Memorandum

To: File

From: Office of Economic Analysis

Subject: Analysis of Trade-throughs in Nasdaq and NYSE Issues

Date: December 15, 2004

To help evaluate comments received on the Regulation NMS proposals, this memo presents descriptive statistics that characterizes trade-throughs in Nasdaq and NYSE stocks. We examined trade and quote data for four sample days, for 3,405 Nasdaq stocks and 1,905 NYSE stocks. [1] Tables 1-7 present findings for Nasdaq stocks and Tables 8-13 present findings for NYSE stocks. The analysis is based on Trade and Quote data (TAQ) and Nastraq data which are available from the NYSE and Nasdaq, respectively.

We find that trade-through rates are sensitive to the calculation methodology, including assumptions about quoted depth as discussed below. Depending on the methodology applied, the *overall* trade-through rate ranged from 2% to 10% of trades and from 2% to 13% of share volume. Using the more conservative of these methods, we estimate that 2% to 3% of all trades and 2% to 8% of all share volume are trade-throughs. However, as shown in the attached tables, trade-through rates vary by stock activity level and rates for particular sets of stocks can be higher (or lower) than sample averages.

A trade-through occurs when a trade executes at a price that is worse than a better price available on another market. By comparing prices of executed trades to bid prices and ask prices quoted on other markets, we identify trade-thoughs. While trade-through identification seems straightforward, in practice it is complicated by quickly changing quotes, system time lags, data limitations, and imperfect access to markets. A simple method compares trade price to the best bid price and offer price quoted on other markets at the trade time. However, this method may overestimate trade-throughs due to factors noted above. To address these issues, we construct quote windows and require reference quote prices to be available for some minimum number of seconds before and after the trade. Trades were compared to quote windows of various durations, including eight seconds, five seconds, three seconds, and one second to evaluate trade-through rates sensitivity to the benchmark. The use of quote windows, instead of quotes at one point in time, will improve the probability that identified trade-throughs are real, but may lower the number of real trade-through we identify.

Other methodological issues that impact trade-through statistics is consideration of trade size to posted quote size. The trade-through volume statistics presented in the attached tables include total trade size, even if the trade is larger than the displayed depth. [2] This method is useful in assessing the potential benefits of increased limit order display and liquidity that the

[1] Sample days are September 18, October 16, November 20, and December 18, 2003.
[2] Table 6 and table 13 show how the trade-through size compares to the posted quote size of one market center.

proposed rule intends to promote. This approach also recognizes that more size can be available than is displayed in the quote.[3] Nonetheless, this method arguably overstates trade-through share volume. A trade-through calculation that includes only that portion of a trade's volume that is equal to or less than the displayed depth generates far lower share volume statistics, albeit likely understates the rules expected impact. For example, the 7.9% of Nasdaq share volume identified as trade-throughs under the three-second quote window, declines to 1.9% of volume if trade-through volume is limited to total displayed depth. [4] Similarly, the 7.2% of NYSE share volume identified as trade-throughs, declines to 1.2% of volume when adjusted for displayed size. If trading strategies are unchanged, a reasonable interpretation of these statistics is they represent a lower and an upper estimate of the potential for improved executions.

Other factors that impact trade-through statistics are the inclusion or exclusion of large trades in share volume calculations and the weighting scheme used to average statistics across stocks. Where and how these factors are considered are noted in the tables.

Findings

Sensitivity of Trade-through Statistics to Reference Quote

The analyses show that trade-through identification is sensitive to the benchmark quote chosen. Table 1 and Table 8 show trade-through rates under different bid-ask quote windows for Nasdaq stocks and NYSE stocks, respectively. Other tables report statistics based on the three-second window.

- The percent of trade-throughs in Nasdaq stocks ranges from 9.4% of trades and 13.0% of share volume benchmarked against the last quote, to 2% - 3% of trades and about 7% of volume using more conservative quote windows. Under the three-second quote window, the trade-through rate is 2.5% of trades accounting for 7.9% of share volume. (Table 1) The three-second quote window compares trades to quotes one second before the trade to one second after the trade (and the second of the trade).

- Trade-through rates for NYSE stocks range from 5.1% of trades and 12.6% of volume measured against the last quote, to 2.5% of trades and 7.2% of volume measured against the three second window. However, under the ITS plan, executions through 100 share quotes are not considered trade-throughs. Using this standard, the trade-through rate for NYSE stocks falls to 1.5% of trades and 5.2% of share volume under the three-second window. (Table 8)

Dollar Cost of Trade-throughs

[3] For example, according to the NYSE report 'New York Stock Exchange Market Quality', September 2004, shares executed at or better than the quote as a percent of quoted depth, was 200% for orders that exceeded the quoted depth.

[4] Total displayed depth is equal to the sum of displayed depth on each market center top of book that was traded-through.

