYSE, the short sale ratio for pilot stocks (23%) is greater than that for control stocks (21%) by approximately two percentage points. Similarly, on the NASDAQ short sale ratio for pilot stocks is 1.4% greater than that for control stocks. These differences are statistically significant. Table 1 also shows that during the post-SHO sample period, the pilot sample is well-matched with the control sample on firm size, book to market ratio, daily share turnover, and investor opinion dispersion. Differences in these characteristics between two samples are not significantly different from zero. Panel A of Table 2 shows that the average daily raw return for the pilot sample is significantly greater than for the control sample. It seems that without the uptick rule restriction, pilot stocks tended to be less overvalued on the NYSE. However, factors other than the uptick rule suspension may have contributed to such return difference. To adjust for stock market systematic risk, I use the risk-adjusted (beta excess) returns to measure the return differences. To calculate the risk adjusted (beta excess) returns, I follow a two-step procedure. First, I run the following market model based on previous year stock returns data to calculate beta estimates for all available stocks in the CRSP dataset.

$$R_{it} - R_{ft} = \alpha_{it} + \beta_i \cdot (R_{mt} - R_{ft}) + \varepsilon_{it}; \quad (3)$$

In the equation, R_{it} is stock returns, R_{mt} is the market return, measured by value-weighted market return, and R_{ft} is the risk free rate, measured by three-month Treasury bill rate. Then, I rank stocks into 10 deciles based on beta estimates. Finally, I calculate beta excess return as the difference between the stock daily returns and beta ranking portfolio returns for both pilot and control stocks. The results show that there is no statistically significant distinction between the pilot sample and the control sample. According to option availability information from the CBOE, about 50% of control stocks have options available while 46% of pilot stocks have options available. This slight difference in the option availability may also contribute to the return difference between pilot and control samples, making it necessary to control for the option availability in later analysis.

4. THE IMPACT OF THE SUSPENSION OF THE UPTICK RULE ON STOCK RETURNS

The extant literature measures stock overvaluation by using the subsequent abnormal returns of various test portfolios (Diether et al., 2002 and Boehme et al., 2006). In this paper, I use the risk-adjusted return differential between low- and high- dispersion portfolios as a proxy for stock overvaluation. If overvaluation is caused by disagreement among investors when short sales are constrained, then portfolios consisting of high-dispersion stocks would yield lower risk-adjusted returns than the portfolio consisting of low-dispersion stocks in the presence of short sale constraints. Therefore, a smaller positive value of the return differential between low- and high-dispersion portfolios in the pilot stock sample than in the control stock sample would provide evidence in support of the null hypothesis, which states that high-dispersion stocks tend to be less overvalued relative to low-dispersion stocks in the pilot sample than in the control sample. Similarly, a non-significant value of the return differential between low- and high-dispersion stocks would support the alternative hypothesis which states that there is an ambiguous relation between short sale constraints and future stock returns.

Following Boehme and Sorescu (2002) and Boehme et al. (2006), I adopt the standard calendar-time portfolio method to measure stock returns. Each day, I sort stocks into different categories based on the measure of investor opinion dispersion, then I hold an equally (or value) weighted portfolio for a specific holding period and calculate the cumulative portfolio holding period return. This process is repeated each day during the sample period, generating a series of observations of portfolio cumulative returns for each holding period. Then, the specific cumulative portfolio holding period return is computed as the simple average of previously generated portfolio holding period cumulative returns. To adjust for serial correlation, t-statistics are calculated based on the Newey-West standard errors (estimator) with lags up to 20 days. Due to the data frequency limitation, previous literature measure portfolio returns by holding stocks for a period equal to or longer than one month. However, it is possible that the impact of short sale constraints will be reflected in stock prices sooner than one month. Previous studies using monthly short interest have been unable to investigate the short-term dynamics on how stock overvaluation is corrected as uncertainty resolves over time. In this paper, high frequency short sale data provide me with great flexibility in choosing the stock return holding period, and allow me to conduct a time dynamics analysis on how the market generates and corrects stock overvaluation as uncertainty raise and resolve as time goes on.

