

(How) Do Price Tests Affect Short Selling?

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A. Before the Reg SHO Pilot:

What do we know about price tests?

1. Compare short and regular sell orders
 - 23% of sell orders are short sell orders
 - 80% of short sell orders are limit orders
(64% of regular sell orders are limit orders)

2. NYSE results on Rule 10a-1 regarding short sell orders:
 - More likely to receive price improvement but at the loss of immediacy (i.e., longer execution times)
 - More likely to be cancelled or not filled
 - Why? Market short orders typically cannot execute at bid, and become limit orders

B. Objective

As stated by the SEC in 2004 when introducing the Pilot:

- (1) Examine how price tests further stated objectives of price tests
 - Allow relatively unrestricted short selling in an advancing market
 - Prevent short selling at successively lower prices
 - Prevent short sellers from accelerating a declining market by exhausting all remaining bids at one price level

- (2) Analyze effect of price tests on:
 - Volatility
 - Price efficiency
 - Liquidity

C. Sample used to examine Reg SHO

1. Compare May with April of 2005

Reg SHO effective Monday May 2, 2005

2. Stock must have trading on each trading day in both months

3. Obtain two-digit SIC industry code and option listing status

4. For each pilot, consider all controls that are from same industry and have same option-listing status

5. For each possible control, calculate Z-score for each of 5 variables:

$$Z_{\rho i} = \{(F_{pi} - F_{ci}) / [(F_{pi} + F_{ci}) / 2]\}^2$$

6. Sum up the Z-scores for each possible control:

$$Z_{\rho} = Z_{\rho 1} + Z_{\rho 2} + Z_{\rho 3} + Z_{\rho 4} + Z_{\rho 5}$$

7. Select set of matches with lowest collective Z-score for each industry

8. Analyze best 50% of these pairs (224 NYSE; 183 Nasdaq)

Sample: Table 1

Variable	Pilot	Control	Difference	Z-score
<i>Panel A. NYSE Sample (224 pairs)</i>				
Price	\$39.06 [\$35.30]	\$37.94 [\$35.09]	-\$1.13 [-\$.78]	.12 [.07]
Market Cap. (\$ billions)	\$6.66 [\$2.46]	\$6.79 [\$2.37]	\$.13 [-\$.07]	.14 [.06]
Volume (millions)	220.07 [97.29]	218.06 [111.05]	-2.01 [3.32]	.13 [.07]
Return 3/1/04-2/28/05	20.7% [16.5%]	20.4% [16.9%]	-.3% [-.2%]	.17 [.08]
Book / Market	.47 [.46]	.45 [.44]	-.02 [-.01]	.12 [.05]
Aggregate Z-Score				.69 [.65]

Variable	Pilot	Control	Difference	Z-score
<i>Panel A. Nasdaq Sample (183 pairs)</i>				
Price	\$20.78 [\$18.40]	\$20.61 [\$19.14]	-\$0.17 [-\$.49]	.10 [.06]
Market Cap. (\$ billions)	\$1.76 [\$.56]	\$1.70 [\$.55]	-\$0.07 [\$.00]	.09 [.04]
Volume (millions)	263.73 [67.48]	245.26 [67.87]	-18.47 [.01]	.14 [.06]
Return 3/1/04-2/28/05	-5.0% [-11.0%]	-4.4% [-9.9%]	.7% [-.1%]	.12 [.05]
Book / Market	.39 [.37]	.40 [.36]	.01 [.00]	.10 [.04]
Aggregate Z-Score				.55 [.52]

Difference is not statistically significant for either NYSE or Nasdaq.

