MEMORANDUM

TO: File

FROM: Office of Economic Analysis

DATE: December 15, 2004

RE: Comparative analysis of execution quality on NYSE and NASDAQ based on a matched sample of stocks

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To help evaluate comments received on the regulation NMS proposal; this analysis compares market and marketable limit order execution quality on NYSE and NASDAQ using a matched sample of 113 pairs of firms. The comparison is based on six months of data (January 2004 – June 2004) reported in accordance with SEC Rule 11Ac1-5 (Dash-5) by market centers. The sample of 113 pairs of firms was selected by closely matching on market capitalization, price, volume of trading and volatility. The Dash-5 data allow us to accurately calculate and compare measures of execution costs, execution speed, price improvement, and fill rates, by order type (market versus marketable limit) and order size up to a size of 9999 shares.

Any comparative analysis of execution quality across market structures is complex due to the multi-dimensional nature of execution quality and the relative importance of these dimensions to different participants in the market. Therefore, we compared several dimension of execution quality that include, execution costs, execution speed, and fill rates. We also note that differences in market structure may cause a different mix of orders to be directed to each trading venue, further complicating the analysis.

Overall, we find mixed results, with NYSE displaying lower execution costs (as measured by effective spreads) for small and medium size orders while NASDAQ had lower costs for large and very large orders. Generally, the NASDAQ displayed higher realized spreads and lower price impact, which suggests that higher effective spreads on the NASDAQ is not due to differences in informed order flow. We also find that order execution was faster on NASDAQ across all order types and order sizes, but the likelihood of execution; particularly for large marketable limit orders were much lower relative to NYSE. The lower price impact and a very low fill rate on the NASDAQ is consistent with NASDAQ market makers selectively executing less informed trades. The low fill rates for marketable limit orders on the NASDAQ may also be due to the high cancellation rates of unfilled orders.

A summary of our findings is listed below:

- We find that 36 percent of the NYSE trades are market orders while only 13.9 percent of the NASDAQ trades are market orders. In addition, most of the market orders on the NYSE are concentrated on small and medium size trades. This pattern persists for all firm size categories. This finding suggests that the type of orders flowing to each market may be endogenously determined; that is, the market structure may influence the type of orders that are submitted. Note that the

lower number market orders on NASDAQ is also due to the inclusion of ECN's in the NASDAQ trades that display only limit orders.

- The difference in order execution cost as measured by effective spreads across the two markets varies according to order size and order type. For small market orders (100-499 shares) and for small and medium marketable limit orders (100-2999 shares), the effective spread is higher on NASDAQ relative to NYSE. For medium to very large (500-9999) market orders and for large and very large (2000-9999) marketable limit orders, the effective spread on the NASDAQ is lower compared to that on the NYSE.
- While effective spread measures the cost to investors, the realized spread is a better indicator of market making costs, as it is the cost of market making net of information based trading. NYSE has lower realized spread compared to NASDAQ for small and medium size market and marketable limit orders. For other order sizes the difference in realized spread is mixed and depends on the market capitalization category.
- Small market orders on NYSE and NASDAQ display net price improvement across all three market capitalization categories (small, medium, and large), and NYSE trades have higher price improvement relative to NASDAQ trades. For all other sizes of market orders, we find that both markets show slippage, and the slippage on the NYSE is more relative to NASDAQ.
- Price impact, which is a measure of information based trading, is generally lower on NASDAQ compared to NYSE.
- Order executions are uniformly faster on the NASDAQ relative to NYSE. The difference in execution times increase with order size. However, the fraction of shares executed is significantly lower for medium to very large (500-9999 shares) marketable limit orders on the NASDAQ relative to NYSE.

Data and Methodology

We closely follow SEC (2001)[1] to identify matched pairs of firms listed on the NYSE and NASDAQ. To avoid potential hindsight bias we estimate the variables used for matching using data in the third quarter of 2003. The sample selection and the matching procedure is described in Appendix A. Data for the analysis was obtained from CRSP, TAQ, and Dash-5.[2]

Descriptive Statistics for the Matching Variables

In table 2, we report descriptive statistics for the four matching variables for NYSE and NASDAQ samples. The correlations for the matching variables vary from .91 for the relative price range (RR) to .99 for market capitalization (MCAP). The issuers in the sample have a wide range in terms of market capitalizations, from a minimum of $130

[1] "Report on the comparison of order execution across equity market structures," U. S. Securities and Exchange Commission, Washington, D. C.

