

## **Short-Selling: The Impact of SEC Rule 201 of 2010**

Chinmay Jain  
Doctoral Candidate  
The University of Memphis  
Memphis, TN 38152, USA  
Voice: 901-652-9319  
cjain1@memphis.edu

Pankaj Jain  
Suzanne Downs Palmer Professor of Finance  
The University of Memphis  
Memphis, TN 38152, USA  
Voice: 901- 678-3810  
Fax: 901-678-0839  
pankaj.jain@memphis.edu

Thomas H. McInish  
Professor and Wunderlich Chair of Finance  
The University of Memphis  
Memphis, TN 38152, USA  
Voice: 901-277-9202  
Fax: 901-678-3006  
tmcinish@memphis.edu

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## **Abstract**

Effective May 10, 2010, the SEC implemented the 'Rule 201' that restricts short-selling of stocks that experience a 10 percent opening or intraday price decline. We investigate its pertinence and effectiveness in curtailing daily and intraday short-selling volume, ensuring fair valuations and price stability, promoting higher liquidity and execution quality, and preventing sudden or prolonged market crises. Our minute-by-minute analysis in calendar time, analysis of stock-day groups in return time, simulation of rule-compliant short orders, and regressions show that the rule has not influenced these parameters in the intended direction. Thus, the rule doesn't have any benefits despite its sizable compliance costs.

# Short-Selling: The Impact of SEC Rule 201 of 2010

## 1. Introduction

In February 2010, the U.S. Securities and Exchange Commission (SEC) voted 3-2 to adopt Rule 201 (“Alternative Uptick Rule”), imposing restrictions on short-selling. This rule is a variation of the 70 year old “uptick rule” that was eliminated in 2007. The rule applies to National Market System (NMS) securities following an intra-day price decline of more than 10 percent from the previous day’s closing price. For such stocks (hereafter, target stocks), the SEC allows short-selling only if the transaction price is above the national best bid. This restriction applies for the remainder of the day (hereafter, trigger date) when the target stock has fallen 10 percent and whole of the following day. The rule requires trading centers to establish, maintain and enforce written policies and procedures that are reasonably designed to prevent the execution or display of a prohibited short-sale order.

The SEC believes that the rule will help prevent potentially manipulative or abusive short-selling, and, thereby, help restore investor confidence. According to SEC Chairman Mary Schapiro, "It is a rule that is designed to preserve investor confidence and promote market efficiency, recognizing short-selling can potentially have both a beneficial and harmful impact on the market." By placing restrictions in only a few securities that decline, and not a complete ban, the SEC is attempting to preserve the benefits of short-selling under normal market conditions. These benefits include increased liquidity and price efficiency. However, when the market is stressed, short-selling may artificially exacerbate the price decline in a security. The rule will allow the long sellers to sell at the best bid ahead of short-sellers and a further decline in the stock prices due to manipulative trading will be less likely, even though prices could continue to decline due to long selling when fundamentals are truly deteriorating. Rep. Gary Ackerman

(D., N.Y.) applauded the SEC's action, saying it is a "vital step toward combating the artificial manipulation of stocks."

The SEC's move was severely criticized by many, including the two republican commissioners, who argued that there was no evidence that short-selling had led to the market crash. On a request by the SEC for comments, the following concerns were raised. Rule 201 will hamper price discovery and also will result in a decline in liquidity. This rule can potentially decrease market volume, liquidity, and price efficiency, widen bid-ask spreads, and increase intra-day volatility. The stocks affected by this rule may also become overpriced when short-sellers are restricted from pushing the price down when its fundamental value has fallen more than 10 percent. Once the rule is in effect short-sellers must only supply liquidity and cannot demand it. Thus, longs may view pending short-seller orders as negative news and step ahead to sell, lowering the price. Some commentators suggested that the rule could weaken investor confidence because they might perceive the stocks being overvalued due to lack of short-selling. The rule can also lead to increased transaction costs as market participants need to incur significant compliance costs estimated to be \$2 billion in the first year and then \$1 billion a year (Johnson (2010)). There were several other concerns about the trigger level and the duration of the rule. Thus, the rule was met with mixed reactions from the industry and the regulators.

In this paper, we make several contributions to short-selling literature by providing the first rigorous analysis of the effectiveness of Rule 201. First, we compare the daily and intraday short-selling volume for target stocks before and after the effective date of the Rule 201 using data from the Financial Industry Regulatory Authority (FINRA) for NYSE and Nasdaq stocks. Even before the approval of Rule 201, we find that daily short-selling declines on days of intraday return of -10 percent as compared to the previous day. Using intraday short volume

data, we find that even the intraday short-selling volume does not increase once the stock has experienced a 10 percent intraday decline. Second, we analyze the short-selling activity on extreme market movement days. In particular, we focus on the extreme down days, when short-sellers may be viewed as playing a negative role in the market. We do not find any evidence of higher short-selling activity in target stocks, even before the approval of the rule. Third, we analyze the future recovery of target stocks from their lowest point. We find that the stocks recover better in the absence of the rule and conclude that the Rule 201 may have worsened the return dynamics instead of improving it.

Fourth, we examine the effectiveness of the Rule 201 by analyzing short-selling volume around the flash crash day and by simulating short-sale orders during the crisis period of 2008. Even after its approval, the rule is ineffective in preventing sudden market crash such as the flash crash of May 6, 2010.<sup>1</sup> The rule-compliant execution rate of simulated short-sale orders during the 2008 crisis period is as high as 83 percent within 5-minutes of order submission, which indicates that Rule 201 would not be binding on short-sellers during the crisis period, if it had existed at that time. Fifth, we analyze the impact of the rule on liquidity of affected stocks. Our liquidity measures are closing bid-ask spreads and share trading volume. The change in liquidity on the day following the 10 percent decline is no better after the rule's effective date than in the period prior to the rule's approval. Finally, our multivariate regression analysis controls for several known determinants of short-selling and continues to indicate that Rule 201 has not reduced the short-selling volume of the target stocks.

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<sup>1</sup> Moreover, short selling volume is not higher on days of significant market-wide decline like the flash crash day.

## 2. Background information and literature review

Short-selling is defined as a transaction in which a trader sells a stock without owning it. The short-seller must borrow the stock to make delivery to the buyer. Otherwise, a fail to deliver occurs on the settlement day. To close a short position, the dealer must buy back the stock in the future and return it to the lender. The gain or loss is the difference between selling price and buying price (ignoring commissions and borrowing costs). Whether or not short-selling is a desirable market feature is a question that has always generated controversy. Proponents of short-selling cite several benefits. Short-sellers provide a substantial amount of additional liquidity in stock markets. In the year 2005, short sales represented 31 percent of share volume for NASDAQ-listed stocks and 24 percent of share volume for NYSE-listed stocks (Diether, Lee and Werner, 2009b). Short-selling by market professionals, such as market makers provide liquidity to buyers by offsetting temporary imbalances in buying and selling interest. Short-sellers also provide liquidity to sellers. This happens when the short-sellers are buying back the stock to cover their position. Short-sellers play an important role in ensuring that stocks trade at fair prices in line with their fundamentals. In particular, they prevent the stocks from becoming overvalued. Asquith, Pathak, and Ritter (2005) and Chang, Cheng and Yu (2007) find that when short-selling is constrained or restricted, stocks become overvalued, and, subsequently, underperform. Ofek and Richardson (2003) document that the limitations in the ability of short-sellers to trade internet stocks created the dot-com bubble, although Battalio and Schultz (2006) reject this claim.<sup>2</sup> Because short-sellers do not own stock, they are motivated by perceived information and not by liquidity needs. Therefore, one can expect to see speedier and more immediate price adjustment with short-selling instead of a prolonged drift in prices after negative

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<sup>2</sup> Battalio and Schultz (2006) claim that investors could easily short stocks synthetically by purchasing puts and writing calls. They suggest that traders did not bet against Internet stocks because they did not know that the Internet stock prices were too high.

news such as announcements of poor earnings. Bris, Goetzmann and Zhu (2007) find some evidence that prices incorporate negative information faster in countries where short sales are allowed and practiced. Another benefit of short-selling is that it makes arbitrage possible and helps in linking derivatives markets such as futures and options with cash markets, ETFs with cash markets, and underlying stocks with ADR markets.

Critics of short-selling argue that short-sellers may push a stock's price below its fundamental value by engaging in predatory short-selling practices and bear raids. In a bear raid, a group of traders attempts to hammer the price of a stock down by taking large short positions and subsequently spreading negative sentiments or rumors about the target firm. This price decline triggers margin calls for long investors, causing some of them to close out their position by selling, resulting in a further price declines. Shkilko, Van Ness and Van Ness (2009) find that even on no-news days, short-selling may cause excessive price pressure resulting in temporary stock declines that are followed by a rebound of 90 percent to 110 percent of the initial decline by the end of the day. They find that short-sellers are abnormally active during the beginning of the price decline. However, we do not observe this pattern for stocks on which the Rule 201 is applicable.