D. Test procedure

P_{Ai} = variable for pilot in April

P_{Mi} = variable for pilot in May

C_{Ai} = variable for control in April

C_{Mi} = variable for control in May

- Comparing P_{Ai} with P_{Mi} is problematic due to stock returns less than -3% in April and greater than $+4\%$ in May
- Comparing P_{Mi} with P_{Ci} is problematic since cannot control for all differences between pilot and control (e.g., institutional holdings, frequency of short selling)
- Analyze “difference of differences” of set of matched pairs:

$$(P_{Mi} - P_{Ai}) - (C_{Mi} - C_{Ai})$$

E. Market reaction analysis: Table 2

	NYSE Sample			Nasdaq Sample		
	Pilot	Control	Difference	Pilot	Control	Difference
<i>Panel A: Announcement Returns</i>						
July 27, 2004	1.12% [.94%]	1.11% [.97%]	.00% [.11%]	2.76% [2.74%]	2.64% [2.23%]	.11% [.45%]
July 28, 2004	-.03% [.00%]	.03% [.00%]	-.06% [-.11%]	-.99% [-1.05%]	-1.02% [-1.00%]	.03% [.07%]
July 29, 2004	1.09% [.90%]	.81% [.75%]	.28% [.06%]	1.71% [1.59%]	2.24% [1.34%]	-.52% [.33%]
<i>Panel B: Returns Around Initiation of Program</i>						
April 29, 2005	.89% [.94%]	.49% [.59%]	.40% ** [.31%]	.65% [.66%]	.89% [.71%]	-.24% [-.20%]
May 2, 2005	.69% [.59%]	.59% [.50%]	.10% [.02%]	.80% [.64%]	.87% [.93%]	-.07% [.26%]
May 3, 2005	-.23% [-.19%]	-.38% [-.32%]	.15% [.17%]	.04% [.08%]	.12% [-.16%]	-.08% [.23%]
<i>Panel C: Cumulative Returns</i>						
April 2005	-3.00% [-1.93%]	-4.08% [-2.47%]	1.08% [.68%]	-8.79% [-8.35%]	-8.13% [-6.96%]	-.66% [.31%]
May 2005	4.22% [3.71%]	4.79% [4.11%]	-.56% [-.41%]	6.92% [7.72%]	7.21% [7.40%]	-.28% [.21%]
Difference of Differences			-1.64% [-.70%]			.37% [-2.06%]

F. Trading: Table 3

Variable	Pilot Stocks			Control Stocks			Difference of Differences
	April	May	% Difference	April	May	% Difference	
<i>Panel A: Consolidated Short Trading Volume in Shares ($\times 100,000$)</i>							
NYSE	53.3 [25.0]	49.5 [24.4]	2.5% [-6.0%]	50.4 [25.9]	46.0 [23.6]	-2.7% [-8.6%*]	5.2% [2.2%]
Nasdaq	70.1 [20.2]	71.9 [18.7]	6.5% [-8.0%]	67.1 [19.8]	73.1 [17.5]	11.9% [-15.5%]	-5.4% [4.2%]
<i>Panel B: Number of Short Trades ($\times 1,000$)</i>							
NYSE	10.5 [6.9]	11.9 [8.7]	25.7%** [19.3%**]	10.0 [6.8]	9.2 [6.5]	-4.1%* [-6.5%**]	29.8%** [28.0%**]
Nasdaq	19.9 [9.5]	19.7 [8.8]	5.0% [-3.9%]	19.0 [8.8]	18.4 [7.5]	6.8% [-11.0%]	-1.8% [8.6%]
<i>Panel C: Short Trade Size in Shares</i>							
NYSE	415 [351]	330 [286]	-19.5%** [-20.6%**]	407 [369]	406 [363]	-1% [-9%]	-19.4%** [-21.0%**]
Nasdaq	236 [216]	233 [214]	-3% [-1.4%]	252 [227]	254 [218]	2.3% [-1.7%]	-2.6% [-1.1%]