[2] CRSP database is available from the Center for Research in Security Prices, University of Chicago; TAQ (Trade and Quote) database is available from the NYSE; Dash-5 data can be downloaded from the market centers' websites or it is available from various vendors.

million to a maximum of $87 billion. The price ranges from $4 to $101 and the volume ranges from 150,000 to 382 million. Since there is a wide variation in the underlying characteristics of the firm, we conduct our analysis for execution quality for three groups of firms sorted by market capitalization. In table 2B, we provide descriptive statistics for these three groups (large, medium, and small market capitalization.)

Comparative Analysis of Execution Quality

Any comparative analysis of execution quality across market structures is complicated by the multi-dimensional nature of execution quality and the relative importance of the different dimensions to various market participants. For example, although retail investors may prefer low effective spreads for small orders, some other type of investors may prefer faster execution at a guaranteed price to slower execution with the possibility of price improvement. The trade-off between the different dimensions of execution quality depends on the trader type and is difficult to quantify. Therefore we compare several dimension of execution quality that include, execution costs as measured by effective spread (which consists of realized spread and price impact), price improvement, execution speed, and fill rates. The definitions for the measures are given in Appendix B.

The comparison of execution quality measures are based on matched pairs of firms traded on the NASDAQ and the NYSE. All the differences are based on NASDAQ minus NYSE. Further, the t-tests are based on the mean of the matched paired differences. Since the sample has considerable heterogeneity in terms of market capitalization, we sort the sample into three groups based on market capitalization. Within each market capitalization group, the variables are sorted by order type (market versus limit) and four order size categories. All the variables within each group are equally weighted.

In table 3, we report the breakdown for the number of shares traded for various groups. The aggregate number of shares traded over the 6-month period on the NASDAQ is 11.1 billion while it is 6.8 billion on the NYSE for the 113 firms. However, if we make an adjustment for double counting of shares on the NASDAQ using a factor of 0.7 the difference is not large (7.8 billion on NASDAQ versus 6.8 billion on the NYSE.) Interestingly, 36 percent of the NYSE trades are market orders while only 13.9 percent of the NASDAQ trades are market orders. In addition, most of the market orders on the NYSE are concentrated on small and medium size trades. This pattern persists for all firm size categories.

In table 4, we report mean levels and the mean difference of effective spreads sorted by market capitalization, order type, and order size groups. Effective spread is one of the most important measures of market quality as it measures the actual cost of trading for investors. The effective spread also includes the net cost associated with the delay in executing a trade. We find that effective spreads are lower for small market orders and for small and medium size marketable limit orders on the NYSE relative to NASDAQ. This cost differential persists across all firm size categories. The differentials increase from 0.3 basis points for small market orders on large firms to 3.4 basis points for small firms. For marketable limit orders, the difference varies from 2.2 basis points for small

and medium size orders of large firms to 11.4 basis points for small firms.[3] While effective spread measures the cost to investors, the realized spread is a better indicator of market making costs, as it is the cost of market making net of information based trading. The realized spreads are reported in Table 5, and we see that for small and medium size market orders, the realized spread on the NYSE is lower by 2.3 basis points to 11.8 basis points, depending on firm size. For small and medium marketable limit orders the differential varies from 4.6 basis points to 18.4 basis points. The higher differential for realized spreads compared to effective spreads is due to the higher price impacts on the NYSE (Table 6). This suggests that NYSE trades on average have more information content than NASDAQ trades. This may be due to NASDAQ market makers executing only less informed trades, or the fragmentation of the NASDAQ market leads to less adverse selection problems. The narrower effective spreads on the NYSE for orders up to 1999 shares comes at the expense of slower execution. On average NYSE orders take 10.6 seconds to 17.6 seconds longer to execute compared to NASDAQ orders (Table 10.)

For large (2000-4999) and very large (5000-9999) orders the effective spread on the NYSE is wider than that on the NASDAQ. The difference for market orders varies from 5.2 basis points for large firms to 28.5 basis points for small firms, and from 1.4 to 5.8 basis points for marketable limit orders. The large differences are driven by much lower price impacts on the NASDAQ and less by differences in realized spreads. In addition to lower effective spreads, the time to execution is significantly lower on the NASDAQ relative to NYSE (14 to 126 seconds faster.) However, the narrower spreads and faster execution is offset by very low fill rates. The fill rates on the NASDAQ are from 87 percent to 96 percent for market orders on the NASDAQ while NYSE has fill rates higher than 97 percent for market orders. On the other hand, for marketable limit orders the fill rates on NASDAQ are significantly lower (20 percent to 35 percent) relative to NYSE (58 percent to 72 percent.) The lower price impact and lower fill rates on the NASDAQ are consistent with NASDAQ market makers selectively executing uninformed trades.