The financial regulators have historically attempted to balance the benefits and pitfalls of short-selling. Many restrictions were placed on short-selling after the great depression of 1929. The NYSE prohibited short-selling on downticks in 1931 and the SEC introduced a related uptick rule later in 1938, to prevent bear raids. The uptick rule specified that a stock can only be shorted at a transaction price that is at least one tick higher than the price of the most recent trade with a different price. Jones (2008) examines these depression related restrictions and finds that the average return associated with these events is positive and the restrictions caused an increase

in liquidity. In contrast, Macey, Mitchell and Netter (1989) argue that the uptick rule hampers index arbitrage by uncoupling the equity and futures market, and that it was responsible for the crash of October 1987. Alexander and Peterson (1999) show that the execution quality of short-sale orders is adversely affected by the uptick rule, stifling price discovery in both bull and bear markets. However, Boehmer and Wu (2010) find that the uptick rule had no effect on price efficiency of stocks.

Short-selling again emerged as a topic of vigorous debate and controversy during the recent financial crisis. The SEC had just relaxed short-sale constraints in September 2007 by removing the uptick rule shortly before the crisis. In a complete reversal of its policy, the SEC then implemented a short-selling ban on 797 financial firms on September 17, 2008 in response to the financial crisis. Boehmer, Jones and Zhang (2009) study the impact of this short-selling ban on market quality. They find that the ban caused a degradation in market quality as measured by spreads, price impact, and intraday price volatility. Their findings suggest that the boost in prices of the banned securities may have been due to the TARP program, which was announced at the same time and not due to the ban on short-selling. Kolasinski, Reed and Thornock (2009) confirm that the SEC's June 2008 emergency order to ban naked short-selling in 19 financial firms degraded their market quality and liquidity. Beber and Pagano (2010) examine this issue in an international context and find similar results about the ban's effect on market quality. They find that imposing bans or regulatory constraints on short-selling reduced market liquidity, especially for stocks with small market capitalizations, high volatility and no listed options. They also find that the bans slow down the price discovery process and fail to support stock prices, except possibly for U.S. financial stocks, which received TARP funding.



The paper most closely related to ours is Diether, Lee and Werner (2009a) who study the effect of the removal of the uptick rule. While they examine the effect of the SEC-mandated temporary suspension of short-sale price tests in 2007 for a set of pilot securities, we examine the effect of the Rule 201 that has the opposite intention. Rule 201 was adopted by SEC in 2010, which again imposes price tests in a slightly different format. Diether, Lee and Werner (2009a) find that the suspension of the NYSE's uptick rule and Nasdaq's bid price test makes it somewhat easier to execute short sales. They also argued that the effect of removing the price tests on market quality were limited. Another study by Alexander and Peterson (2008) also examines the effect of removal of short-sale price tests and find that traders benefit from the removal of price tests and receive faster execution of trades. They also find that the removal of price tests does not lead to a degradation of market quality and conclude that such tests should be removed. Soon after the completion of these studies and removal of the uptick rule, we observed a historical financial crisis and unprecedented market declines stimulating the SEC to impose a temporary ban on short-selling followed by a reinstatement of a permanent but modified version of uptick rule. Clearly, there is a need for a fresh examination of short-selling behavior in the market. We examine how the new Rule 201 has affected the dynamics of short-selling.

The SEC's new Alternative Uptick Rule is expected to make short-selling more difficult for securities that decline 10 percent or more on any particular day. In this regard, another paper which is similar to our study is Blau, Van Ness, Van Ness and Wood (2010). They examine short-selling of NYSE stocks contained in the S&P 500 index on days with extreme increases (up days) and extreme decreases (down days) in the level of the overall market index. They find that short-selling activity increases on large down days and decreases on large up days suggesting that the short-sellers tend to follow the crowd on extreme market movement days.

There are two key distinctions between their paper and our study. First, they focus on extreme market movements, whereas we focus on extreme individual stock price movements. We also perform a conditional analysis in which we simultaneously investigate the variations in market returns and individual stock price returns. This difference is very important because they find that short-selling increases on days of overall market decline, whereas we find that short-selling decreases on days of individual stock price decline even on days of extreme market declines. Our findings about the impact of market wide returns on short-selling reconcile with their results, but the effects of market wide return and individual stock price return on short-selling behavior are opposite to each other. Second, their work is a general analysis of short-selling, whereas we provide the first analysis of this issue in the presence of the new Rule 201. Our goal is to extend this literature along the dimensions of the role of short-sellers on stock-days with extreme intraday returns and the need for restricting short-selling on these stock-days, if any.

### **3. Data source and descriptive statistics**

We extract and merge data from three sources: Datastream International, FINRA and TAQ. We begin to form our sample with all NYSE and Nasdaq listed stocks for a period from September 1, 2008 to October 28, 2010. From Datastream International, we obtain each firm's unadjusted daily closing price, split-adjusted closing price, intraday high price, intraday low price, return index including dividends, volume-weighted average price, closing ask price, closing bid price, and daily volume in number of shares. We also obtain market capitalization and number of shares outstanding for the same stocks at end of years 2008 and 2009. Following Diether, Lee and Werner (2009b), we exclude stock-days with lagged price below \$5. We also exclude stock-days with lagged price above \$999. We exclude ex-dividend days and stock-split

days from our sample. To minimize the impact of outliers, we exclude stocks with intraday high return more than 100 percent or intraday low return less than -90 percent.

We download the daily short-sale volume files and monthly short-sale transaction files from the FINRA website from the first available date of August 3, 2009 to October 28, 2010. The daily files provide aggregated short volume for each firm. The monthly files provide transaction-by-transaction detail of all short-sale trades reported to a consolidated tape.

We merge the FINRA transaction files with trade and quote (TAQ) data to assess the intraday conditions at the time of actual short-sale trade execution. In particular, the TAQ files enable us to obtain the exact time stamp of 10 percent price decline, which triggers Rule 201. TAQ data is also required to assess the performance of simulated short-sale orders during the crisis period of 2008 and normal period of 2009 to investigate the effectiveness of Rule 201 if it would have been in force at that time.

Using the stock's intraday high and low prices, we calculate its intraday high return and intraday low return relative to the stock's closing price on the previous day. We classify the stock-days in our sample into six groups as follows: (i) Intraday low return  $\leq -10\%$ ; (ii)  $-10\% < \text{Intraday low return} \leq -5\%$ ; (iii)  $-5\% < \text{Intraday low return} < 0\%$ ; (iv)  $0\% < \text{Intraday high return} < 5\%$ ; (v)  $5\% \leq \text{Intraday high return} < 10\%$ ; (vi)  $10\% \leq \text{Intraday high return}$ . Since a volatile stock-day may potentially fall into multiple categories, we use the absolute value of the intraday high and intraday low returns as an additional criterion for allocating the stock-day in only one of the above groups. If the absolute value of the intraday high return is greater than absolute value of the intraday low return, we assign the stock-day to the applicable intraday high

groups, and so forth.<sup>3</sup> Table 1 illustrates the distribution of the average number of stocks in each of the stock-day groups. On average, our final sample has 4,161 stocks on each day. About 28 stocks have an intraday decline of 10 percent or more, on a typical day during our sample period and about 34 stocks have an intraday price increase of 10 percent or more. We also present the mean and standard deviation of market capitalization and price of stocks in each stock-day group in columns 4 through 7. Stocks with lower market capitalization and lower price are much more likely to fall in the extreme groups of intraday returns above +10 percent or below -10 percent than larger stocks or high priced stocks.

[Insert Table 1 here]

Although, the rule was approved by the SEC on February 24, 2010, it had an effective date of May 10, 2010, and the SEC gave all trading centers six months to comply.<sup>4</sup> We divide our sample period into three sub-periods. The *pre-approval* period ranges from August 3, 2009 to February 23, 2010, the *post-approval* period ranges from February 24, 2010 to May 9, 2010 and *post-implementation* period ranges from May 10, 2010 to October 28, 2010, during which period many exchanges have successfully modified their current procedures for adhering to Rule 201.

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<sup>3</sup> For example if stock A experiences -12% and +11% intraday return on the same day, we allocate it to the first group of intraday low return below 10%. If another stock B experiences -4% and +6% return on the same day, we allocate it to the fifth group of intraday high return between +5% and +10%.

<sup>4</sup> Securities and Exchange Commission (SEC) Memo No. 34-61595 (February 26, 2010). Some exchanges were unable to adhere to the original compliance deadline of November 10, 2010. Therefore, on November 4, 2010, the SEC extended the compliance date to February 28, 2011, according to SEC Memo No. 34-63247 (November 4, 2010).