Estimates of the dollar cost of trade-throughs will vary considerably depending on the trade-through rates selected. However, even under a very conservative assumption, we estimate that over 12 billion shares of Nasdaq and NYSE stocks traded-through better prices in 2003. This represents about $209 million in trade-throughs on Nasdaq and $112 million per year on NYSE for a total of $321 million per year.[5] This includes only share volume that traded-through depth displayed on market center's top of book (1.9% for Nasdaq and 1.2% for NYSE). Inclusion of additional share volume to reflect potential increased depth available at the best price will increase these numbers significantly.

The above estimates were obtained as follows. For each trade-through, share volume (capped at displayed depth) was multiplied by the per share amount of the trade-through. The per share amount is equal to the absolute value of the difference in the trade price and the near side quote. These per trade trade-through costs were summed across the day, and then averaged over the four day sample to obtain a daily average. The daily average was multiplied by 252, the approximate number of trading days in a year, to obtain the annual dollar estimates of trade-through costs. Trade-throughs that occurred at prices more than $5.00 outside the quote were excluded, thus limiting the impact of outliers on the estimates.

Descriptive Statistics on Trade-throughs in Nasdaq Stocks

As noted above, we identify 2.5% of all trades in Nasdaq stocks and 7.9% of share volume as trade-throughs (or 1.9% of share volume limited to total displayed depth). Trade-through frequencies vary somewhat across market centers, size of trade, and stock activity level. Statistics that describe these and other patterns are found in Tables 2-7.

- In Nasdaq issues, trade-throughs occurred least frequently on the ArcaEx. We identified 1.6% of trades reported on the ArcaEx as trade-throughs. The comparatively low ArcaEx trade-through rate likely reflects their electronic trading model that evaluates prices across markets and routes or executes orders accordingly. The manual Amex model, in contrast, generates an extremely high rate of trade-throughs. Although Amex trading of Nasdaq stocks is miniscule, 26.3% of their trades were trade-throughs. Trade-through rates were 3.3% for trades reported to Nasdaq, 3.0% for ADF trades, and 2.0% for CSE trades. (Table 2)

- Overall, trade-through rates are higher for larger size orders. For example, 2.5% of 100 share executions are trade-throughs compared to 9.9% of 5,001-10,000 share trades. However, this result is largely driven by trades reported on the Nasdaq which shows a steep increase in trade-through rates by trade size. (Table 2) We might expect more trade-throughs in larger size orders, if traders determine that accessing small quote size is not the most cost efficient strategy. However, it is interesting to note that on ArcaEx and the CSE, trade-throughs are no more likely for larger executions than smaller. This could be viewed as evidence that markets which operate under rules or

[5] These numbers assume that the share volume executes at the best available price. Estimates that use the least aggressive price traded-through, yield $161 million in trade-through costs on Nasdaq and $91 million on NYSE for a total of $252 million annually.

structures (in this case ArcaEx's own) that limit trade-throughs, can effectively limit trade-throughs for large trades as well as small.

- Many trade-throughs are outside the quote by one cent per share, although a significant percent of trade-throughs are for greater amounts. In Nasdaq stocks, 56.4% of trade-throughs are for one cent, 17.5% are for two cents, and 23.5% are for three or more cents worse than the quote. (Table 3) Trade-throughs of less than one cent can occur where trades are executed in sub-penny increments, but are not counted as trade-throughs in this study.

- Trade-through frequency increases somewhat with stock activity level. (Table 4) In the 20 most active Nasdaq stocks, the average trade-through rate (equal stock weighted) was 2.9% of trades and 9.7% of share volume. The trade-through rate decreases to 1.8% of trades and 3.6% of volume for the least active group of stocks. This apparent relationship between trade activity and trade-through rates may reflect the difficulty of avoiding trade-throughs in active markets, or less precision in trade-through estimates of active stocks. However, even using an eight-second window, the pattern persists.

- Table 4 presents trade-through statistics equal weighted across stocks, weighted by trades and share volume, and statistics that exclude large trades. This allows the reader to see how the statistics are affected by the weighting schemes, and the inclusion or exclusion of large trades.

- Table 5 presents trade-through data by executing market center and quoting center. Trades more often traded through Nasdaq (SuperMontage) quotes than other market quotes. This may simply reflect the frequency with which Nasdaq quotes are at the inside.

- Table 6 shows all trade-throughs categorized by trade size and quote size traded-through. For example, 75% of all trade-throughs were 100 share trades trading through quotes of equal or larger size.