Net price improvement, which is the difference between effective spread and quoted spread, is another measure of market quality. Note that a negative value means price improvement and a positive value indicates slippage. Small market orders on NYSE and NASDAQ display net price improvement across all market capitalization categories (small, medium, and large). Further, for small market orders NYSE trades have higher price improvement relative to NASDAQ trades. For all other sizes of market orders, we find that both markets show slippage, and the slippage on the NYSE is more relative to NASDAQ. In the case of small marketable limit orders, the NYSE orders receive price improvement while NASDAQ trades show slippage. For other order sizes, the results are mixed and generally, there is slippage across both markets and the relative amounts vary depending on market capitalization category.

[3] A 0.2-cent difference for a $20 stock is 1 basis point (bp). If one trades one million round trip shares (buy plus sell) then the cost differential is $2000.

The above findings are quite robust to non-parametric statistics using medians. We also estimated regression models to control for any residual differences in the control variables, and the main findings do not change. These results are not included in this report, but they are available on request.

Appendix

A. Matching Procedure

We constructed the sample for the analysis in three stages. First, we subjected the universe of stocks available from the CRSP database to a number of filters to obtain a subset of 1711 NASDAQ stocks and 1293 NYSE stocks. The details of these filters are described in Table 1. Next, we applied a stratified sampling scheme to the 1711 NASDAQ stocks to obtain a list of 368 stocks. The details of that stratified sampling scheme are explained below. Finally, we carried out a matched sampling procedure to match each of the 368 NASDAQ stocks to one of the 1293 NYSE stocks. The matched sampling scheme, which is also explained below, resulted in a sample of 113 NASDAQ stocks and 113 NYSE stocks.

We used the following procedure to construct the stratified sample of NASDAQ stocks: First, we sorted the 1711 NASDAQ stocks by dollar volume and selected every fifth stock yielding a list of 342 stocks. We then produced three sorted lists of the 1711 NASDAQ stocks based on 1) market capitalization, 2) dollar volume, and 3) share volume. We then took the top 20 stocks from each of the three lists, combined these stocks into a list of 60 stocks, and then obtained a list of every unique stock on the list. There were 31 unique stocks on the list. We then added these 31 stocks to stratified sample of 342 stocks. Five of the 31 stocks were already in the stratified sample. This yielded a net gain of 26 stocks for a total sample of 368 NADSAQ stocks. Including the top 31 stocks ensures that we have good sample of stocks that represent the majority of trading volume on the two markets.

The matching was based on the following four variables:

1. Market capitalization (*MCAP*) = (Price on the last trading day of 2003)*(Shares outstanding)
2. Price (*PRC*) = Price on the last trading day of 2003
3. Average daily dollar volume (*ADV*) calculated over a 3-month period from October 2003 – December 2003. To adjust for difference in volume reporting between the NASDAQ and the NYSE, we adjust NASDAQ volume by multiplying by 0.7.
4. Relative price range (*RR*). The average of the daily relative price range where the daily relative price range is defined as the high minus the low divided by the close for each day.

We used CRSP data to obtain estimates for the matching variables.

We compared each of the 368 NASDAQ stocks subscripted by 'i', to each of the 1293 NYSE stocks subscripted by 'j', and compute the matching error *E*, where,

$$E = \left|\frac{MCAP_i}{MCAP_j} - 1\right| + \left|\frac{PRC_i}{PRC_j} - 1\right| + \left|\frac{ADV_i}{ADV_j} - 1\right| + \left|\frac{RR_i}{RR_j} - 1\right|.$$

Next, we compared the first NASDAQ stock to all NYSE stocks selected the NYSE stock with the smallest matching error as the match for that NASDAQ stock. We then removed the selected NYSE stock from the pool of available NYSE stocks. The above procedure was repeated to obtain matches for all the NASDAQ stocks. Finally, to ensure close matching, we retain only the pairs with a matching error of 0.7 or less. This results in a sample of 119 matched pairs. Five of the NYSE stocks and one of the NASDAQ stocks were missing Dash-5 data. We deleted these six pairs from the sample leaving 113 matched pairs available for analysis.