To construct portfolios with holding periods ranging from one day to one year, I first sort both pilot and control stocks into thirds based on the measure of investors' opinions dispersion. Then I hold an equally-weighted portfolio for a variety of periods ranging from one day to one year⁵. This process is repeated each day from May 2, 2005 to Dec 30, 2005, so there is an overlap of 170 holding periods on the portfolio returns. Each portfolio return is the average of 170 different accumulative portfolio returns with holding periods in the same range as above. If lifting uptick rules relaxes short sale constraints and mitigates stock overvaluation, then the return differential between low and high dispersion portfolios will be less for pilot stocks than for control stocks.

Table 2 presents the risk-adjusted return differential between low- and high-dispersion portfolios during the post-SHO period, for pilot and control samples on the both stock exchanges. The risk-adjusted return differentials are denoted as (D1-D3) in Table 2, where D1 is the low-dispersion portfolio return and D3 is the high-dispersion portfolio return.

⁵ Equally-weighted portfolio returns are calculated and presented in this paper. Value-weighted portfolio returns are also calculated but not reported because results based on value-weighted portfolio returns are essentially the same as the results based on equally-weighted portfolio returns.

Table 2. The risk-adjusted return differential between low- and high-dispersion portfolios during the post-SHO period

HD	NYSE						NASDAQ					
	Pilot	t	Control	t	Diff	t	Pilot	t	Control	t	Diff	t
	(1)		(2)		(2)-(1)		(3)		(4)		(4)-(3)	
1	0.03%	0.99	0.04%	1.15	0.01%	0.18	0.03%	0.24	0.04%	0.88	0.02%	0.14
5	0.06%	0.94	0.19%**	2.20	0.13%	1.22	0.03%	0.16	0.11%	1.03	0.08%	0.32
10	0.20%**	2.33	0.34%***	2.71	0.14%	0.93	0.03%	0.10	0.31%**	1.93	0.28%	0.83
20	0.49%***	3.64	0.41%**	2.24	-0.07%	-0.21	-0.20%	-0.45	0.60%***	2.70	0.80%	1.63
30	0.43%***	2.51	0.86%**	2.20	0.43%	0.99	-0.40%	-0.77	1.00%***	3.40	1.40%**	2.34
40	0.56%***	2.70	1.23%***	2.62	0.67%	1.31	-0.68%	-1.14	1.36%***	4.20	2.04%***	3.00
50	0.72%***	2.94	1.99%***	3.64	1.27%**	2.11	-1.33%**	-2.05	1.24%***	3.95	2.57%***	3.57
60	0.93%***	3.70	2.18%***	3.11	1.25%**	1.98	-1.94%***	-2.90	1.22%***	3.62	3.16%***	4.22
70	1.23%***	5.26	2.83%***	4.87	1.60%***	2.56	-2.60%***	-3.94	1.21%***	3.40	3.81%***	5.08
80	1.49%***	7.82	3.28%***	5.08	1.79%***	2.66	-3.01%***	-4.66	1.16%***	3.06	4.16%***	5.57
90	2.08%***	7.76	3.93%***	7.38	1.85%***	3.10	-3.27%***	-5.25	1.04%***	2.88	4.32%***	5.99
100	2.08%***	11.34	4.11%***	8.03	2.03%***	3.73	-3.42%***	-5.78	0.97%***	2.72	4.39%***	6.35
110	2.22%***	11.81	4.37%***	7.56	2.15%***	3.53	-3.53%***	-5.67	1.05%***	3.04	4.58%***	6.43
120	2.42%***	12.26	4.97%***	8.05	2.56%***	3.94	-3.67%***	-5.62	1.16%***	3.31	4.83%***	6.52
130	2.34%***	12.01	4.53%***	7.78	2.19%***	3.56	-4.09%***	-5.97	0.97%***	2.40	5.06%***	6.36
140	2.50%***	12.05	5.02%***	7.45	2.52%***	3.57	-4.17%***	-5.79	1.02%***	2.80	5.18%***	6.43
150	2.50%***	11.39	4.88%***	6.85	2.38%***	3.20	-3.98%***	-5.21	1.06%***	2.75	5.03%***	5.89
160	2.50%***	10.86	4.71%***	6.69	2.21%***	2.98	-3.81%***	-4.73	1.44%***	3.84	5.25%***	5.91
170	2.49%***	9.34	5.16%***	6.76	2.67%***	3.30	-3.52%***	-3.97	1.74%***	4.32	5.25%***	5.40
180	2.38%***	8.99	5.00%***	5.86	2.62%***	2.93	-3.31%***	-3.53	2.18%***	6.25	5.49%***	5.49
190	2.36%***	8.93	5.49%***	6.47	3.13%***	3.52	-2.94%***	-2.98	2.30%***	6.55	5.24%***	5.00
200	2.42%***	8.52	4.96%***	7.04	2.53%***	3.34	-2.54%***	-2.49	2.54%***	6.84	5.08%***	4.67
210	2.39%***	8.17	5.11%***	7.14	2.72%***	3.52	-2.24%**	-2.17	2.87%***	7.89	5.11%***	4.68
220	2.26%***	7.36	5.19%***	6.51	2.93%***	3.43	-1.81%**	-1.73	3.22%***	9.24	5.02%***	4.55
230	2.03%***	6.71	3.89%***	4.64	1.86%**	2.09	-1.44%*	-1.39	3.42%***	8.44	4.85%***	4.37
240	1.63%***	5.13	5.13%***	5.26	3.50%***	3.42	-0.98%	-1.01	3.59%***	8.43	4.57%***	4.29
251	1.16%***	3.45	3.21%***	3.84	2.06%**	2.28	-0.14%	-0.15	3.65%***	7.95	3.79%***	3.75