- In addition to the cost of inferior execution prices, bypassed limit orders are potentially harmed from trade-throughs. Table 7 presents data on quotes (by market) that were bypassed as inferior executions occurred on other markets. For example, Panel A shows that ArcaEx quotes were traded through about 30,000 times per day, accounting for 49 million shares of displayed depth. (This counts each instance a quote is traded-through, even if one quote is traded-through multiple times). It is difficult to assign a cost to the bypassed orders, as the orders may or may not subsequently be filled, and the cost of a delayed fill would need to be considered. Nonetheless, the costs incurred by unfilled limit orders are additional to the costs estimated earlier in this memo.

Descriptive Statistics on Trade-throughs in NYSE Stocks

- Overall, the trade-through rate for NYSE stocks was 2.5% of trades and 7.2% of share volume (or 1.2% of share volume limited to displayed depth) under the three-second quote window. Excluding trades through 100 share quotes which are not subject to the trade-through rule, reduces the trade-through rate to 1.5% of trades and 5.2% of volume. (Table 8)

- For trades reported to the NYSE, the trade-through rate is comparatively low at 1.6% of trades, and falls to 0.9% if 100 share quotes are not considered. However, trade-throughs were more common on the regional exchanges and third market. Trade-through rates were 7.8% on BSE, 3.8% on the CSE, 6.1% on the CHX, 5.8% on the third market, and 8.2% on the PHLX. ArcaEx has a relatively small share of NYSE trading, but 15.1% of their trades were identified as trade-throughs. This is due to the concentration of trading on ArcaEx at times when the market was locked or crossed. Other than the ArcaEx statistics in NYSE stocks, the trade-through rates are not materially affected by executions that occurred in crossed markets. (Table 9)

- The typical amount of a trade-through was one cent per share, although 16.8% of trade-throughs were for two cents, and 21.2% were for three or more cents. The average trade-through was 2.2 cents per share. (Table 10)

- As with Nasdaq stocks, trade-through rates are higher in the more active NYSE stocks.[6] The top 20 NYSE stocks had an average trade-through rate of over 5%. For the least active stocks, the trade-through rate falls to almost 1%. Share volume statistics are higher, but show the same pattern of fewer trade-throughs in less active stocks. The data show that 11.1% of shares were trade-throughs in the most active stock and 2.4% of shares were trade-throughs in the least active stocks (equal stock weighted). Again, these figures include all share volume, regardless of displayed quote size. (Table 11)

- Table 12 shows trade-throughs by executing market center and quoting market. NYSE quotes are traded-through most often, reflecting the fact that NYSE quotes often set the NBBO.

- Table 13 shows trade-through size by quote size. For example, the data show that 24% of all trade-throughs in NYSE stocks are 100 share trades trading through 100 share or greater quotes.

Conclusion

Although trade-through estimates are sensitive to the calculation methodology, the data show that the level and amount of trade-throughs is significant. At a minimum, trade-throughs

[6] Table 4 and Table 11 group Nasdaq and NYSE stocks by their dollar volume rank. Trade-through statistics of the ranked groups may not be directly comparable across the two markets, as the stocks will have different characteristics which influence trade-through rates.

represent at least two to three percent of trading activity and may account for as much as seven or eight percent of total trading activity.

Methodology and Data Appendix

Quote Window and Trade-through Calculations

Quote windows were constructed to create benchmark quotes against which trade prices are compared. Trades were compared to quote windows of various durations, including eight seconds, five seconds, three seconds, and one second to evaluate trade-through rates sensitivity to the benchmark. Most tables present trade-through statistics using the three-second quote window.

A quote window is calculated from a market center's top of book quote, which is the best displayed bid price and offer price. This means that quotes below the top of book are not included in the analysis. The quote window captures a market center's top of book low bid and high ask during a given number of seconds. For example, if during a three-second interval, the bid quote on Market A changed from $19.98 to $19.99, the window bid quote is $19.98, the lowest (least aggressive) quote available. This is the best price available on Market A for the entire three seconds, even though a better price was available for some fraction of the time. A similar calculation is made for the offer side, with the highest (least aggressive) ask quote assigned as the ask quote for the window. A quote window is constructed for each quoting center. The three-second window is used to compare trades to quotes from 1 second before the trade time (t-1) to 1 second after the trade time (t+1). The eight-second and five-second windows are used to compare trades to quotes that span from six seconds before the trade to one second after, and from four seconds before the trade to one second after the trade, respectively.

For Nasdaq stocks, quote windows are constructed for ADF, CSE, ArcaEx, and Nasdaq quotes as these markets are largely automated or good linkages exist. Quotes issued by Amex are excluded as their quotes are less accessible. In the analysis of NYSE stocks, quotes windows were constructed for NYSE, BSE, CHX, NSX, PCX, PHLX, and third market quotes.

The example below shows how the quotes for the three-second quote window are determined from a set of quotes. In addition to price, quoted size is calculated for the window by selecting the smallest bid size and ask size available during the time period.