B. Definition of Variables

Effective Spread

The effective spread is calculated as double the difference between the execution price and the mid point of consolidated best bid and offer (BBO) at the time of order receipt, and for sell orders, as double the amount of the difference between BBO and execution price. The effective spread for each month is the share-weighted average effective spreads. The effective spread can be separated into a realized spread and price impact components. The price impact is a measure of the information content of trade (or the adverse selection cost borne by market makers for trading with informed traders), and the realized spread measures the cost of trading net of the information impact of trades.

Effective Spread = Realized Spread + Price Impact

Realized Spread

For buy orders, this is calculated as double the amount of the difference between the execution price and the mid point of consolidated BBO five minutes after the time of order execution. For sell orders, it is double the difference between the midpoint of the BBO 5-minutes after order execution and the execution price. The average for the month is based the share weighted average realized spreads.

Price Impact

For buy orders, it is twice the difference between the mid quote of the BBO 5-minutes after the trade to the mid quote BBO at the time of order submission. For sell orders, it is equal to twice the difference between the mid quote BBO at order submission and the mid quote BBO 5-minutes after order execution.

Net Price Improvement (Slippage)

This is calculated as the difference between effective spread and quoted spread (BBO). A positive number indicates slippage and a negative number indicates price improvement.

Execution Speed (Seconds)

The average time between when an order was received by a market center to the time when it was executed.

Executed Shares (percent)

The fraction of covered orders that was executed.

Quoted Spread

The difference between NBBO offer and NBBO bid at the time of order entry weighted by share volume.

All the above cost measures are calculated in terms of absolute values (cents) and in terms of proportional costs as a percentage of stock prices based on stock price at the end of the previous month.

Table 1		
Selection Criteria		
	NYSE	NASDAQ
All Domestic Securities	2391	3220
Dual Class Stock	-60	-79
Non-Common Stock	-896	-167
No Price on 12/31/03	-11	-79
No Market Capitalization on 12/31/03	0	0
No SIC Code on 12/31/03	-1	0
Any Missing Trade Data 10/1/03-12/31/03	-77	-783
Avg $ Volume 10/1/03-12/31/03 < $20000	0	-12
Change in Share Class or Type	0	0
Minimum Price 10/1/03-12/31/03 < $3	-32	-337
Avg Daily Trades 10/1/03-12/31/03 < 20	-8	-35
No Financial Data 10/1/03-12/31/03	-13	-17
Stocks Available for Matching	1293	1711
Stocks Produced by Matching Procedure	119	119
No Dash-5 Data 1/1/04-6/30/04	-1	-5
Stocks Matched to Those Missing Above	-5	-1
Stocks Available for Analysis	113	113

Table 2A : Descriptive Statistics for Matching Variables

Descriptive Statistics for the Matching Variables(N=113 Firms)							
	Mean			Median			Correlation
	NYSE	NASDAQ	p-value (Difference=0)	NYSE	NASDAQ	p-value (Difference=0)	(NYSE,NASDAQ)
Price ($)	25.80	26.16	0.31	22.96	23.12	0.32	0.97
Market Cap ($ Billions)	3.00	3.08	0.36	0.82	0.77	0.24	0.99
Dollar Volume (000's)	20.40	20.80	0.73	4.10	4.50	0.34	0.96
Daily Relative Price Range (% Daily Relative Price Range)	3.06%	3.35%	<0.0001	2.96%	3.33%	<0.0001	0.91