The Newey-West adjusted t-statistics are presented following the mean estimations. HD represents holding period (in days). ***, **, and * are significant at 1%, 5%, and 10% level, respectively.

For NYSE-listed stock, Table 2 shows that the risk-adjusted return differentials between low- and high-dispersion portfolios are significantly positive for holding periods greater than 10 trading days in both the pilot and control samples. This is consistent with Miller's overpricing hypothesis, which states that high-dispersion stocks tend to be overvalued relative to low-dispersion stocks in the presence of both short sale constraints and investor opinion dispersion. More importantly, Table 2 shows that the risk-adjusted return differentials between the low- and high-dispersion portfolios are significantly greater in the control stocks than those in the pilot sample for holding periods that are greater than 50 trading days. The return differential difference between the control and pilot samples increases with the portfolio holding period and reaches the highest level of 3.13% when the portfolios are held for 190 trading days, suggesting that the suspension of the uptick rule on the NYSE help to mitigate stock overvaluation up to about 3% in an one-year time period. This finding supports the null hypothesis that stock overvaluation are mitigated when the uptick rule is suspended on the NYSE during the post-SHO period.

With regard to NASDAQ-listed stocks, results in Table 2 show a similar pattern of the return differentials between low- and high-dispersion portfolios for control stocks listed on the NASDAQ as for control stocks listed on the NYSE. However, instead of having a smaller positive return differential than control stocks, pilot stocks on the NASDAQ now have a significant negative return differential between low- and high-dispersion portfolios across most holding periods. This result indicates that when the bid-test was suspended on the NASDAQ during the pilot program, high-dispersion stock prices were depressed relative to low-dispersion stock prices. This leads to higher subsequent future returns for high-dispersion stocks than for low-dispersion stocks, or negative low- and high-dispersion portfolio return differentials. In particular, high-dispersion pilot stocks subsequently out-perform low-dispersion pilot stocks by as much as 5.5% of the stock value over a one year period.

To show how stock overvaluation are generated and corrected by the market as uncertainty raise and resolve as time goes on in a one-year period, I plot risk-adjusted return differential between low-and high-dispersion portfolios, (D1-D3), for holding periods ranging from one day to one year for both pilot and control samples in Figure 1 and 2 for NYSE and NASDAQ-listed stocks, respectively.

Figure 1. Cumulative Holding Period Risk Adjusted Return Differential between Low- and High-Dispersion Portfolios during the post-SHO Period for NYSE listed Stocks

Figure 2. Cumulative Holding Period Risk Adjusted Return Differential between Low- and High-Dispersion Portfolios during the post-SHO Period for NASDAQ Listed Stocks

Figure1 displays the time path of stock overvaluation for pilot and control stocks on the NYSE during the post-SHO period. It reveals two important patterns. First, the return differential between low- and high-dispersion portfolios in the control sample is generally greater than in the pilot sample across virtually all holding periods, supporting the null hypothesis that the suspension of the uptick rule helps to mitigate stock overvaluation. Second, the return differential between low- and high-dispersion portfolios in the pilot sample diminishes, but never reach zero over a one-year time period. This is a reasonable, because while the uptick rule was suspended for pilot stocks,

other short sale constraints still existed, preventing the market from fully correcting all the overvaluation. Another possible explanation is that firms' earnings uncertainty will not diminish to zero over time, because as the uncertainty in the most recent quarter's earning resolves with time, the uncertainty in the forthcoming quarter's earnings emerges.