## 4. Results

### 4.1 Daily short-selling volume before and after the Rule 201

For each stock on each day, we compute relative short selling (*relss*) as short-selling volume of a stock in FINRA as a proportion of its total trading volume. In Figure 1, we plot the difference between the relative short-selling on day  $t$  and relative short-selling on day  $t-1$ , where  $t$  is the day on which we form the portfolios of the six stock-day groups. For stock-days with missing short-selling data, we do one of the following two things. If the stock appears in FINRA on at least 1 day during the entire sample period, then we assign a short volume of 0 to that stock on the missing short volume day. Otherwise, if the stock does not appear in FINRA at all during the entire sample period, we exclude that stock from our analysis. In general, relative short-selling decreases on negative return days. Relative short-selling is particularly lower on day  $t$  as compared to day  $t-1$  in the Rule 201's target stocks, i.e., those with a 10 percent price decline. We see a similar pattern for the other two groups with smaller magnitudes of negative intraday returns. Relative short-selling increases only on positive return days. In sum, we do not see any evidence of an increase in short-selling that is being used for exacerbating a price decline after the stock price has already dropped significantly.

[Insert Figure 1 here]

Formal analysis in Table 2 again points to the same pattern, i.e., relative short-selling declines on negative return days. We separately analyze the *pre-approval* period (Panel A), the *post-approval* period (Panel B) and the *post-implementation* period (Panel C) surrounding Rule 201. For each return group within these periods, we present relative short-selling on day  $t-1$ , day  $t$ , and day  $t+1$ , where  $t$  is the day on which we form six portfolios based on intraday high and low returns. In column 5, we present the difference between relative short-selling on day  $t$  and day  $t-1$

to assess the relationship between short-selling and intensity of contemporaneous intraday returns. For all the negative return groups, relative short-selling is lower on day  $t$  compared to day  $t-1$  in all three periods surrounding Rule 201. In contrast, relative short-selling on day  $t$  increases for all positive return groups in all three periods. The difference between relative short-selling on day  $t$  and day  $t-1$  for target stocks is -2.40 percent even in the *pre-approval* period. In other words, short volume usually declines on its own for the stocks that Rule 201 attempts to regulate. Thus, the rule appears to be addressing a non-existent problem. The rule would only help if there was a negative relationship between contemporaneous intraday returns and short-selling. In reality, this relationship is positive, as we can see in the monotonically increasing difference between relative short-selling on day  $t$  and day  $t-1$  moving from intraday low return groups to intraday high return groups in each panel. The policy concerns about the role of short-sellers in exacerbating stock price declines appear unfounded. We also present the difference between relative short-selling on day  $t+1$  and day  $t-1$  in column 6 and again find that the short-selling was not increasing for the target stocks, even before the Rule 201 was approved.

[Insert Table 2 here]

#### 4.2 Short selling volume on extreme market movement days

The results presented so far are based on individual stock price returns, which have a positive relationship with short-selling volume, i.e., short-selling volume is higher on positive return days and lower on negative return days. The overall market return is an additional dimension that affects short-selling activity. Blau, Van Ness, Van Ness (2010) demonstrate that short-selling volume decreases on extreme market up days and increases on extreme market down days. In light of these opposite effects of individual stock returns and market-wide returns, we integrate these two determinants of short-selling volume by forming 12 different portfolios.

These correspond to the 6 portfolios based on individual stock price returns described previously, but now we also take into account whether the market-wide return was extremely positive or extremely negative. Our method of selecting days of extreme market movements is similar to Dennis and Strickland (2002), Lipson and Puckett (2007) and Blau, Van Ness, Van Ness and Wood (2010). We calculate the mean and the standard deviation of the close-to-close market-wide returns based on S&P 500 index values at the end of its measurement day and the end of the previous day. Extreme market movement days are defined as the days on which close-to-close market-wide return is two standard deviations above or below the mean. During our sample period, we find 12 extreme market down days and 7 extreme market up days according to this definition.

The results of this analysis are presented in Table 3. Panel A focuses on extreme market down days and Panel B on extreme market up days. Within each market condition panel, we present 3 columns focusing on the overall time period, the *pre-approval* period, and the *post-implementation* period surrounding Rule 201.<sup>5</sup> For brevity, in Table 3, we directly present the changes in the relative short-selling, which correspond to the difference columns of Table 2.

[Insert Table 3 here]

A vertical comparison of this difference in relative short-selling in Table 3, Panel A and Panel B, for the overall time period indicates that market condition is indeed an important determinant of short-selling volume, consistent with Blau, Van Ness, Van Ness, Wood (2010). Overall, more positive changes in relative short-selling on day  $t$  in Panel A relative to Panel B

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<sup>5</sup> Since all of the top 7 extreme positive return days (those exceeding 2 standard deviations above the mean) fall in post-implementation period, we include top 7 days of highest returns during pre-approval period as extreme up days for the analysis of pre-rule 201 period and the overall time period.

confirm that relative short-selling increases on large down days and decreases on large up days.<sup>6</sup> The relative short-selling on the following day, i.e.,  $t+1$ , appears to be unrelated to the extreme market return on day  $t$ . Thus, the impact of extreme market return on short-selling lasts for a very short duration. More importantly, the stock's own return plays a more important role in determining the amount of short-selling for the stocks on which Rule 201 applies.

Controlling for the market condition within each panel, our previous results hold for the group of stocks on which the Rule 201 applies. Relative short-selling decreases for the stocks with a 10 percent price decline, whether the market condition was extremely negative or extremely positive. This pattern applies to the overall time period, *pre-approval* period, and the *post-implementation* period. For example, relative short-selling decreases by 4.73 percent in stocks on days of a 10 percent price decline in the pre-approval column of Table 3, Panel A. Even for the extreme up days in Table 3, Panel B, relative short-selling decreases by 1.17 percent for this group of stocks which are affected by Rule 201. Thus, our main results are robust to extreme market conditions. Typically, short-selling in the stocks that would be affected by Rule 201 declines in all market conditions, undermining the need for any regulatory intervention.

#### *4.3 Intraday analysis of short-selling volume before and after the Rule 201*

Our findings are further strengthened when we perform an intraday analysis of short-selling volume. We begin our analysis by plotting the intraday split of short-selling volume and overall trading volume including all buys and sells. We divide each target stock-day into thirteen 30-minute intervals. We sum short-selling volume from FINRA and overall trading volume from TAQ in each of these intervals. We divide the sums of the short-selling volume in each 30-

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<sup>6</sup> For example, on extreme down days, short selling increases by 0.93 percent for the group of stocks which decline by 0 to 5 percent. In contrast, for extreme up days, short selling decreases by 0.61 percent for the group of stocks which increase by 0 to 5 percent.



minute interval by the total short-selling volume of the entire trading day to compute the intraday split of daily short-selling volume. Next, we compute the intraday split of overall trading volume for each 30-minute interval, analogously. In figure 2, we plot these intraday proportions of short-selling volume and intraday proportions of trading volume. We find a U-shaped pattern in overall trading volume as reported by McNish and Wood (1990). More interestingly, proportional short-selling volume shows a similar U-shaped pattern and almost overlaps proportional total trading volume throughout the day, except when the market opens. We do not see meaningfully higher proportional short-selling volume as compared to proportional total trading volume in any 30-minute interval of the day.

[Insert Figure 2]

Next, we perform an intraday analysis based on the actual time-stamp of 10 percent decline in each stock-day. This analysis is important because we can focus specifically on the short-selling volume after the rule has actually triggered for any given stock. For example, if a particular stock trades at a price near the previous day's close for most of the day, but suddenly drops by 10 percent at 3 pm, we would be more interested in the short-selling activity around 3 pm instead of the coarser information included in the aggregated daily short-selling volume. Although, FINRA transaction-by-transaction short data has time stamps for each trade, it does not contain information on exact time when Rule 201 would trigger for any stock. So, we calculate the exact time of 10 percent drop from TAQ and form a merged dataset following the procedure described below.

We begin with TAQ data for all the stocks that decline by 10 percent on any given day relative to previous day's closing price, since Rule 201 only applies to those stocks. We compare each trade's transaction price with the previous day's closing price and note the time-stamp of

the first trade for which the transaction price is 10 percent below the previous day's closing price. We merge this time-stamp into the FINRA short-selling dataset. Based on that time-stamp, we divide the given stock-day into 2 time groups, i.e., before the 10 percent decline and after the 10 percent decline.<sup>7</sup> The mean time at which stocks in our sample decline 10 percent is at 11:55:58 AM, although the exact time would be unique for each stock. Using each stock-day's unique cut-off time, we sum the short-selling volume in the before and the after time groups, respectively. Next, we divide those sums in each group by the total short-selling volume of the entire trading day to compute the intraday split of daily short-selling volume reported in Table 4 Panel A. For example, the proportion of short-selling volume that occurs before the 10 percent decline is 36.58 percent of the total short-selling volume during the entire day. Likewise, the proportion of short-selling volume that occurs after the 10 percent decline is 63.42 percent of the total short-selling volume during the entire day.