* p-value for t-test
** p-value for Sign Rank test

Table 2B: Descriptive Statistics for Matching Variables by Size Groups

Characteristics of Match Variables by Market Cap Categories												
	Large				Medium				Small			
Variable	Mean	Median	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median	Minimum	Maximum
NQ_Market Capitalization ($Billion)	8.54	3.20	1.48	87.12	0.87	0.80	0.48	1.61	0.32	0.30	0.13	0.52
NY_Market Capitalization ($Billion)	8.22	3.18	1.58	80.75	0.91	0.83	0.53	1.52	0.34	0.31	0.11	0.53
NQ_Adjusted Daily Volume(Million)	58.59	30.90	2.35	382.34	6.44	5.46	0.49	20.41	1.62	1.22	0.15	5.71
NY_Adjusted Daily Volume(Million)	57.33	33.70	2.22	274.88	6.28	4.97	0.71	19.53	1.58	1.27	0.23	5.23
NQ_Relative Price Range (% Daily STD)	2.80%	2.80%	1.40%	4.10%	3.40%	3.30%	1.50%	5.80%	4.20%	4.10%	1.40%	6.20%
NY_Relative Price Range (% Daily STD)	2.60%	2.40%	1.60%	3.90%	3.10%	3.00%	1.70%	5.20%	3.80%	3.60%	1.30%	5.80%
NQ_Price ($)	38.6	37.3	6.6	95.4	24.2	23.0	7.2	59.4	13.4	13.6	4.1	39.5
NY_Price ($)	37.6	36.1	8.9	101.1	24.2	22.5	7.1	52.1	13.2	12.1	4.0	40.8

Table 3: Breakdown of Number of Shares Traded on the NYSE and NASDAQ by Order Type and Firm Size

Entire Sample

	Percentage of Shares		Number of Shares (Million)	
	NASDAQ	NYSE	NASDAQ	NYSE
Market				
0100-0499	3.4	10.5	379	718
0500-1999	5.8	14.7	645	1006
2000-4999	3.1	7.6	350	519
5000-9999	1.6	3.2	180	220
Marketable Limit				
0100-0499	24.1	16.9	2688	1160
0500-1999	34.6	29.9	3859	2051
2000-4999	16.2	10.7	1813	734
5000-9999	11.2	6.6	1256	450
Total	100	100	11171	6857

By Market Capitalization

	Percentage of Shares						Number of Shares in Millions					
	Large Mkt Cap		Medium Mkt Cap		Small Mkt Cap		Large Mkt Cap		Medium Mkt Cap		Small Mkt Cap	
OrderSize	NASDAQ	NYSE	NASDAQ	NYSE	NASDAQ	NYSE	NASDAQ	NYSE	NASDAQ	NYSE	NASDAQ	NYSE
Market												
0100-0499 Shares	3.3	10.7	3.7	10.2	4.0	9.0	286	556	62	115	30	47
0500-1999 Shares	5.6	15.5	5.7	11.6	8.3	13.5	487	804	96	131	62	71
2000-4999 Shares	3.1	8.3	2.8	5.1	4.2	5.9	270	430	48	57	32	31
5000-9999 Shares	1.7	3.6	1.1	2.0	1.7	2.0	150	187	18	22	13	11
Marketable Limit												
0100-0499 Shares	22.9	15.0	28.9	23.6	26.1	21.4	2002	781	489	266	197	113
0500-1999 Shares	35.0	30.2	33.8	30.1	31.2	26.7	3052	1570	572	339	235	141
2000-4999 Shares	16.6	10.4	14.8	10.9	15.6	13.3	1446	541	250	123	118	70
5000-9999 Shares	11.8	6.4	9.3	6.6	8.8	8.3	1032	332	158	75	66	44
Total	100.0	100.0	100.0	100.0	100.0	100.0	8726	5200	1691	1129	754	529

Table 4: Effective Spread

	Large Market Capitalization				Medium Market Capitalization				Small Market Capitalization			
OrderSize	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference
Market Orders												
0100-0499 Shares	222	2.650	2.490	**0.160**	207	3.590	3.130	**0.460**	172	3.468	2.985	**0.483**
0500-1999 Shares	221	3.370	4.040	**-0.660**	180	4.340	5.020	**-0.670**	176	4.892	5.488	**-0.596**
2000-4999 Shares	203	5.370	7.160	**-1.790**	125	6.020	8.600	**-2.580**	112	6.546	9.124	**-2.578**
5000-9999 Shares	151	7.000	10.850	**-3.850**	52	6.320	11.090	**-4.770**	60	8.037	10.215	-2.178
Marketable Limit Orders												
0100-0499 Shares	222	2.520	1.590	**0.920**	227	3.460	2.170	**1.290**	225	4.250	2.427	**1.823**
0500-1999 Shares	222	2.930	1.960	**0.960**	227	3.910	2.900	**1.010**	222	4.589	3.438	**1.151**
2000-4999 Shares	222	3.150	2.860	0.290	227	4.190	4.610	**-0.420**	213	4.554	5.086	**-0.532**
5000-9999 Shares	219	3.300	3.620	**-0.320**	215	4.490	6.020	**-1.530**	201	4.722	5.662	**-0.940**