Figure 2 shows that , on the NASDAQ, the market corrects overvaluation in high-dispersion pilot stocks quickly in a very short time period, then it goes further to depress high-dispersion pilot stock prices. Such negative return differential eventually diminishes to zero over a longer period. The surprising results here suggest that removing the uptick rule restriction on the NASDAQ goes beyond mitigating overvaluation in high-dispersion stocks; it leads to depressed prices for these stocks. With no uptick rule restriction, investors who hold more pessimistic opinions can short sell stocks at a price that may be lower than the true stock value. Also, the suspension of the uptick rule makes it easier for predatory short sellers to aggressively submit short orders and manipulate stock prices downwards⁶. Therefore, the results here suggest that we cannot rule out the possibility that removing the uptick rule on the NASDAQ makes it easier for "predatory" short sellers to manipulate stock prices downward. According to Reuters News August 9, 2007, "The hedge funds were very, very aware of this (the removal of the uptick rule). They sit around and giggle when this stuff happens," said Mallory Hill, chief executive of mortgage lender Novelle Financial Services. "Without the uptick rule, they can put anyone out of business." Further, Mortgage lenders, battered by the subprime lending crisis, are particularly worried that removing short sale restrictions has contributed to their sector's troubles. These media reports highlighted concerns that the uptick rule may be effective in preventing short sellers from manipulating prices downwards and suggested that removing the uptick rule may not be considered as an optimal policy.

5. ROBUSTNESS TESTS

5.1. Fama-French four-factor time series regressions

The risk-adjusted portfolio return differential between the control and pilot sample may be caused by firm-specific characteristics such as firm size, book-to-market ratio, and momentum factors. The pilot and control sample matching procedure performed in this paper should have addressed this issue. To further ensure the effects of the suspension of the uptick rule on stock returns are not caused by other systematic differences between the pilot and control stocks, I adopt the following a four-factor time series regression method suggested by Fama-French (1996) and Carhart (1997).

$$R_{pt} - R_{ft} = \alpha_p + \beta_p(R_{mt} - R_{ft}) + s_pSMB_t + h_pHML_t + u_pUMD_t + \varepsilon_{pt} \quad (4)$$

where $(R_{mt} - R_{ft})$, is the excess return (portfolio return minus the one-month Treasury bill rate) on the value-weighted market portfolio, SMB is the difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks, and HML is the difference between the return on a portfolio consisted of high book-to-market stocks and the return on a portfolio comprised of low book-to-market stocks. The variable HML represents the value premium and the variable SMB represents the size premium. To capture the momentum factor, I include the variable UMD, the return difference between a portfolio comprised of stock with high return from month t-12 to month t-2 and a portfolio consisted of stocks with low return from month t-12 to month t-2.

In such regressions, a well-specified asset pricing model produces intercepts that are indistinguishable from zero and the estimated intercepts provide a simple return metric and a formal test of how well different combinations of the common factors capture the cross section of average return (Fama and French, 1996). If high-dispersion stocks earn lower returns than low-dispersion stocks due to the short sale constraints, then time-series portfolio of high (low) dispersion stocks should be associated with lower (higher) returns relative to an explicit asset pricing

⁶ Brunnermeier and Pedersen (2005) define predatory short selling as the trading that induces and/or exploits the need of other investors to reduce their positions. If one or a group of traders needs to sell, others may also engage in selling (or short selling) and then cover their positions for a profit by buying the stock at a lower price.

model⁷.