Market A Top of Book Quotes and Size

	Bid Quote	Bid Size	Ask Quote	Ask Size
10:00:04	**19.98**	5,000	20.01	700
10:00:05	19.99	1,000	20.01	**600**
10:00:06	19.99	**400**	**20.02**	1,500
Quote Window Values	19.98	400	20.02	600

A trade that occurs at a price outside another market's bid or ask quote window is a trade-through. [7] In the above example, a trade executed at 10:00:05 at a price below $19.98 or above $20.02 is a trade-through. Execution prices at or between $19.98 and $20.02 are not trade-throughs. If a trade executes outside more than one market's quote window, it is counted as only one trade-through. Under the ITS plan, which applies to listed stocks, trades through 100 share quotes are not considered trade-throughs. In our analysis, it is noted in the table when such trades are not counted as trade-throughs.

Unless a table states otherwise, trades of all sizes are included and are counted as a trade-through even if the displayed quote size is smaller than the trade size. Likewise, trade-through share volume is equal to the trade size volume and does not consider displayed depth of the traded-through quote. However, two tables show the distribution of trade-throughs by trade size and posted quote size on one market. In these tables, quote size is the smallest quote size posted during the window.

Weighting Across Stocks

Trade-through statistics are weighted by trades or share volume except where noted. This means the trade-through rate represents the total number of trades or share volume traded through as a percent of all trades or share volume. This method has the effect of weighting stocks in proportion to their trading activity. More active stocks receive greater weight than less active stocks in the average. Two tables include equal-weighted stock averages. Using this method, low volume and high volume stocks are given equal weight in calculating the average.

Nasdaq Trade and Quote Data

Trade data from the Nastraq file was used for the analysis of Nasdaq stocks. This file contains the executed price, share volume, trade report time, trade execution time, and an indicator of non-regular or unusual trade reporting or settlement conditions. The Nastraq trade file was selected over the TAQ trade file, as the latter does not have trade execution time, only trade report time. [8] While the trade report and trade execution times on the Nastraq file are often identical, trade execution time was used when not blank. On occasion, the trade report time precedes the execution time, in which case the earlier of the two times is used. Otherwise the trade report time was used.

[7] Because Amex quotes are excluded, executions at prices worse than the Amex quote are not counted as trade-throughs. Trades executed in sub-penny increments that trade outside the quote by less than one cent are not counted as trade-throughs.

[8] A comparison of the number of trades in Dell, on a day with about 22,000 trades, confirmed that the number of trades reports on the PCX, CSE, and Amex were virtually identical on the Nastraq and TAQ datasets. The number of Nasdaq reported trades differed by about 10 trades. A comparison of trade report times (matching files on execution price, trade size converted to round lots, and exchange) finds that about 90-95% of the trades matched. Nearly all of the unmatched trades were Nasdaq trades, many of which did not match due to differences in the time stamps. The majority of time stamp differences were one second. In addition, Nasdaq staff confirmed that the trade time stamps in the Nastraq file are ACT time stamps, and are SIP time stamps for UTP trades.

About two percent of trades with a non-blank condition code were excluded. These are primarily trades executed after hours, average price trades, out-of-sequence trades, late reports, and previous reference price trades. Our sample also excludes trade executed before 9:35 a.m. or after 4:00 p.m. We exclude trades during the first five minutes of the trading day in order to eliminate trades at the open.

We obtain Nasdaq quote data from TAQ which has individual market center quotes necessary for this analysis. Nastraq data, source of the trade data, has only the inside national bid and offer quotes. Consistency of the TAQ quote data with the Nastraq quote data was confirmed by comparing the two files. Time stamps of an NBBO constructed from the TAQ data were compared to the inside quotes on the Nastraq quote data, for symbol DELL. Matched on quote time, bid price and ask price, about 99% of the quotes matched. [9] This allows the use of the TAQ data with its individual market quotes. Staff at Nasdaq also confirmed that TAQ and Nastraq quote data are both SIP level data.

NYSE Trade and Quote Data

Trade and quote data from TAQ were used for the NYSE analysis. Trades with a condition code other than 'E' or blank were excluded. (E denotes trades executed on DirectPlus). Trades marked either 0 or 1 in the correction code field were included (corrected trades or original not corrected). Trades marked with either 140 or 240 in the 'G127' variable field were excluded. These were generally stopped stock, market imbalance orders, and some orders reported after normal hours. Trades marked with g127 values indicating display book reports, and own account trades were included. The sample also excludes trades executed before 9:35 a.m. or after 4:00 p.m.

[9] Only 28 TAQ quotes and 56 Nastraq quotes did not match and 8,090 quotes matched.