	Effective Spread (Pct)											
	Large Market Capitalization				Medium Market Capitalization				Small Market Capitalization			
OrderSize	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference
Market Orders												
0100-0499 Shares	222	0.075	0.071	**0.003**	207	0.150	0.134	**0.017**	172	0.300	0.266	**0.034**
0500-1999 Shares	221	0.093	0.112	**-0.019**	180	0.196	0.219	**-0.024**	176	0.417	0.460	**-0.043**
2000-4999 Shares	203	0.147	0.199	**-0.052**	125	0.320	0.421	**-0.100**	112	0.689	0.906	**-0.217**
5000-9999 Shares	151	0.191	0.294	**-0.103**	52	0.438	0.723	**-0.285**	60	1.051	1.250	**-0.199**
Marketable Limit Orders												
0100-0499 Shares	222	0.069	0.047	**0.022**	227	0.143	0.095	**0.049**	225	0.305	0.191	**0.114**
0500-1999 Shares	222	0.080	0.057	**0.022**	227	0.162	0.121	**0.041**	222	0.334	0.258	**0.076**
2000-4999 Shares	222	0.086	0.080	0.006	227	0.175	0.185	-0.010	213	0.351	0.369	-0.018
5000-9999 Shares	219	0.090	0.104	**-0.014**	215	0.195	0.248	**-0.053**	201	0.390	0.448	**-0.058**

The differences reported in **bold** indicates that the difference in means is significantly different from zero at the 5 percent level based a two-tail t-test.

Table 5: Realized Spreads

	Realized Spread (Cents)											
	Large Market Capitalization				Medium Market Capitalization				Small Market Capitalization			
OrderSize	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference
Market Orders												
0100-0499 Shares	222	1.486	0.092	**1.394**	207	1.790	0.223	**1.568**	222	2.233	0.892	**1.342**
0500-1999 Shares	221	1.352	0.533	**0.819**	180	2.029	1.037	**0.993**	221	2.290	1.533	**0.757**
2000-4999 Shares	203	1.163	2.327	**-1.164**	125	1.640	2.640	**-1.000**	203	1.535	2.026	-0.491
5000-9999 Shares	151	0.618	3.127	**-2.509**	52	1.379	3.684	-2.305	151	2.477	3.722	-1.245
Marketable Limit Orders												
0100-0499 Shares	222	0.974	-0.721	**1.695**	227	1.609	-1.095	**2.704**	222	2.556	-0.139	**2.695**
0500-1999 Shares	222	0.705	-1.218	**1.923**	227	0.867	-1.469	**2.336**	222	1.635	-0.662	**2.297**
2000-4999 Shares	222	-0.209	0.399	**-0.608**	227	0.140	-0.045	0.185	222	0.303	-0.131	0.434
5000-9999 Shares	219	-1.062	0.508	**-1.570**	215	-0.941	-0.362	-0.579	219	-0.780	-1.100	0.320
	Realized Spread (Pct)											
	Large Market Capitalization				Medium Market Capitalization				Small Market Capitalization			
OrderSize	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference
Market Orders												
0100-0499 Shares	222	0.047	0.004	**0.043**	207	0.073	0.017	**0.056**	222	0.208	0.090	**0.118**
0500-1999 Shares	221	0.040	0.017	**0.023**	180	0.091	0.054	**0.037**	221	0.224	0.158	**0.066**
2000-4999 Shares	203	0.036	0.067	**-0.031**	125	0.089	0.136	**-0.047**	203	0.216	0.236	-0.020
5000-9999 Shares	151	0.022	0.089	**-0.067**	52	0.109	0.293	**-0.185**	151	0.319	0.407	-0.087
Marketable Limit Orders												
0100-0499 Shares	222	0.027	-0.019	**0.046**	227	0.067	-0.036	**0.103**	222	0.187	0.003	**0.184**
0500-1999 Shares	222	0.021	-0.034	**0.055**	227	0.043	-0.056	**0.099**	222	0.133	-0.042	**0.175**
2000-4999 Shares	222	-0.001	0.010	**-0.011**	227	0.011	0.004	0.007	222	0.047	-0.007	**0.055**
5000-9999 Shares	219	-0.027	0.017	**-0.044**	215	-0.028	-0.006	-0.022	219	-0.041	-0.072	0.031

The differences reported in **bold** indicates that the difference in means is significantly different from zero at the 5 percent level based a two-tail t-test.