G. Volatility: Table 4

Variable	Pilot Stocks			Control Stocks			Difference of Differences
	April	May	% Difference	April	May	% Difference	
<i>Panel A: Realized Volatility, Sum of Squared 5-minute Returns</i>							
NYSE	.71 [.57]	.58 [.46]	-14.1%** [-21.8%**]	.73 [.51]	.54 [.42]	-17.4%** [-22.1%**]	3.3% [.2%]
Nasdaq	1.59 [1.26]	1.35 [1.00]	-11.5%** [-20.0%**]	1.84 [1.36]	1.45 [1.01]	-11.8%** [-28.7%**]	.4% [5.4%]
<i>Panel B: Semi-Variance ($\times 10^6$)</i>							
NYSE	2.13 [1.75]	1.75 [1.38]	-13.9%** [-19.2%**]	2.27 [1.55]	1.62 [1.28]	-16.9%** [-22.1%**]	3.0% [.9%]
Nasdaq	4.67 [3.93]	4.00 [2.99]	-12.0%** [-23.2%**]	5.27 [3.97]	4.12 [2.90]	-13.5%** [-26.8%**]	1.5% [3.1%]
<i>Panel C: Daily Relative Price Range ($\times 10^2$)</i>							
NYSE	2.37 [2.27]	2.08 [1.92]	-10.8%** [-12.7%**]	2.37 [2.17]	2.05 [1.93]	-11.0%** [-13.4%**]	.3% [-.2%]
Nasdaq	3.86 [3.69]	3.46 [3.17]	-9.8%** [-11.4%**]	4.04 [3.73]	3.51 [3.14]	-10.8%** [-13.5%**]	1.0% [1.8%]

H. Market Efficiency: Table 5

Variable	Pilot Stocks			Control Stocks			Difference of Differences
	April	May	Difference	April	May	Difference	
<i>Panel A: Absolute Autocorrelation</i>							
NYSE $\Delta t = 30$ min.	.075 [.061]	.071 [.063]	-.004 [-.003]	.070 [.056]	.069 [.058]	-.000 [-.000]	-.004 [-.010]
NYSE $\Delta t = 5$ min.	.088 [.076]	.113 [.112]	.025** [.023**]	.087 [.076]	.096 [.074]	.008 [.005]	.017* [.011*]
Nasdaq $\Delta t = 30$ min.	.073 [.064]	.070 [.056]	-.003 [-.001]	.082 [.068]	.067 [.058]	-.015* [-.013**]	.012 [.011]
Nasdaq $\Delta t = 5$ min.	.047 [.038]	.051 [.041]	.004 [.002]	.050 [.040]	.051 [.043]	.000 [-.002]	.004 [.004]
<i>Panel B: Upside – Downside R^2</i>							
NYSE $\Delta t = 30$ min.	.022 [.022]	-.012 [-.011]	-.034** [-.020**]	.018 [.017]	-.017 [-.020]	-.035** [-.031**]	.001 [.009]
NYSE $\Delta t = 5$ min.	.032 [.023]	-.017 [-.019]	-.049** [-.040**]	.029 [.024]	-.023 [-.018]	-.053** [-.046**]	.004 [.002]
Nasdaq $\Delta t = 30$ min.	.005 [.010]	.010 [.014]	.005 [-.003]	.004 [.008]	.014 [.002]	.010 [.008]	-.005 [-.012]
Nasdaq $\Delta t = 5$ min.	.009 [.006]	-.016 [-.011]	-.025** [-.023**]	.013 [.011]	-.011 [-.010]	-.024** [-.022**]	-.001 [-.005]