Next, we go back to the TAQ dataset to compute the intraday split of daily trading volume, analogously. The proportion of trading volume (including buys, sells and short sells) that occurs before the 10 percent decline is 35.51 percent of the total short-selling volume during the entire day. Likewise, the proportion of trading volume that occurs after the 10 percent decline is 64.49 percent of the total trading volume during the entire day. If there is any excessive short-selling happening after a 10 percent decline, then the proportion in the short-selling column should be much higher than the proportion in the total trading volume column. In contrast, if the short-selling activity is normal, then the proportions of short volume and total volume should be similar to each other. In column 4, we report the difference between the proportional short-

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<sup>7</sup> FINRA monthly short sale transaction files are available from August 2009, but we exclude monthly short sale transaction files for the month of August because NASDAQ TRF file for that month truncates all symbols to 3-characters. For example, AAPL appears as AAP in that file. FINRA corrected this error in the data files for September 2009 onwards.

selling volume and the proportional trading volume during each time group of the day. The difference of -1.07 after 10 percent decline indicates no evidence of higher proportional short-selling volume compared to proportional total trading volume after a stock declines 10 percent. Thus, on an intraday basis also, we find that the short-selling was not increasing for the stocks in the group representing 10 percent stock price decline, even before the Rule 201 was approved.

[Insert Table 4 here]

In Table 4, Panel B, we further subdivide the before and after 10 percent decline groups into finer intervals. For this purpose, we calculate the time-stamps when a stock declines by 2 percent, then 4 percent, and each additional 2 percent decline thereafter until 20 percent decline. Then, each stock-day is split into 11 intervals based on these time-stamps. We calculate proportional short-selling volume and proportional trading volume in each of those 11 intervals.<sup>8</sup> Short-selling is not abnormally high in any of the intervals after a 10 percent decline. In fact, for the interval of 10 percent to 12 percent decline, the difference between proportional short selling and proportional trading volume is -0.78 percent and statistically significant, indicating that the short-selling is lower after price decline, even before the approval of Rule 201.

In Table 4, Panel C, we take a more detailed look at short-selling activity in thirty 1-minute intervals around the 10 percent decline. This panel is based on a combination of return time and calendar time. For example, if a stock declines by 10 percent at 12:00 PM, the first group, *15- to 14-minute before decline*, is based on the clock time of 11:45 AM to 11:46 AM. For that particular stock, the last group in Table 4, Panel C, i.e., *14- to 15-minute after decline* is based on the clock time of 12:14 PM to 12:15 PM. These clock times are unique for each stock-

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<sup>8</sup> For stocks that experience an intraday low return which is higher than the range of an interval, we assign a value of 0 for total trading volume and short selling volume for that interval. For example, a stock with an intraday low return of -17% will be assigned a value of 0 for trading volume and short selling volume for intervals of -18% to -20% return.

day based on the time of a 10 percent decline. Short-selling is not higher in any of the 1-minute intervals after a 10 percent decline. In fact, for the first 6 1-minute intervals following a 10 percent decline, the difference between proportional short-selling and proportional trading volume is negative and statistically significant, even without the Rule 201.

#### *4.4 Stock return dynamics before and after the Rule 201*

In this section, we analyze whether Rule 201 has changed the way in which short-selling affects contemporaneous and future stock returns. In Table 5, we present the contemporaneous return, intraday (high or low) return, future opening return, and future closing return. For the *pre-approval* period in Table, Panel A, we find that the stocks with an intraday decline of 10 percent or more have an average closing return of -9.15 percent. If short-sellers were manipulating prices of these stocks in a negative direction after a 10 percent decline, then we would expect the closing return to be lower than -10 percent. But, the closing return of -9.15 percent indicates that the price decline does not worsen during the remainder of the day for the target stocks. Thus, Rule 201 would not have any significance for the returns on the trigger date. Even prior to the Rule's approval, these stocks have a positive future opening return of 0.30 percent and a positive future closing return of 0.42 percent, indicating that the short-selling restrictions imposed by Rule 201 on the next day are not required from a valuation perspective.

We also analyze the returns in the post-implementation period to investigate whether Rule 201 has helped improve the contemporaneous return of the target stocks by making it less negative than the -9.15 in the *pre-approval* period or improve the future returns by making them more positive than 0.42 percent. Since Rule 201 became effective on May 10, 2010, the contemporaneous return is actually more negative at -9.91 percent in *post-approval* period, suggesting that the rule is not only ineffective, but may actually be damaging for the target

stocks' valuation. The analysis of future returns gives the same message. After Rule 201 became effective, future closing return is negative -0.26 percent, whereas it used to be positive before the rule's effective date. Instead of improving the return dynamics of target stocks Rule 201 may have worsened it.

[Insert Table 5 here]

This return analysis also provides the rationale for why short-selling does not increase for the target stocks even prior to the rule's approval. Any momentum trader who short sells a stock at a price 10 percent below previous day's closing price actually will incur a loss of 0.85 percent if they cover their position at the closing price of the same day. If they continue to hold their position, they will incur an additional loss of 0.30 percent by next day's open or 0.42 percent by the next day's close. In addition to the loss due to negative return, a short-seller also incurs stock borrowing fees in the form of lower interest rebates. It is the contrarian traders, i.e., those buying the stocks after a 10 percent decline, who would end up making a profit in the amounts mentioned above. Table 5, Panel B, shows that although Rule 201 has not dynamically altered the return dynamics, the direction of the change is undesirable, because it has worsened the gains for the contrarian traders, who were previously helping the markets by stepping in to buy the target stocks after their huge price decline.

#### *4.5 Analysis of short-selling volume on May 6, 2010 Flash Crash*

Now, we analyze whether Rule 201 can help further the SEC's goal of market stability by preventing sudden market crashes. On May 6, 2010, the Dow Jones Industrial Average witnessed the biggest intraday point decline. Did short-sellers have a big hand in causing the flash crash? We investigate whether there was a sudden spike in short-selling on the day of the flash crash. In

Table 6, we report the relative short-selling on the flash crash day and compare it with the normal relative short-selling on the previous day. On that day, had Rule 201 existed, it would trigger for 1,408 stocks compared to only 28 stocks on an average day. Another 1,499 stocks had an intraday decline between 5 percent and 10 percent on that day compared to 196 on an average day. But, the rule would not have altered the short-selling behavior or the return outcome on that day. Relative short-selling was not high on May 6 and May 7 than the relative short-selling on May 5. Nonetheless, the prices crashed anyway. Clearly, the crash was not the result of any spike in short-selling volume because there was no spike on that day for the target stocks that declined by 10 percent. The relative short-selling in other stock-day groups was higher than average, but the Rule 201 does not address those other groups.

[Insert Table 6 here]

#### *4.6 Simulation of short-selling orders during the crisis period of 2008*

Rule 201 aims at preventing potentially manipulative or abusive short-selling. The rule will be considered effective if short-sellers are not able to execute their orders immediately during periods of steep decline in stock prices. Would Rule 201 be binding on short-sellers during the historic financial the crisis of 2008? In order to test the effectiveness of Rule 201, we simulate short-sale orders that comply with Rule 201, during the crisis period of September-October 2008 and normal benchmark period of September-October 2009. If Rule 201 is effective and binding during crisis, it should prevent a large proportion of short-sale orders from executing after a 10 percent declines. To assess the bindingness of Rule 201, we compute the rule-compliant execution rate for simulated short-sale orders during 0-5 minute period after order submission using the procedure described below.

For each day on which Rule 201 would theoretically apply to a given stock for the entire trading day, we simulate a round-lot short-sale order at every 5-minute interval. For example, the first simulated short-sale order is placed at 9:35 am, 5 minutes after the open of trading hours. The last simulated short-sale order is placed at 3:55 pm, 5 minutes before the close of the trading hours. All simulated short-sale orders adhere to Rule 201 with respect to their limit price in relation to the NBBO. For example, if the market is at \$20.00 bid and to \$20.05 offered for a stock at the time of submission of the simulated short-sale order, then we assign the limit price of \$20.01 to this order. Any trade at or above \$20.01 after this order submission results in the execution of this simulated short-sale order. The short-sale order can be executed at a price less than or equal to the current national best bid provided that, at the time the order was initially placed by the trading center it was permissibly priced. Also, if the bid changes from \$20.00 to \$20.01 or above in the TAQ data, we assume that the simulated short-sale order has been executed. In Table 7, we present the rule-compliant execution rates of these simulated short-sale orders within each 1-minute interval during the next 5 minutes. In Table 7, columns 2 and 3, we report the results for the crisis period of 2008. In column 2, we report the percentage of simulated orders that are executed and in column 3, we report the cumulative percentage of simulated orders executed. We find that even in the presence of Rule 201, a large majority of simulated orders, 82.9 percent to be exact, are executed within 5 minutes of the order placement during the crisis period of 2008. Thus, Rule 201 is not particularly binding on short-selling activity in stocks with serious price declines. Moreover, the cumulative fill rate of 82.9 percent during the crisis period is much higher than the cumulative fill rate of 72.1 percent during the normal non-crisis benchmark period. In the last column of Table 7, we present the difference in cumulative percentage of executed short-sale orders between crisis period and normal period.

Thus, the rule seems to be more binding during periods of low volatility when it is not needed. In other words, in times of high volatility and potential crisis, this rule seems ineffective in curtailing short-selling activity.