Table 1: Sensitivity of Nasdaq Trade-through Statistics to Reference Quote

Sample days are September 18, 2003, October 16, 2003, November 20, 2003 and December 18, 2003. Figures are daily averages. Trade-throughs are identified when a trade execution price is outside another market's bid or ask quote window. Quote windows contain the lowest bid price and the highest ask price from a market center's top of book during a specified time interval. Quotes issued by the ADF, CSE, PCX, or Nasdaq are included and Amex quotes are excluded from the quote calculation. Quote windows bracket trade times. For example, under the 3 second window, trades are compared to quotes from 1 second before the trade time (t-1) to 1 second after the trade time (t+1). Trade-through share volume is the total trade volume and does not consider displayed depth of the traded-through quote.

	8 second window (t-5 to t+2)	5 second window (t-2 to t+2)	3 second window (t-1 to t+1)	2 second window (t-1 to t)	Same Second (Lowest bid, highest ask within second)	Last Quote
Trade-throughs:						
As % of Total Trades	1.7%	2.0%	2.5%	3.2%	4.8%	9.4%
As % of Share Volume	6.8%	7.2%	7.9%	8.5%	9.8%	13.0%

Excludes trades Greater Than 10,000 shares or $200,000

Trade-throughs as*:*						
% of Total Trades	1.7%	1.9%	2.4%	3.2%	4.7%	9.3%
% of Share Volume	3.0%	3.3%	3.8%	4.5%	5.8%	9.2%

Table 2: Trade-Through Rate For Nasdaq Stocks By Market Center and Trade Size, 3-second Quote Window

		Trade-throughs as % of Own Market		Trade-through Trade % by Trade Size				
	Market Share of Trades	Trades	Share Volume	100 Share Trades	101-1000	1001-5000	5001-10000	10,001 & up
Amex	0.01%	26.3%	38.0%	27.6%	32.2%	8.2%	33.3%	72.7%
CSE	22.1%	2.0%	1.9%	2.0%	2.0%	2.0%	1.6%	1.6%
ADF	8.7%	3.0%	3.1%	3.4%	2.7%	2.5%	2.6%	4.0%
ArcaEx	27.8%	1.6%	1.7%	1.6%	1.5%	2.0%	1.9%	1.4%
Nasdaq	41.4%	3.3%	12.7%	3.2%	2.5%	5.3%	14.0%	28.2%
				2.5%	2.1%	3.8%	9.9%	22.7%

Table 3: Trade-through Amount (cents outside quote) for Nasdaq Stocks by Market, 3-second Quote Window

	Distribution of Trade-through Amount (Percentiles)					
	Average Amount in cents per share	90^{th}	75^{th}	50^{th}	25^{th}	10^{th}
Amex	4.6	9.0	5.0	2.0	1.0	1.0
CSE	1.9	3.6	2.0	1.0	1.0	1.0
ADF	2.0	4.0	2.0	1.0	1.0	1.0
ArcaEx	1.8	3.0	2.0	1.0	1.0	1.0
Nasdaq	2.9	6.0	3.0	1.0	1.0	1.0
Total	2.3	5.0	2.0	1.0	1.0	1.0

Trade-throughs by Cents outside the Quote, All Trades,

	1 cent	2 cents	3 cents	More than 3 cents
Percent of all Trade-throughs	56.4%	17.5%	7.9%	15.6%
Percent of Trade-Through Share Volume	40.6%	18.6%	9.8%	31.0%

Table 4: Nasdaq Stocks Trade-throughs by Stock Dollar Trading Volume Rank

	Top 20 Stocks	Stocks 21-100	Stocks 101-500	Stocks 501-1,000	Stock 1,001 +	All Stocks
Nasdaq Trade-through %						
Trade Weighted	2.9%	2.7%	2.4%	2.2%	2.1%	2.5%
Equal Stock Weighted	2.9%	2.8%	2.4%	2.3%	1.8%	2.0%
Excludes 10,000 + share trades						
Trade Weighted	2.8%	2.6%	2.3%	2.2%	2.1%	2.4%
Equal Stock Weighted	2.9%	2.8%	2.4%	2.3%	1.8%	2.0%
Share Volume						
Nasdaq Trade-through %						
Share Volume	9.1%	7.9%	8.2%	6.6%	4.8%	7.9%
Equal Stock Weighted	9.7%	10.1%	9.2%	8.2%	3.6%	5.1%
Excludes 10,000 + share trades						
Share Volume	3.9%	3.9%	4.2%	3.6%	2.8%	3.8%
Equal Stock Weighted	4.4%	5.1%	5.1%	4.8%	2.6%	3.3%

Table 5: Number & Percent of Own Market Trades in Nasdaq Stocks that Trade Though Other Exchange Quotes