Next, I run four-factor Fama-French time series regressions on low-, medium-, and high-dispersion portfolios separately for both the pilot and control samples⁸. Each regression covers the period from May 02 to Dec 30, 2005 with a total of 170 time-series observations. The holding period dynamic analysis requires me to repeat the regressions for various holding periods ranging from one day to 251 days. Therefore, for portfolios with holding periods greater than one day, I need to include stock returns data from 2006. For example, for portfolios with a holding period of 251 days, the first observation in the time series is the return of a one year period from May 2, 2005 to May 2, 2006, and the last observation in the time series is the return of a one year period from December 31, 2005 to December 31, 2006. So there are 251 regressions for each dispersion stock portfolio, resulting in a total of 753 of regressions for either the pilot or control sample. I report in Table 3 the intercept estimates in those regressions for low-, medium-, and high-dispersion portfolios with a variety holding periods.

Panel A of Table 3 reports the estimates of the intercepts in four-factor time-series regressions for NYSE-listed stocks. The estimated intercepts for the control sample indicate that the four-factor model leaves an unexplained large negative return for the high-dispersion portfolio and an unexplained large positive return for the low-dispersion portfolio. This is consistent with the regression results in Diether et al. (2002). In contrast, for pilot stocks, high-dispersion portfolios did not systematically produce unexplained negative intercepts, and low-dispersion portfolios rarely showed unexplained positive intercepts, indicating that the four-factor asset pricing model does a better job in capturing expected stock returns based on common risk factors for pilot stocks than for control stocks. It also shows that for pilot stocks, the unexplained intercepts, periodically but not predominately demonstrate significance for certain holding periods, suggesting that the overvaluation anomaly in pilot stocks has not been completely eliminated. This is consistent with previous results and the fact that the uptick rule is not the only short sale constraint that prevents short sellers from projecting their negative opinions into stock prices. In essence, the regression results suggest that after controlling for firm size, book-to-market, and momentum factors, the stock overvaluation anomaly existing in the control stocks has been mitigated in the pilot stocks on the NYSE. Panel B of Table 3 presents the intercept estimates in four-factor time-series regressions for NASDAQ-listed stocks. For the NASDAQ-control sample, consistent with the results in the NYSE, the four-factor model leaves unexplained negative intercepts for high-dispersion portfolios and unexplained positive intercepts for low-dispersion portfolios. For the NASDAQ-pilot sample, however, the results show that the undervaluation of high-dispersion stocks relative to low-dispersion stocks is caused by either the negative deviation of high-dispersion stock values from the fair valuation reflected in the four-factor model or the positive deviation of low-dispersion stock values relative to the fair valuation in the model.

Table 3. Time Series Tests of Four-factor Models for Dispersion Thirds during the Post-SHO Period

Panel A. NYSE-listed stocks						
Holding Period	Pilot Sample			Control Sample		
	D1	D2	D3	D1	D2	D3
1	0.0001 (0.98)	-0.0002 (-1.80)	-0.0002 (-0.95)	0.0001 (0.99)	0.0001 (1.27)	-0.0002* (-1.76)
10	0.0008* (1.80)	-0.0016 (-1.70)	-0.0005 (-1.03)	0.0013*** (2.88)	0.0005 (0.96)	-0.0023*** (-3.72)
20	0.0013 (1.21)	-0.0046*** (-3.01)	-0.0010 (-1.17)	0.0034*** (3.75)	-0.0008 (-0.54)	-0.0047*** (-2.67)
30	-0.0017 (-0.95)	-0.0045** (-2.36)	-0.0039*** (-2.89)	0.0058*** (5.23)	-0.0027 (-1.36)	-0.0079* (-1.77)
60	0.0070 (1.37)	-0.0073 (-1.02)	0.0119*** (2.70)	0.0209*** (8.40)	-0.0074 (-1.36)	0.0088 (0.89)
120	0.0174*** (3.53)	-0.0020 (-0.16)	-0.0056 (-1.21)	0.0201*** (6.46)	-0.0083 (-1.26)	-0.0307** (-2.26)
180	0.0397*** (3.33)	0.0173 (0.81)	0.0099 (1.19)	0.0293*** (3.29)	-0.0043 (-0.45)	-0.0540*** (-5.18)
251	0.0293 (1.67)	-0.0206 (-0.52)	-0.0762*** (-5.14)	0.0202* (1.81)	0.0260 (1.92)	-0.1522*** (-11.6)

⁷ While the intercept in the regressions appears to be similar to Jensen's alpha in the context of the Capital Asset Pricing Model (CAPM), I do not interpret it as a measure of portfolio performance attribution.