[Insert Table 7 here]

#### *4.7 Liquidity measures before and after the effective date of the Rule 201*

Rule 201 prevents short-sellers from readily executing their orders at the current bid price and, thus, can potentially result in decreased liquidity in the stocks that are affected by this rule. We analyze the changes in the liquidity of the target stocks in the 3-day period enveloping the date of the 10 percent decline. We report the results separately for the *pre-approval* period and the *post-implementation* period in Table 8, Panel A and Panel B, respectively. In both panels, we report the liquidity measure on day  $t-1$ , day  $t$  and day  $t+1$  in column 2 through 4. We report the difference between the liquidity measure on day  $t+1$  compared to day  $t-1$  in column 5. We find that the turnover on day  $t+1$  is significantly higher than the turnover on day  $t-1$  in both panels. The bid-ask spread on day  $t+1$  is significantly lower than the bid-ask spread on day  $t-1$  resulting in a liquidity improvement in both periods.

In Table 8, Panel C, we report the differences in differences analysis of these two periods. The differences are statistically insignificant for both bid-ask spread and turnover. Thus, liquidity neither improved nor deteriorated as a result of Rule 201.

[Insert Table 8 here]

#### *4.8 Regression Analysis of daily relative short-selling*

In Table 9, we estimate a multivariate regression with the daily relative short-selling for the target stocks as the dependent variable. The key explanatory variable is an indicator variable



for effective date of Rule 201. The regression equation, which includes several known determinants of short-selling from Diether, Lee and Werner (2009b) and Christophe, Ferri, and Angel (2009) as control variables, is:

$$\begin{aligned}
 relss(t) = & \alpha_0 + \alpha_1 Rule\ 201 + \alpha_2 r_{-5,-1} + \alpha_3 r_t + \alpha_4 spread_t + \alpha_5 relss_{-5,-1} + \alpha_6 \sigma_t + \alpha_7 \sigma_{-5,-1} + \alpha_8 \sigma_t \\
 & + \alpha_9 \sigma_{-5,-1} + \alpha_{10} tv_{-5,-1} + \alpha_{11} Monday + \alpha_{12} Tuesday + \alpha_{13} Thursday + \alpha_{14} Friday + \varepsilon \quad (1)
 \end{aligned}$$

The *Rule 201* indicator variable takes a value of 1 for a period from May 10, 2010 onwards, and a value of 0 prior to that.  $r_{-5,-1}$  is the return for a stock from the closing price on day  $t-6$  to the closing price on day  $t-1$ .  $spread_t$  is the day  $t$  stock-level closing proportional bid-ask spread.  $\sigma_t$  is the difference in the high and low price on day  $t$  divided by the high price.  $\sigma_{-5,-1}$  is average daily  $\sigma$  from day  $t-5$  to day  $t-1$ .  $tv_{-5,-1}$  is the average daily share turnover of a stock for day  $t-5$  to day  $t-1$ . *Monday*, *Tuesday*, *Thursday* and *Friday* are the day-of-the-week dummy variables.

We report the coefficients from 3 alternative specifications based on all or subsets of the above variables. In all 3 specifications, the coefficient for *Rule 201* is positive and significant. Thus, short-selling increased after the approval and implementation of Rule 201, although the goal of the rule was to reduce short-selling. Thus, the rule is ineffective.

Short-selling in the target stocks increases with contemporaneous returns, and past short volume and is also higher on Thursdays. Short-selling decreases with spread, contemporaneous volatility, and past volatility. The coefficients for past returns and past turnover are statistically insignificant. More importantly, our conclusions regarding the ineffectiveness of Rule 201 in curtailing short-selling survive after inclusion of these control variables.

[Insert Table 9 here]

## **5. Robustness tests**

As a robustness test, we repeat our analysis of daily relative short-selling analogous to Table 2 for the target stocks that continue to decline further and end the day with a return more severe than -10 percent. If short-selling is being used for manipulating prices in the downward direction after a 10 percent decline, we should see some evidence of higher relative short-selling on these stock-days. We use data for a period from August 2009 to January 2010, i.e., before the approval of Rule 201. We do not find any evidence of higher short-selling in the sub-sample of stocks that continued to the decline beyond the cut-off point of -10 percent.

We also perform an intraday analysis of short-selling activity for the same sub-sample of the stocks mentioned above that continue to decline further and end the day with a return more severe than -10 percent. We do not find any evidence of higher proportional short-selling volume compared to proportional trading volume after a 10 percent decline in stock price.<sup>9</sup> Since, the stocks are declining in the absence of any increase in short-selling, the most likely cause is a genuine deterioration in their business fundamentals. Thus, Rule 201 appears to be addressing a non-existent problem.

## **6. Conclusion**

The SEC approved Rule 201 on February 24, 2010 (effective on May 10, 2010) to restrict short-selling in stocks that have an intraday decline of 10 percent or more. The SEC's goal is to stabilize the market by preventing potentially manipulative, abusive, or panic-driven short-selling. We investigate the pertinence and effectiveness of the Rule 201 in curtailing daily and intraday short-selling, ensuring fair valuations and price stability, promoting higher liquidity and execution quality, and preventing sudden or prolonged market crises.

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<sup>9</sup> The robustness analysis is not tabulated for brevity, but the results are available from the authors on request.

We find that even prior to the implementation of the Rule 201, short-selling actually declined on stock-days with extreme negative returns and increased on stock-days with extreme positive returns, obviating the need for the rule. This short-selling behavior did not change after implementation of the rule. Even on extreme market down days prior to the rule's approval, we find that short-selling already declined for the targeted stocks, prior to the Rule's approval.

We create a merged dataset using information from TAQ and FINRA to conduct our intraday analysis. From TAQ, we identify the exact time-stamp of the first trade which represented a 10 percent decline to divide the day in two time groups of before 10 percent decline and after the 10 percent decline. We compute proportional short-selling volume from FINRA and proportional overall trading volume from TAQ in these time groups and find that proportional short-selling volume was not higher than proportional overall trading volume after a 10 percent decline. We also divide each time group into finer intervals by finding the time-stamp of each successive 2 percent price decline on these stock-days. Furthermore, we perform minute-by-minute analysis for a 30-minute calendar time-period surrounding the 10 percent price decline. Throughout this analysis, we find that proportional short-selling volume was not higher than proportional total trading volume after a 10 percent price decline in any of the subgroups listed above.

Next, we analyze the future recovery of target stocks from their lowest price point. Even before the rule's approval, target stocks recover from a 10 percent decline by the end of the day. The next day's opening and closing returns are also positive on average. After the Rule 201 became effective, the recovery process for the target stocks actually worsened. The contemporaneous closing return is more negative after the rule than before. The next day's opening return is less positive with the rule than without. The next day's closing return is

negative after the rule whereas it was positive before the rule. Overall, we find that the target stocks recover better in the absence of the rule and conclude that Rule 201 may have worsened the valuation dynamic instead of improving it.

To understand the usefulness of the Rule 201 in periods of crisis, we examine short-selling on May 6, 2010, the day of the flash crash and also during the September-October 2008 historic financial crisis. Short-selling was actually lower on May 6 for target stocks compared to its normal level in the benchmark period. Thus, the rule would not have altered short-selling behavior or the return outcome on that day.

We simulate short-sale orders that comply with Rule 201 during September and October of 2008 to examine the potential effectiveness of the rule in restricting short-selling during crisis period, if it had been in force. We find that Rule 201 would not have been binding on short-sellers during the 2008 crisis as the simulated orders executed at a very high rate. In contrast, the rule-compliant execution rates of these simulated short-sale orders is significantly lower during normal period of September and October 2009, when it is not needed.

We also study the changes in liquidity for stocks affected by Rule 201. We compare the liquidity measures 1-day before the rule is triggered and 1-day after it triggers. We perform this liquidity change analysis both for the *pre-approval* period and *post-implementation* period. Our differences in differences analysis indicates that Rule 201 does not affect the pattern of liquidity changes in the periods surrounding 10 percent price declines.

Finally, we perform a multivariate regression analysis to test the effectiveness of Rule 201, controlling for other known determinants of short-selling. Short-selling does not decrease for stocks for which Rule 201 is triggered. Short-selling in the target stocks increases with contemporaneous returns and past short volume and it decreases with spread and volatility. More

importantly, our conclusions regarding the ineffectiveness of Rule 201 in curtailing short-selling survive after inclusion of these control variables. Overall, we find no apparent benefits from Rule 201.