Daily Average, Three-second Quote Window

Trade-throughs Executed on:	CSE Quotes	ADF Quotes	PCX Quotes	Nasdaq Quotes
Amex	29 (10.1%)	45 (15.4%)	48 (16.2%)	50 (16.9%)
CSE	246 (0.0%)	5,258 (1.0%)	4,218 (0.8%)	6,405 (1.2%)
ADF	1,666 (0.6%)	1,655 (0.6%)	3,296 (1.2%)	5,204 (1.9%)
ArcaEx	1,386 (0.2%)	5,675 (0.7%)	32 (0.0%)	7,954 (0.9%)
Nasdaq	14,037(1.1%)	18,279 (1.4%)	20,773 (1.6%)	11,051 (0.9%)

Table 6: Trade Size Trading Through Quote Size, Nasdaq Stocks, Three-second quote window
This table shows trade size trading through the quote size of one market center top of book. The quote size does not represent the sum of all top of book displayed sizes. Use of these statistics to back-out equivalent Table 4 statistics will result in slightly different numbers due to the exclusion of large trades from certain calculations in Table 4, and how trade-throughs of multiple quotes are reported in this table.

Panel A - Percent of All Trade-throughs

	Quote Size						
Trade Size	100 Shares	101-500	501-1,000	1,001-5,000	5,001-10,000	10,001 +	Total
100 Shares	32.7%	21.6%	9.1%	9.3%	1.4%	1.0%	75.1%
101-500	6.0%	3.1%	1.4%	1.6%	0.3%	0.3%	12.7%
501-1,000	1.7%	0.9%	0.5%	0.6%	0.1%	0.2%	12.7%
1,001-5,000	1.2%	1.4%	0.7%	0.9%	0.2%	0.2%	4.7%
5,001-10,000	0.2%	0.5%	0.3%	0.4%	0.1%	0.1%	1.5%
10,001 +	0.2%	0.5%	0.4%	0.6%	0.1%	0.1%	2.0%
Total	42.1%	28.0%	12.4%	13.4%	2.3%	1.9%	100%

Panel B Weighted by Trade Share Volume

	Quote Size						
Trade Size	100 Shares	101-500	501-1,000	1,001-5,000	5,001-10,000	10,001 +	Total
100 Shares	0.8%	0.4%	0.1%	0.1%	0.0%	0.0%	1.5%
101-500	1.7%	0.9%	0.4%	0.5%	0.1%	0.1%	3.6%
501-1,000	1.2%	0.7%	0.4%	0.5%	0.1%	0.1%	3.0%
1,001-5,000	2.9%	3.8%	2.1%	2.4%	0.5%	0.6%	12.4%
5,001-10,000	1.9%	3.8%	2.2%	2.8%	0.5%	0.7%	11.9%
10,001 +	6.3%	15.2%	12.6%	19.9%	4.3%	9.4%	67.7%
Total	14.7%	24.8%	17.7%	26.3%	5.5%	10.9%	100%

Table 7: Quotes Traded-Through, Nasdaq Stocks, Daily Average

Each instance that a market center quote is traded through is counted. Therefore, one limit order can be traded-through multiple times in this analysis.

Panel A: All trades including trades greater than the quote size

Exchange Quote Traded-Through	Number of Instances Quote was Traded-through	Share Volume of Trade-Through	Displayed Size of Quotes Traded Through	(a) Smaller of Trade Size or Quote Size	(a) as % of Shares Executed on Own Exchange
CSE	18,634	60,596,600	24,204,825	7,147,325	2.6%
ADF	32,514	77,069,650	31,327,275	10,504,175	10.9%
ArcaEx	30,173	82,584,825	48,975,825	12,263,925	3.6%
Nasdaq	32,552	87,389,650	33,583,325	10,645,650	1.2%

Panel B: Trades greater than 10,000 shares or $200,000 excluded from sample

Exchange Quote Traded-Through	Number of Instances Quote was Traded-through	Share Volume of Trade-Through	Displayed Size of Quotes Traded Through	(a) Smaller of Trade Size or Quote Size	(a) as % of Shares Executed on Exchange
CSE	17,366	17,875,125	22,812,375	5,810,700	2.2%
ADF	30,913	27,289,275	29,495,200	8,775,150	9.4%
ArcaEx	28,366	27,019,475	45,470,125	9,248,125	2.8%
Nasdaq	30,664	29,337,350	31,018,500	8,284,575	1.2%

Panel C: Trades that Exceed the Displayed Quote Size are Not Counted as Trade-throughs. Trades greater than 10,000 shares or $200,000 excluded from sample

Exchange Quote Traded-Through	Number of Instances Quote was Traded-through	Share Volume of Trade-Through	Displayed Size of Quotes Traded Through	(a) Smaller of Trade Size or Quote Size	(a) as % of Shares Executed on Own Exchange
CSE	11,515	3,526,575	20,528,250	3,526,575	1.3%
ADF	19,333	5,098,150	25,818,200	3,526,575	3.8%
ArcaEx	18,846	5,799,800	42,021,800	5,799,800	1.8%
Nasdaq	17,810	4,780,425	27,514,350	4,780,425	0.7%