More on Market Efficiency: Price Runs

Variable	Pilot Stocks			Control Stocks			Difference of Differences	
	April	May	Difference	April	May	Difference		
<i>Panel C: Average Conditional Probability of Subsequent Price Decreases/Increases Following Short Sale</i>								
NYSE	P ₁	.263	.263	.000	.262	.256	-.006*	.007
Price	P ₂	.212	.242	.030**	.208	.200	-.008	.038**
Dec.	P ₃	.260	.279	.019	.252	.246	-.006	.025
Nasdaq	P ₁	.209	.214	.005	.217	.220	.003	.002
Price	P ₂	.165	.170	.005	.162	.165	.003	.002
Dec.	P ₃	.193	.191	-.002	.211	.169	-.042**	.040
NYSE	P ₁	.204	.264	.060**	.204	.197	-.007*	.067**
Price	P ₂	.279	.243	-.036**	.275	.252	-.023**	-.014
Inc.	P ₃	.280	.273	-.007	.285	.288	.003	-.010
Nasdaq	P ₁	.169	.173	.004	.167	.173	.006	-.002
Price	P ₂	.165	.164	-.001	.165	.163	-.001	.000
Inc.	P ₃	.224	.196	-.029	.230	.217	-.012	-.017

I. Liquidity: Table 6

Variable	Pilot Stocks			Control Stocks			Difference of Differences
	April	May	Difference	April	May	Difference	
<i>Panel A: Quoted Spreads (¢)</i>							
NYSE	4.19 [3.83]	4.14 [3.70]	.0% [.0%]	4.04 [3.43]	3.79 [3.30]	-5.5%** [-5.9%**]	5.5%** [5.1%**]
Nasdaq	3.70 [2.66]	3.72 [2.61]	1.1% [-2.5%]	3.64 [2.76]	3.58 [2.65]	-2.2%* [-1.8%**]	3.3%* [2.6%**]
<i>Panel B: Relative Spreads (basis points)</i>							
NYSE	13.45 [11.49]	13.38 [11.23]	-.07 [.04]	13.71 [10.74]	13.00 [9.93]	-.72** [-.63**]	.65** [.51**]
Nasdaq	24.19 [20.94]	24.26 [20.89]	.07 [.27]	25.51 [20.03]	24.81 [20.00]	-.71* [-.37**]	.77* [.43*]

More on Liquidity: Depths

Pilot Stocks

Control Stocks

Variable	April	May	Difference	April	May	Difference	Difference of Differences
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Panel C: NYSE-NBBO Depths

Bid Size (100s)	9.92 [6.03]	9.36 [5.55]	-2.7%* [-3.9%**]	9.03 [6.47]	9.33 [6.69]	4.5%** [2.1%*]	-7.2%** [-6.4%**]
Ask Size (100s)	12.29 [7.65]	9.59 [5.76]	-21.5%** [-23.7%**]	11.63 [8.34]	12.59 [8.64]	8.2%** [4.1%**]	-29.7%** [-30.3%**]
Bid Size / Ask Size	.85 [.83]	1.06 [1.05]	28.6%** [25.7%**]	.90 [.85]	.88 [.82]	-.2% [-1.4%]	28.7%** [29.1%**]

Panel D: Nasdaq-NBBO Depths

Bid Size (100s)	12.83 [4.99]	15.10 [5.24]	7.6%** [2.0%**]	15.25 [5.30]	16.88 [5.44]	7.4%** [1.8%**]	.2% [.5%]
Ask Size (100s)	12.29 [4.57]	13.76 [4.99]	12.0%** [4.9%**]	14.26 [4.51]	15.99 [5.11]	14.8%** [10.2%**]	-2.8% [-1.1%]
Bid Size / Ask Size	1.23 [1.15]	1.19 [1.12]	-.8% [-2.9%]	1.27 [1.15]	1.20 [1.12]	-1.2% [-2.7%]	.3% [-.3%]

J. More on Liquidity: Table 7

Variable	Pilot Stocks			Control Stocks			Difference of Differences
	April	May	Difference	April	May	Difference	
<i>Panel A: Effective Spreads (basis points)</i>							
NYSE	8.37 [6.86]	7.51 [5.97]	-.86** [-.67**]	9.00 [7.17]	8.25 [6.28]	-.75** [-.46**]	-.11 [-.07]
Nasdaq	18.80 [15.33]	17.84 [15.03]	-.96** [-.47**]	20.09 [16.39]	19.04 [15.88]	-1.04** [-.64**]	.08 [.32]
<i>Panel B: Volume-Weighted Price Location of Short Sales</i>							
NYSE	.48 [.48]	.13 [.13]	-.34** [-.35**]	.48 [.49]	.49 [.49]	.01 [.00]	-.35** [-.34**]
Nasdaq	.16 [.15]	.12 [.10]	-.04** [-.05**]	.17 [.16]	.18 [.17]	.01 [.01]	-.05** [-.06**]