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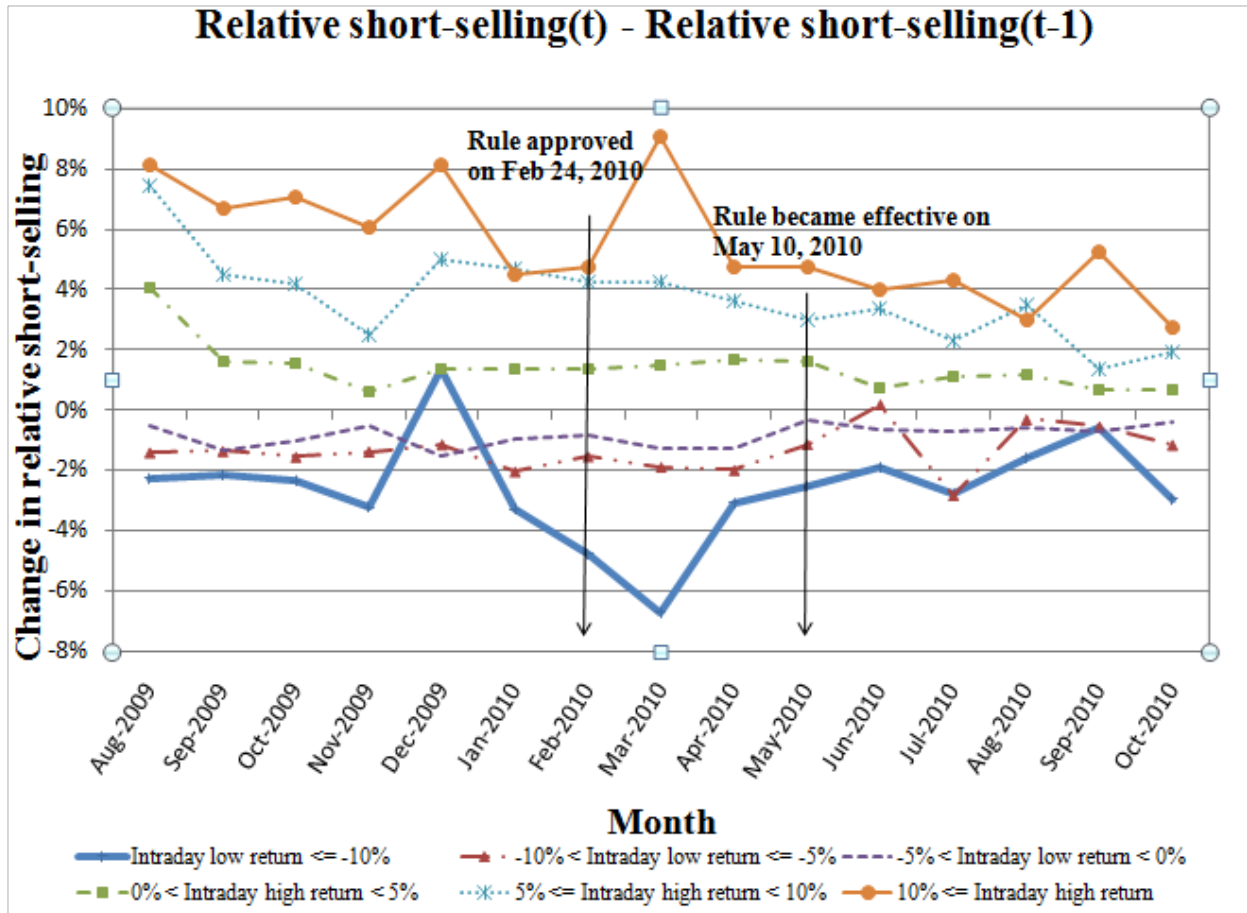


Figure 1

### Month-by-month short-selling activity

For each stock for each day  $t$ , we determine the return from the previous day's closing price to the lowest trade price and the highest trade price of the day. Using these returns, we form six stock-day groups: (1) Intraday low return  $\leq -10\%$ ; (2)  $-10\% < \text{Intraday low return} \leq -5\%$ ; (3)  $-5\% < \text{Intraday low return} < 0\%$ ; (4)  $0\% < \text{Intraday high return} < 5\%$ ; (5)  $5\% \leq \text{Intraday high return} < 10\%$ ; and (6)  $10\% \leq \text{Intraday high return}$ . Since a stock-day may fall into multiple categories, we take the absolute value of the intraday high and intraday low returns. If the absolute value of the intraday high return is greater than absolute value of the intraday low return, we assign the stock-day to the applicable intraday high groups, and vice versa. For each month, from August 2009 to October 2010, we plot the difference between the relative short selling on day  $t$  and the ratio on day  $t-1$ , where relative short selling ( $relss$ ) is defined as the short-selling volume as a percentage of total trading volume.



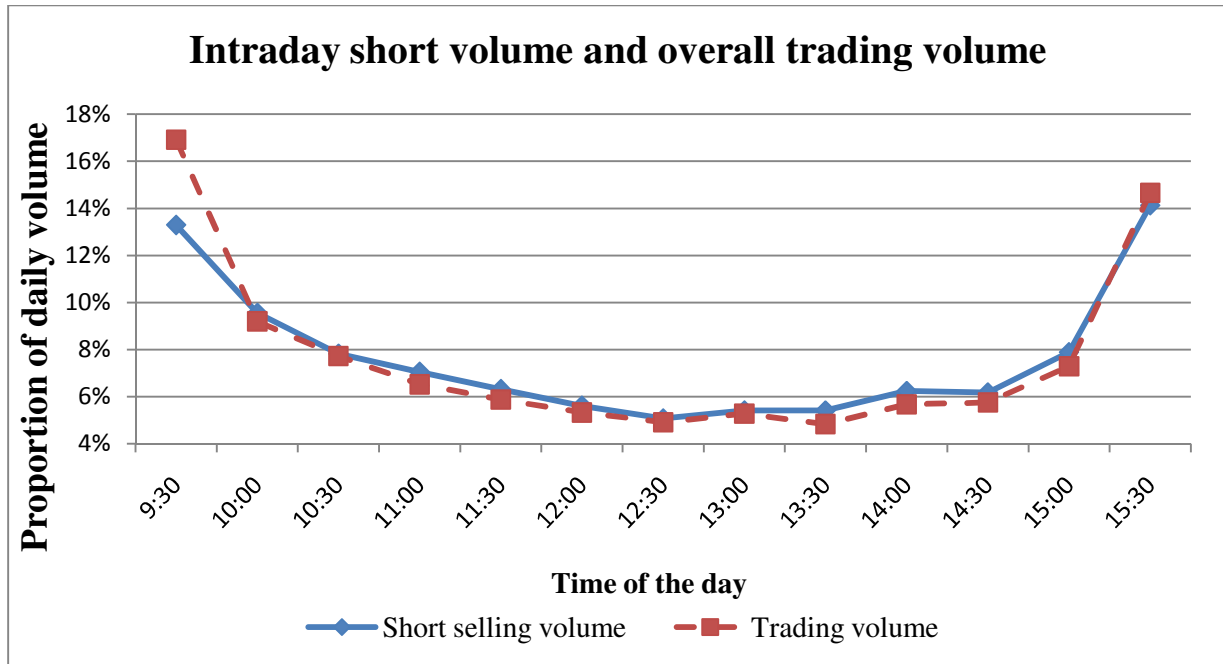


Figure 2

### Intraday split of short-selling volume and total trading volume

We cumulate short-selling volume and trading volume in each 30-minute interval of the day for stocks that are affected by Rule 201. We divide the sums of the short-selling volume in each 30-minute interval by the total short-selling volume of the entire trading day to compute the intraday split of daily short-selling volume. Next, we compute the intraday split of daily trading volume for each 30-minute interval, analogously. In this figure, we plot these intraday proportions of short-selling volume and intraday proportions of trading volume.

Table 1

**Descriptive statistics**

We present the descriptive statistics for the stock-day groups formed based on intraday low return and intraday high return for a period from August 2009 to October 2010. We provide the daily average number of stocks in each group. We also present the mean and standard deviation of the market capitalization and the prices of those stocks.

Stock-day group	Number of stocks	Market Capitalization		Price	
	Daily Average	Mean	Std	Mean	Std
Intraday low return $\leq -10\%$	28.5	1,234	7,461	15.9	21.6
$-10\% <$ Intraday low return $\leq -5\%$	195.6	1,383	6,476	17.2	19.2
$-5\% <$ Intraday low return $< 0\%$	1,850	3,365	14,086	24.4	27.8
$0\% <$ Intraday high return $< 5\%$	1,856	3,341	14,039	24.3	27.2
$5\% \leq$ Intraday high return $< 10\%$	197.8	1,356	5,753	16.9	18.6
$10\% \leq$ Intraday high return	33.7	663	3,329	14.0	18.8

Table 2

**Short-selling volume for different stock-day groups**

We define relative short selling as the short-selling volume as a % of total volume. We present the relative short-selling on days  $t-1$ ,  $t$ , and  $t+1$  for stock-day groups based on intraday low or intraday high returns, where day  $t$  is the day on which we assign each stock-day to a stock-day group. We also present the difference between relative short-selling on day  $t$  and  $t-1$  in column 5, and the difference between relative short-selling on day  $t+1$  and day  $t$  in column 6. Panel A presents the relative short-selling before the approval date, Panel B covers the period from the approval date of the rule to the effective date of the rule, and Panel C covers the period after the effective date of the rule.