Table 8: Sensitivity of NYSE Trade-through Statistics to Reference Quotes, Daily Values

Sample days are September 18, 2003, October 16, 2003, November 20, 2003, and December 18, 2003 and includes 1,905 NYSE stocks. A quote window contains the lowest bid and the highest ask price that existed on a market center during the time interval. A trade-through occurs when the trade execution price is outside any market's bid or ask quote window**.** Quotes issued by the BSE, CSE, CHX, NYSE, ArcaEx, Nasdaq or PHLX are included in quote window calculations. Quote windows bracket trade times. For example, the 3 second window compares trades to the lowest bid and highest ask from 1 seconds (t-1) before the trade time to 1 seconds (t+2) after the trade time. Trade-through share volume is the trade volume and does not consider displayed depth of the traded-through quote.

	8 second Window	3 second Quote Window			Last Quote
Trade-throughs:	All Trades	All Trades	Excludes Trades >10,000 Shares/$20,000	TT 100 share quotes not counted	All Trades
As % of Total Trades	1.8%	2.5%	2.4%	1.5%	5.1%
As % of Share Volume	6.0%	7.2%	3.5%	5.2%	12.6%

Table 9: NYSE Stocks Trade-Through Percentages By Exchange and Trade Size, Three-Second Quote Window

		Trade-throughs as % of			Trade-through Trade % by Trade Size, 100 share quote trade-throughs not counted				
	Market Share of Trades in NYSE Stocks	Own Exchange Trades	Trades, 100 share quote trade-throughs not counted	Share Volume, 100 share quote trade-throughs not counted	100 Share Trades	101-1000	1001-5000	5001-10000	10,001 & up
BSE	2.2%	7.7%	5.6%	8.2%	4.2%	5.4%	9.5%	13.6%	10.6%
CSE	1.0%	3.8%	2.8%	4.4%	2.6%	2.4%	4.5%	4.3%	4.7%
CHX	2.7%	6.1%	3.9%	10.8%	1.9%	4.0%	7.5%	7.9%	14.6%
NYSE	82.4%	1.6%	0.9%	3.7%	0.5%	0.7%	2.1%	4.2%	6.4%
ArcaEx	1.4%	15.1%	8.7%	6.5%	10.2%	8.2%	4.9%	3.0%	2.3%
Nasdaq	9.9%	5.8%	3.8%	13.8%	3.4%	3.3%	6.1%	13.4%	20.3%
PHLX	0.3%	8.2%	6.0%	5.3%	5.2%	5.9%	7.8%	7.6%	5.7%
All	100%	2.5%	1.5%	5.2%	1.1%	1.3%	2.8%	5.0%	7.9%

Table 10: Distribution of Trade-through Amount (cents outside quote) in NYSE Stocks, by Market

Three-second Quote Window, All Trades

	Distribution of Trade-through Amount (Percentiles) (cents per share)					
	Average Amount	90th	75th	50th	25th	10th
BSE	1.8	3.0	2.0	1.0	1.0	1.0
CSE	1.8	3.0	2.0	1.0	1.0	1.0
CHX	2.8	5.0	3.0	1.0	1.0	1.0
NYSE	1.8	3.0	2.0	1.0	1.0	1.0
ArcaEx	2.5	5.0	3.0	2.0	1.0	1.0
Nasdaq	2.9	6.0	3.0	1.0	1.0	1.0
PHLX	2.2	4.0	2.0	1.0	1.0	1.0
Total	2.2	4.0	2.0	1.0	1.0	1.0

Trade-throughs by Cents outside the Quote Using Last Quote, All Trades

	1 cent	2 cents	3 cents	More than 3 cents
Percent of all Trade-throughs	61.5%	16.8%	7.9%	13.3%
Percent of Trade-Through Share Volume	54.6%	16.2%	8.4%	20.9%

Table 11: Trade-through Statistics by NYSE Stock $ Volume Rank
This table shows trade-through rates equal weighted by stock and weighted by trades or share volume. All trade-through numbers are calculated using the three-second quote window.

Trades

NYSE Trade-through %	Top 20 Stocks	Stocks 21-100	Stocks 101-500	Stocks 501-1,000	Stock 1,001 +	All Stocks
Trade Weighted	5.8%	4.0%	2.2%	1.3%	1.2%	2.5%
Equal Stock Weighted	5.4%	3.9%	1.8%	1.2%	1.2%	1.5%
Trades through 100 Share Quotes not Counted as tt						
Trade Weighted	3.7%	2.5%	1.3%	0.7%	0.6%	1.5%
Equal Stock Weighted	3.4%	2.4%	1.1%	0.7%	0.6%	0.8%
Excludes 10,000 + and $200,000+ trades, No 100 share Trade-throughs						
Trade Weighted	3.3%	2.3%	1.2%	0.7%	0.6%	1.4%
Equal Stock Weighted	3.1%	2.2%	1.0%	0.6%	0.6%	0.8%