⁸ In addition, I run Fama-French three-factor model regressions, which produce essentially similar results as those in Table 3.

Panel B. NASDAQ-listed stocks

Holding Period	Pilot Sample			Control Sample		
	D1	D2	D3	D1	D2	D3
1	-0.002 (-1.21)	0.01% (0.36)	0.005*** (2.70)	0.001*** (3.38)	0.000 (-0.47)	0.000 (-0.49)
10	-0.002 (-0.21)	0.0007% (-0.05)	0.00% (0.02)	0.005*** (4.83)	0.000 (-0.03)	-0.001 (-1.11)
20	-0.003 (-0.83)	-0.001 (-0.34)	0.17% (0.71)	0.008*** (5.21)	0.002 (1.11)	-0.004** (-2.07)
30	-0.008*** (-4.66)	0.002 (0.08)	0.18% (0.84)	0.014*** (9.02)	0.005 (1.26)	-0.007** (-2.45)
60	-0.014*** (-4.75)	-0.005 (-1.39)	0.004** (2.06)	0.023*** (10.24)	0.007* (1.75)	-0.008** (-2.46)
120	-0.011 (-1.07)	0.009 (0.57)	0.060** (2.50)	0.033*** (5.12)	0.017 (1.60)	0.020** (2.27)
180	0.007 (0.24)	-0.031 (-1.17)	0.030 (0.91)	0.009 (1.32)	0.002 (0.39)	0.040* (1.75)
251	-0.015*** (-4.41)	-1.00% (-0.30)	0.031 (0.32)	-0.004 (-0.27)	0.009 (0.63)	0.049 (1.47)

Holding periods are in days. The sample period is from May 02, 2005 through Dec 30, 2005. The dispersion equal-weighted thirds are formed as in Table 4. The *t*-statistics are in parentheses. ***, **, * are significant at 1%, 5%, and 10% level, respectively.

5.2 Controlling for availability of exchange-traded-options

Since stock options provide pessimists with an alternative vehicle to speculate on their negative private information, short sale constraints will be mitigated by their presence. Stocks with options will be less overvalued (or depressed) than those without (Danielsen and Sorescu, 2001). Therefore, for stocks with options, it is reasonable to expect that the effect of the suspension of short sale price tests in mitigating stock overvaluation would be minor. I address this issue and control for the effect of stock option availability by separating stocks with exchange-traded-options from those with no exchange-traded-options. Table 4 presents the risk adjusted return differentials between low- and high-dispersion portfolios for stocks with options and stocks with no options.

Table 4 shows that on both the NYSE and NASDAQ, for stocks with no option, the effect of suspending the uptick rule in mitigating overvaluation is profound in stocks with no exchanged-traded-options. For stocks with exchange-traded-options, such effect is not statistically significant across all holding periods. This result is consistent with that the effect of reducing high-dispersion stock overvaluation by the suspension of the uptick rule is not significant for stocks with options, because as an alternative to short, exchange traded options helped to reduce the overvaluation in pilot stocks before the suspension of the uptick rule takes effect. This is consistent with Danielsen and Sorescu (2001) and highlights the role of stock option as an alternative of short selling vehicle in reducing stock overvaluation. The implication here is that in order to mitigate stock overvaluation and to improve stock price efficiency, introducing stock options can be a substitute of removing the uptick rule.

Table 4. The risk adjusted cumulative return differential between low- and high-dispersion portfolios for pilot and control samples during the post-SHO period: controlling for exchange traded option availabilities

Panel A. NYSE-listed stocks												
Holding Period	Stocks with no options					Stocks with options						
	Pilot	t	Control	t	Diff	t	Pilot	t	Control	t	Diff	t
	(1)		(2)		(2)-(1)		(3)		(4)		(4)-(3)	
1 day	0.02%	0.53	0.04%	0.92	0.02%	0.34	0.03%	1.18	0.03%	1.00	0.00%	-0.08
1 week	-0.02%	-0.28	0.20%	2.07	0.23%	1.80	0.14%	2.14	0.19%	2.23	0.05%	0.47
1 month	0.21%	1.52	0.60%	2.47	0.39%	1.39	0.66%	4.51	0.34%	0.69	-0.32%	-0.62
3 months	0.19%	0.90	2.21%	5.19	2.02%***	4.24	1.79%	5.96	2.45%	3.62	0.65%	0.88
6 months	1.71%	9.57	4.89%	9.23	3.19%***	5.70	3.19%	11.89	4.12%	6.63	0.93%	1.37
9 months	1.30%	6.38	4.65%	8.22	3.35%***	5.57	3.89%	9.65	4.08%	5.33	0.19%	0.22
12 months	-0.12%	-0.41	3.37%	4.68	3.49%***	4.50	3.35%	7.66	2.79%	4.00	-0.57%	-0.69