Stock-day group	Relative short-selling on day				
	$t-1$	$t$	$t+1$	Difference $t-(t-1)$	Difference $(t+1)-(t-1)$
<i>Panel A: Pre-approval period</i> (August 3, 2009 to February 23, 2010)					
Intraday low return $\leq -10\%$	32.0	29.6	31.0	-2.40***	-0.92*
$-10\% <$ Intraday low return $\leq -5\%$	35.6	34.0	34.4	-1.52***	-1.15***
$-5\% <$ Intraday low return $< 0\%$	35.8	34.9	35.1	-0.95***	-0.69***
$0\% <$ Intraday high return $< 5\%$	35.3	37.0	36.3	1.71***	1.07***
$5\% \leq$ Intraday high return $< 10\%$	35.4	40.1	37.8	4.70***	2.41***
$10\% \leq$ Intraday high return	33.0	39.7	35.4	6.72***	2.41***
<i>Panel B: Post-approval period</i> (February 24, 2010 to May 9, 2010)					
Intraday low return $\leq -10\%$	36.5	33.2	35.0	-3.34***	-1.57***
$-10\% <$ Intraday low return $\leq -5\%$	37.4	36.0	36.2	-1.43***	-1.18***
$-5\% <$ Intraday low return $< 0\%$	36.5	35.4	35.7	-1.07***	-0.79***
$0\% <$ Intraday high return $< 5\%$	36.3	37.9	37.1	1.56***	0.84***
$5\% \leq$ Intraday high return $< 10\%$	36.8	40.8	38.6	3.92***	1.72***
$10\% \leq$ Intraday high return	35.7	42.3	37.1	6.58***	1.40*
<i>Panel C: Post-implementation period</i> (May 10, 2010 to October 28, 2010)					
Intraday low return $\leq -10\%$	34.4	32.4	32.3	-2.04***	-2.09***
$-10\% <$ Intraday low return $\leq -5\%$	38.1	37.2	36.7	-0.89***	-1.36***
$-5\% <$ Intraday low return $< 0\%$	36.9	36.3	36.2	-0.59***	-0.77***
$0\% <$ Intraday high return $< 5\%$	36.6	37.5	36.7	0.93***	0.10*
$5\% \leq$ Intraday high return $< 10\%$	38.4	41.0	39.3	2.61***	0.97***
$10\% \leq$ Intraday high return	36.3	40.4	36.7	4.14***	0.40

\*\*\*, \*\* and \* indicate significance at 1%, 5% and 10%, respectively.

Table 3

**Short-selling volume during extreme market movements**

First, we present relative short-selling on days of extreme market movements for the overall sample period. Then, we divide the sample period into two sub-periods surrounding Rule 201's approval - the *pre-approval* period and the *post-implementation* period. We present changes in relative short-selling from day  $t-1$  to day  $t$  and from day  $t$  to day  $t+1$ , where day  $t$  is the day on which we assign each stock to a return group. Panel A and Panel B present changes in relative short-selling for the days of extreme negative market movements and for the days of extreme positive market movements, respectively. To determine the extreme market movement days, we calculate close-to-close returns of the S&P 500 for the period of August 3, 2009 to October 28, 2010. After calculating the mean of daily returns, we select days when the S&P 500 moves two standard deviations above or below the mean.

Stock-day group	Relative short-selling difference					
	Overall time period		Pre-approval		Post-implementation	
	$t-(t-1)$	$(t+1)-(t-1)$	$t-(t-1)$	$(t+1)-(t-1)$	$t-(t-1)$	$(t+1)-(t-1)$
<i>Panel A: Short-selling on extreme down days</i>						
Intraday low return $\leq -10\%$	-2.73***	-0.58	-4.73***	-2.70**	-0.09	1.60
$-10\% < \text{Intraday low return} \leq -5\%$	-0.24	-0.66***	-1.83***	-1.84***	0.71***	0.26
$-5\% < \text{Intraday low return} < 0\%$	0.93***	0.10	-0.35	-1.25***	2.07***	0.98***
$0\% < \text{Intraday high return} < 5\%$	3.46***	1.64***	2.85***	3.12***	4.50***	0.74
$5\% \leq \text{Intraday high return} < 10\%$	3.28***	-0.44	0.83	-0.98	6.76***	2.70
$10\% \leq \text{Intraday high return}$	2.34	-0.46	-2.59	-2.78	12.41	0.46
<i>Panel B: Short-selling on extreme up days</i>						
Intraday low return $\leq -10\%$	-1.18	0.74	-1.17	2.61	-1.21	-2.60
$-10\% < \text{Intraday low return} \leq -5\%$	-2.84**	-3.84***	-2.54*	-2.74**	-3.29*	-5.53***
$-5\% < \text{Intraday low return} < 0\%$	-1.51***	-1.80***	-1.42***	-1.51***	-1.64***	-2.23***
$0\% < \text{Intraday high return} < 5\%$	-0.56***	0.02	-0.16	0.00	-0.97***	0.04
$5\% \leq \text{Intraday high return} < 10\%$	1.59***	1.68***	3.30***	1.87***	0.70***	1.59***
$10\% \leq \text{Intraday high return}$	4.90***	3.35***	5.00***	2.35**	4.83***	4.02***

\*\*\*, \*\* and \* indicate significance at 1%, 5% and 10%, respectively.

Table 4

**Intraday analysis of short-selling volume for days with 10% intraday declines**

This table is based on the 5-month period from September, 2009 to January, 2010. In Panel A, we divide each stock-day with an intraday decline of 10% or more into 2 time groups: before a 10% decline and after a 10% decline. The time-stamp for the 10 percent decline is identified from TAQ and short-selling volume is obtained from FINRA. We sum the short-selling volume in the before and after time groups, respectively. Next, we divide those sums in each group by the total short-selling volume of the entire trading day to compute the intraday proportions of daily short-selling volume. Next, we compute the intraday proportions of daily overall trading volume from TAQ, analogously. We report the average of proportional trading volume and proportional short-selling volume across all stock-days in each of the 2 time groups in column 2 and column 3. In column 4, we report the difference in the proportional short-selling and proportional overall trading volume in each time group. In Panel B, we divide the day in following 11 time groups for all target stocks: (1) Until 2% decline (2) Between 2% to 4% decline (3) Between 4% to 6% decline (4) Between 6% to 8% decline (5) Between 8% to 10% decline (6) Between 10% to 12% decline (7) Between 12% to 14% decline (8) Between 14% to 16% decline (9) Between 16% to 18% decline (10) Between 18% to 20% decline (11) After 20% decline. In Panel C, we repeat this analysis for thirty 1-minute intervals around the 10% decline.

	Intraday split of daily short- selling volume	Intraday split of total daily volume	Difference
<i>Panel A: Short-selling activity before and after 10% decline</i>			
Until 10% decline	36.58%	35.51%	1.07%**
After 10% decline	63.42%	64.49%	-1.07%**
<i>Panel B: Short-selling activity in 2% decline intervals for stocks that decline 10%</i>			
Until 2% decline	6.81%	4.84%	1.97%***
Between 2% to 4% decline	4.83%	4.69%	0.14%
Between 4% to 6% decline	6.24%	6.42%	-0.18%
Between 6% to 8% decline	8.06%	8.28%	-0.22%
Between 8% to 10% decline	10.65%	11.27%	-0.62%***
Between 10% to 12% decline	27.67%	28.45%	-0.78%**
Between 12% to 14% decline	14.17%	14.32%	-0.15%
Between 14% to 16% decline	6.73%	6.88%	-0.15%
Between 16% to 18% decline	4.99%	4.94%	0.05%
Between 18% to 20% decline	2.93%	2.91%	0.02%
After 20% decline	6.94%	6.99%	-0.05%

Table 4- continued

	Intraday split of daily short- selling volume	Intraday split of total daily volume	Difference
<i>Panel C: Short-selling activity in thirty 1-minute interval around 10% decline</i>			
15- to 14-minutes before 10% decline	0.25%	0.24%	0.01%
14- to 13-minutes before 10% decline	0.21%	0.25%	-0.04%
13- to 12-minutes before 10% decline	0.20%	0.26%	-0.06%
12- to 11-minutes before 10% decline	0.22%	0.31%	-0.09%***
11- to 10-minutes before 10% decline	0.22%	0.25%	-0.03%
10- to 9-minutes before 10% decline	0.29%	0.31%	-0.02%
9- to 8-minutes before 10% decline	0.23%	0.32%	-0.09%***
8- to 7-minutes before 10% decline	0.24%	0.32%	-0.08%***
7- to 6-minutes before 10% decline	0.29%	0.34%	-0.05%
6- to 5-minutes before 10% decline	0.38%	0.42%	-0.04%
5- to 4-minutes before 10% decline	0.32%	0.41%	-0.09%***
4- to 3-minutes before 10% decline	0.38%	0.47%	-0.09%*
3- to 2-minutes before 10% decline	0.47%	0.51%	-0.04%
2- to 1-minutes before 10% decline	0.53%	0.70%	-0.17%**
1- to 0-minute before 10% decline	4.77%	2.90%	1.87%***
0- to 1-minute after 10% decline	2.08%	6.44%	-4.36%***
1- to 2-minutes after 10% decline	0.80%	1.01%	-0.21%**
2- to 3-minutes after 10% decline	0.69%	0.86%	-0.17%**
3- to 4-minutes after 10% decline	0.48%	0.69%	-0.21%***
4- to 5-minutes after 10% decline	0.54%	0.65%	-0.11%**
5- to 6-minutes after 10% decline	0.46%	0.64%	-0.18%***
6- to 7-minutes after 10% decline	0.53%	0.62%	-0.09%
7- to 8-minutes after 10% decline	0.54%	0.55%	-0.01%
8- to 9-minutes after 10% decline	0.44%	0.53%	-0.09%**
9- to 10-minutes after 10% decline	0.52%	0.49%	0.03%
10- to 11-minutes after 10% decline	0.53%	0.50%	0.03%
11- to 12-minutes after 10% decline	0.48%	0.49%	-0.01%
12- to 13-minutes after 10% decline	0.45%	0.43%	0.02%
13- to 14-minutes after 10% decline	0.41%	0.44%	-0.03%
14- to 15-minutes after 10% decline	0.44%	0.45%	-0.01%

\*\*\*, \*\* and \* indicate significance at 1%, 5% and 10%, respectively.