Share Volume

NYSE Trade-through %	Top 20 Stocks	Stocks 21-100	Stocks 101-500	Stocks 501-1,000	Stock 1,001 +	All Stocks
Share Volume Weighted	12.1%	8.4%	6.4%	4.6%	4.2%	7.2%
Equal Stock Weighted	11.1%	8.3%	4.5%	3.4%	2.4%	3.4%
Trades through 100 Share Quotes not Counted as tt						
Share Volume Weighted	8.8%	6.5%	4.3%	3.2%	2.9%	5.2%
Equal Stock Weighted	7.7%	5.8%	3.0%	2.2%	1.3%	2.2%
Excludes 10,000 + and $200,000+ trades, No 100 share Trade-throughs						
Share Volume Weighted	4.3%	3.2%	2.0%	1.3%	1.2%	2.3%
Equal Stock Weighted	3.9%	2.9%	1.5%	1.0%	0.8%	1.1%

Table 12: Number and Percent of Own Exchange Trades that Trade Though Other Exchange Quotes (NYSE Stocks)
Three-second Quote Window, Daily Values

Trade-throughs Executed on:	BSE Quotes	CSE Quotes	CHX Quotes	NYSE Quotes	PCX Quotes	Nasdaq Quotes	PHLX Quotes
BSE	50 (0.1%)	48 (0.1%)	113 (0.3%)	1475 (4.5%)	43 (0.1%)	379 (1.1%)	67 (0.2%)
CSE	64 (0.4%)	0 (0%)	39 (0.2%)	369 (2.2%)	15 (0.1%)	98 (0.6%)	27 (0.2%)
CHX	161 (0.4%)	21 (0.01%)	196 (0.5%)	979 (2.6%)	25 (0.1%)	434 (1.1%)	59 (0.2%)
NYSE	1,544 (0.1%)	314 (0.02%)	1271 (0.1%)	2,370 (0.2%)	697 (0.1%)	5793 (0.4%)	571 (0.04%)
ArcaEx	65 (0.3%)	6 (0.02%)	65 (0.3%)	2,459 (9.9%)	25 (0.1%)	164 (0.7%)	17 (0.07%)
Nasdaq	521 (0.3%)	166 (0.1%)	522 (0.3%)	4,084 (2.6%)	97 (0.1%)	1,073 (0.7%)	260 (0.2%
PHLX	17 (0.4%)	3 (0.1%)	9 (0.2%)	221 (4.9%)	8 (0.2%)	44 (1.0%)	9 (0.2%)

Table 13: Trade Size Trading Through Quote Size in NYSE Stocks Three-second quote window
Use of these statistics to back-out equivalent Table 11 statistics will result in slightly different numbers due to the exclusion of large trades from certain calculations in Table 11, and how trade-throughs of multiple quotes are reported in this table.

Panel A: Percent of All Trade-throughs

	Quote Size						
Trade Size	100 Shares	101-500	501-1,000	1,001-5,000	5,001-10,000	10,001 +	Total
100 Shares	16.1%	3.6%	1.7%	2.0%	0.4%	0.2%	24.0%
101-500	23.6%	4.9%	2.4%	2.6%	0.5%	0.3%	34.4%
501-1,000	10.1%	2.4%	1.4%	1.5%	0.3%	0.2%	15.9%
1,001-5,000	10.7%	2.8%	1.6%	1.9%	0.3%	0.2%	17.6%
5,001-10,000	2.2%	0.7%	0.4%	0.4%	0.1%	0.0%	3.9%
10,001 +	2.3%	0.6%	0.5%	0.7%	0.1%	0.1%	4.3%
Total	65.0%	15.0%	8.0%	9.2%	1.6%	1.1%	100%

Panel B: Percent of All trade-throughsWeighted by Trade Share Volume

	Quote Size						
Trade Size	100 Shares	101-500	501-1,000	1,001-5,000	5,001-10,000	10,001 +	Total
100 Shares	0.6%	0.1%	0.1%	0.1%	0.0%	0.0%	0.9%
101-500	3.0%	0.6%	0.3%	0.3%	0.1%	0.1%	4.4%
501-1,000	3.4%	0.8%	0.5%	0.5%	0.1%	0.1%	5.3%
1,001-5,000	10.4%	2.6%	1.6%	2.0%	0.3%	0.2%	17.1%
5,001-10,000	6.7%	2.1%	1.3%	1.3%	0.2%	0.1%	11.7%
10,001 +	29.8%	7.0%	6.5%	12.6%	2.0%	2.6%	60.6%
Total	53.9%	13.3%	10.2%	16.8%	2.7%	3.1%	100%