Panel B. NASDAQ-listed stocks

Holding Period	Stocks with no options					Stocks with options						
	Pilot	t	Control	t	Diff	t	Pilot	t	Control	t	Diff	t
	(1)		(2)		(2)-(1)		(3)		(4)		(4)-(3)	
1 day	0.08%	1.47	0.05%	0.78	-0.03%	-0.36	0.02%	0.46	0.00%	0.12	-0.02%	-0.46
1 week	0.28%	2.49	0.25%	2.22	-0.03%	-0.19	0.09%	0.92	0.06%	0.62	-0.03%	-0.22
1 month	0.66%	2.78	0.75%	3.34	0.09%	0.28	0.01%	0.04	0.67%	2.84	0.66%**	1.92
3 months	0.68%	2.01	1.85%	5.45	1.17%***	2.44	-0.69%	-2.39	1.17%	3.25	1.86%***	4.03
6 months	-0.26%	-0.64	2.17%	4.84	2.43%***	4.02	-1.15%	-3.17	0.95%	2.52	2.10%***	4.01
9 months	-1.41%	-5.77	3.47%	11.2	4.88%***	12.4	0.71%	1.63	1.36%	2.24	0.65%	0.87
12 months	1.56%	5.64	5.60%	13.85	4.04%***	8.25	0.91%	2.17	1.13%	1.87	0.22%	0.3

Newey-West adjusted t-statistics are reported with the mean estimations. Diff is defined as the difference between the control sample and the pilot sample. ***, **, and * are significant at 1%, 5%, and 10% levels, respectively.

6. CONCLUSIONS

The recently adopted SHO Regulation provided us with a natural experiment to study if the uptick rule inflates stock prices in a controlled environment. In this paper, I used Regulation SHO data from 2005 to examine whether the suspension of uptick rules mitigates stock overvaluation by comparing stocks with less short sale constraints (pilot stocks) and stocks with more short sale constraints (control stocks). The results show that the suspension of the uptick rule mitigated stock overvaluation on the NYSE during the sample period from May to December 2005. In particular, the comparison based on the matched pilot and control samples shows that the suspension of uptick rules on the NYSE can mitigate stock overvaluation as much as 3% of the stock value in a one year period. This results is consistent with Miller (1977)'s overpricing hypothesis, which argue that stock overvaluation is associated with the presence of high investors' opinion dispersion and more short sale constraints. On the NASDAQ, however, the lifting of the uptick rule went beyond correcting stock overvaluation. Prices of high-dispersion stocks tended to be depressed relative to prices of low-dispersion stocks when the uptick rule was suspended. The results here also suggest that the SEC's decision to revoke the uptick rule restriction may not be considered as an optimal policy, if such undervaluation is driven by 'predatory' short sellers' price manipulations. Results are robust when I control for firm size, book-to-market ratio, and momentum factors. For stocks with exchange-traded -options, it appears that the suspension of uptick rules cannot effectively help to reduce the overvaluation since overvaluation in those stocks has already been mitigated by the introduction of options, suggesting that in order to mitigate stock overvaluation and to improve stock price efficiency introducing stock options can be a substitute of removing uptick rules.

The results in this paper generate several interesting questions for future research. First, why are the effects of removing the short sale price tests on stock returns so different for the NYSE and the NASDAQ? Is this caused by different market microstructures, such as trading liquidity and trading costs, or other unknown forces? Second, it would be a promising extension to establish a direct link between predatory short sellers' price manipulation and the undervaluation in the NASDAQ pilot stocks. Finally, taking a closer look at how the suspension of the short sale price tests and intra-day stock returns by using intra-day short selling data would improve our understanding of how the suspension of the short sale price tests help improve stock price efficiency, a key issue that is of interest to both regulators and investors.

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