Table 5

**Return dynamics before and after Rule 201**

This table presents the average contemporaneous and future returns relative to the trigger date or the date on which the stock is allocated to one of the six stock-day groups. Contemporaneous return is calculated as the closing price on the trigger or allocation date minus the closing price on the previous day divided by the closing price on the previous day. The future opening return is defined as the opening price on day  $t+1$  minus the closing price on day  $t$  divided by the closing price on day  $t$ . The future closing return is defined as the closing price on day  $t+1$  minus the closing price on day  $t$  divided by the closing price on day  $t$ . Panel A covers the period before the approval date of Rule 201 and Panel B covers the period after the effective date of the Rule 201.

Stock-day group	Contemporaneous Return	Future return (opening)	Future return (closing)
<i>Panel A: Pre-approval period</i>			
<i>(August 3, 2009 to February 23, 2010)</i>			
Intraday low return $\leq -10\%$	-9.15	0.30	0.42
$-10\% <$ Intraday low return $\leq -5\%$	-4.07	0.13	0.08
$-5\% <$ Intraday low return $< 0\%$	-0.98	0.09	0.06
$0\% <$ Intraday high return $< 5\%$	1.09	0.03	0.11
$5\% \leq$ Intraday high return $< 10\%$	4.29	0.07	0.12
$10\% \leq$ Intraday high return	10.12	0.23	0.00
<i>Panel B: Post-implementation period</i>			
<i>(May 10, 2010 to October 28, 2010)</i>			
Intraday low return $\leq -10\%$	-9.91	0.08	-0.26
$-10\% <$ Intraday low return $\leq -5\%$	-4.34	-0.07	-0.15
$-5\% <$ Intraday low return $< 0\%$	-1.01	0.05	0.00
$0\% <$ Intraday high return $< 5\%$	1.09	0.04	0.08
$5\% \leq$ Intraday high return $< 10\%$	4.59	0.02	0.27
$10\% \leq$ Intraday high return	10.25	-0.05	0.03

Table 6

**Short-selling volume around flash crash day (May 6, 2010)**

We present relative short-selling on day  $t-1$ ,  $t$ , and  $t+1$  for the stock-day groups formed based on the intraday low return and the intraday high return on the day of the flash crash, May 6, 2010. We also present the difference between the relative short-selling on day  $t$  and  $t-1$  in column 6, and the difference between the relative short-selling on day  $t+1$  and day  $t-1$  in column 7.

Stock-day group	No of stocks	Relative short selling on day				
		$t-1$	$t$	$t+1$	$t-(t-1)$	$(t+1)-(t-1)$
Intraday low return $\leq -10\%$	1408	37.2	34.4	36.5	-2.81***	-0.64
$-10\% <$ Intraday low return $\leq -5\%$	1499	39.8	41.2	38.4	1.36***	-1.41***
$-5\% <$ Intraday low return $< 0\%$	786	32.6	34.9	33.1	2.28**	0.41
$0\% <$ Intraday high return $< 5\%$	237	34.2	39.6	31.6	5.40**	-2.55
$5\% \leq$ Intraday high return $< 10\%$	89	37.1	39.4	31.9	2.31	-5.21**
$10\% \leq$ Intraday high return	62	37.2	39.6	39.2	2.38	2.02

\*\*\*, \*\* and \* indicate significance at 1%, 5% and 10%, respectively.



Table 7

**Simulation of short-sale orders during the crisis period and normal periods**

We simulate short-sale orders at every 5-minute interval for stocks-days on which Rule 201 would apply for the entire day if it had existed in September 2008 – October 2008 and September 2008 – October 2009. We present the hypothetical rule-compliant execution rates of these short-sale orders in the next five 1-minute interval in the presence of the hypothetical alternative uptick rule in column 2 and column 4. Column 3 and 5 report the cumulative percentage of simulated short-sale orders that are executed. In column 6, the difference between cumulative execution rates during crisis period and normal period is reported.

Time interval	Crisis period (Sept 2008-Oct 2008)		Normal period (Sept 2009-Oct 2009)		Difference (C1-C2)
	Percentage of short-sale orders executed	Cumulative percentage of short-sale orders executed (C1)	Percentage of short-sale orders executed	Cumulative percentage of short-sale orders executed (C2)	
First 1-minute	69.2	69.2	55.0	55.0	14.1***
1- to 2-minute	6.6	75.7	7.6	62.7	13.1***
2- to 3-minute	3.3	79.0	3.9	66.6	12.4***
3- to 4-minute	2.2	81.2	2.7	69.3	11.9***
4- to 5-minute	1.6	82.7	2.1	71.3	11.4***

\*\*\* represents significance at 1%.

Table 8

**Liquidity changes around 10% price declines**

We present the bid-ask spread and trading volume on the day before 10 percent price decline ( $t-1$ ), on the day of 10 percent price decline ( $t$ ) and 1-day after 10 percent price decline ( $t+1$ ). In column 5, we report the difference in liquidity measure on day  $t+1$  and day  $t-1$ . In Panel A, we use the data before the approval of the rule and in Panel B, after the effective date of the rule. In Panel C, we report the difference in differences analysis for these two periods.

	Day $t-1$	Day $t$	Day $t+1$	Day ( $t+1$ ) - Day ( $t-1$ )
<i>Panel A: Pre-approval period</i> (August 3, 2009 to February 23, 2010)				
Bid-ask spread	21.17	20.23	19.07	-2.1***
Turnover	1293.6	2893.1	1728.4	434.84***
<i>Panel B: Post-implementation period</i> (May 10, 2010 to October 28, 2010)				
Bid-ask spread	16.6	16.09	15.23	-1.37**
Turnover	1298.0	3398.7	1799.1	501.12***
<i>Panel C: Differences in Differences</i>				
<i>Panel B - Panel A:</i>				
Bid-ask spread				0.73
Turnover				66.28

\*\*\*, \*\* and \* represent significance at 1%, 5% and 10%, respectively

Table 9

**Regression results**

We regress daily relative short-selling (*relss*) on *Rule 201* indicator and other control variables. We run regressions for the period from August 2009 to October 2010. *Rule 201* takes a value of 1 for the *post-implementation period* after May 10, 2010, and a value of 0 prior to that. We follow Diether, Lee and Werner (2009) for the control variables in this regression.  $r_t$  is the return of the stock on day  $t$ .  $r_{-5,-1}$  is the return for the stock from the closing price on day  $t-6$  to the closing price on day  $t-1$ .  $spread_t$  is the day  $t$  stock-level closing proportional bid-ask spread.  $\sigma_t$  is the difference in the high and low price on day  $t$  divided by the high price:  $(high - low)/high$ .  $\sigma_{-5,-1}$  is the average daily  $\sigma$  from day  $t-5$  to day  $t-1$ .  $tv_{-5,-1}$  is the average daily share turnover of the stock for day  $t-5$  to day  $t-1$ . *Monday*, *Tuesday*, *Thursday* and *Friday* are the day-of-the-week dummy variables.

<i>Dependent variable: relss(t)</i>			
	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>
Intercept	0.3104***	0.2825***	0.2743***
Rule 201	0.0131***	0.0109**	0.0125***
$r_{-5,-1}$		0.0011	0.0027
$r_t$		0.2174***	0.1973***
$spread_t$		-0.7694***	-0.7391***
$relss_{-5,-1}$		0.2596***	0.2587***
$\sigma_t$		-0.1084***	-0.1319***
$\sigma_{-5,-1}$		-0.1730**	-0.1346*
$tv_{-5,-1}$		0.0485	0.0472
Monday			-0.0089
Tuesday			0.0004
Thursday			0.0178***
Friday			0.0083
Adjusted R-Square	0.0007	0.1221	0.1246
Number of observations	8,525	6,398	6,398

\*\*\*, \*\* and \* indicate significance at 1%, 5% and 10%, respectively.