More on Liquidity: Table 7

Variable	Pilot Stocks			Control Stocks			Difference of Differences
	April	May	Difference	April	May	Difference	
<i>Panel C: Probability of Price of Short Sale Being Less Than or Equal to Bid</i>							
NYSE	.148 [.148]	.298 [.300]	.151** [.148**]	.147 [.148]	.146 [.147]	-.001 [.000]	.152** [.148**]
Nasdaq	.322 [.316]	.337 [.340]	.015** [.011**]	.315 [.315]	.306 [.312]	-.009* [-.010**]	.025** [.026**]
<i>Panel D: Probability of Price of Short Sale Being Greater Than or Equal to Ask</i>							
NYSE	.617 [.619]	.391 [.383]	-.226** [-.221**]	.620 [.628]	.619 [.618]	.000 [.001]	-.226** [-.221**]
Nasdaq	.434 [.430]	.403 [.396]	-.031** [-.033**]	.436 [.429]	.436 [.426]	.001 [.003]	-.031** [-.035**]
<i>Panel E: Price Impacts (basis points)</i>							
NYSE	.24 [.01]	2.40 [1.93]	2.16** [1.99**]	.55 [-.11]	.01 [-.70]	-.55* [-.28*]	2.71** [2.13**]
Nasdaq	10.15 [7.66]	10.42 [7.17]	.27 [-.58]	10.89 [8.50]	8.98 [5.82]	-1.91* [-2.88**]	2.18 [1.75*]

K. More on Liquidity: Multivariate Analysis

Ordered Probit Price Location Regression (All Short Sales)

OLS Price Impact Regression (Short Initiators)

NYSE

Nasdaq

NYSE

Nasdaq

Panel A: Average [Median] Coefficient Estimates

	NYSE	Nasdaq	NYSE	Nasdaq
PostPilot (PP)	-7.50E-1** [-7.14E-1**]	-1.47E-1** [-1.48E-1**]	4.83E0** [4.21E0**]	2.17E0** [.54E0*]
TradeSize	2.43E-5** [1.06E-5**]	9.16E-6 [-.28E-6]	4.17E-4** [.50E-4**]	2.31E-4 [-.92E-4]
PPTradeSize	3.63E-5** [.59E-5]	1.57E-5 [.49E-5]	7.04E-4** [1.92E-4**]	-1.54E-4 [1.73E-4]

Panel B: Marginal Effects of Short Sale of Pilot Stock in May

Prob: {P ? Bid}	.168** [.164**]	.027** [.026**]
Prob: {Bid < P < Ask}	.060** [.059**]	.001 [.001**]
Prob: {Ask ? P}	-.227** [-.222**]	-.028** [-.028**]

Price Impact			3.70** [3.36**]	-1.57 [-1.18]
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L. Conclusion

- Price tests do not further the stated objectives of short sale regulation
- Suspension of price tests has not led to an increase in market volatility and a degradation of price efficiency and liquidity
- Specifically, pilot stocks on NYSE have relatively:
 - Smaller short trade sizes
 - More short trades
 - Larger quoted spreads
 - Smaller bid and, more notably, ask depths
 - Short sales have lower execution prices and larger price impacts
 - Thus:
 - short sales of pilot stocks “take” liquidity
 - short sales of control stocks “make” liquidity
 - Hence price tests distort liquidity by typically causing short sales to be executed above the midpoint
- Effect of price tests on Nasdaq has been inconsequential