Table 6: Price Impact

Price Impact (Cents)											
Large Market Capitalization				Medium Market Capitalization				Small Market Capitalization			
Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference
222	1.169	2.400	**-1.231**	207	1.798	2.903	**-1.105**	172	1.234	2.093	**-0.859**
221	2.021	3.504	**-1.483**	180	2.316	3.979	**-1.663**	176	2.602	3.955	**-1.353**
203	4.204	4.832	-0.629	125	4.377	5.962	**-1.584**	112	5.012	7.098	**-2.087**
151	6.380	7.719	**-1.338**	52	4.941	7.404	-2.463	60	5.561	6.493	-0.932
222	1.543	2.315	**-0.772**	227	1.853	3.269	**-1.416**	225	1.694	2.566	**-0.872**
222	2.223	3.182	**-0.960**	227	3.042	4.366	**-1.324**	222	2.955	4.100	**-1.146**
222	3.358	2.458	**0.900**	227	4.052	4.654	-0.602	213	4.250	5.216	**-0.966**
219	4.362	3.113	**1.249**	215	5.426	6.381	-0.955	201	5.501	6.762	-1.261

Price Impact (Pct)											
Large Market Capitalization				Medium Market Capitalization				Small Market Capitalization			
Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference
222	0.027	0.067	**-0.040**	207	0.077	0.117	**-0.040**	172	0.092	0.176	**-0.084**
221	0.053	0.095	**-0.042**	180	0.104	0.165	**-0.061**	176	0.193	0.302	**-0.108**
203	0.111	0.132	**-0.021**	125	0.231	0.285	**-0.054**	112	0.473	0.670	**-0.197**
151	0.170	0.205	**-0.036**	52	0.330	0.430	-0.100	60	0.732	0.844	-0.112
222	0.042	0.067	**-0.025**	227	0.076	0.131	**-0.054**	225	0.118	0.187	**-0.070**
222	0.059	0.091	**-0.032**	227	0.119	0.177	**-0.058**	222	0.201	0.300	**-0.099**
222	0.087	0.070	**0.017**	227	0.165	0.182	-0.017	213	0.303	0.376	**-0.073**
219	0.117	0.087	**0.030**	215	0.223	0.254	-0.031	201	0.430	0.520	**-0.090**

The differences reported in **bold** indicates that the difference in means is significantly different from zero at the 5 percent level based a two-tail t-test.

Table 7: Net Price Improvement

Net Price Improvement (Cents)

	Large Market Capitalization				Medium Market Capitalization				Small Market Capitalization			
OrderSize	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference
Market Orders												
0100-0499 Shares	222	-0.082	-0.299	**0.218**	207	-0.406	-0.737	**0.331**	172	-0.298	-0.992	**0.694**
0500-1999 Shares	221	0.534	1.102	**-0.568**	180	0.824	1.461	**-0.637**	176	0.991	1.489	**-0.498**
2000-4999 Shares	203	2.668	4.368	**-1.700**	125	3.186	5.505	**-2.319**	112	3.384	5.417	**-2.033**
5000-9999 Shares	151	4.559	8.339	**-3.780**	52	4.156	8.390	**-4.234**	60	5.399	7.389	-1.990
Marketable Limit Orders												
0100-0499 Shares	222	0.393	-0.305	**0.698**	227	0.249	-0.444	**0.693**	225	0.135	-0.551	**0.687**
0500-1999 Shares	222	0.528	-0.047	**0.575**	227	0.348	0.046	**0.302**	222	0.308	0.080	**0.228**
2000-4999 Shares	222	0.753	0.570	0.183	227	0.687	1.287	**-0.600**	213	0.637	1.549	**-0.912**
5000-9999 Shares	219	0.968	1.329	**-0.361**	215	1.310	2.795	**-1.485**	201	1.118	2.141	**-1.023**

Net Price Improvement (Pct)

	Large Market Capitalization				Medium Market Capitalization				Small Market Capitalization			
OrderSize	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference
Market Orders												
0100-0499 Shares	222	-0.002	-0.010	**0.008**	207	-0.015	-0.033	**0.018**	172	-0.024	-0.088	**0.064**
0500-1999 Shares	221	0.014	0.027	**-0.014**	180	0.034	0.053	**-0.020**	176	0.076	0.101	**-0.025**
2000-4999 Shares	203	0.070	0.116	**-0.046**	125	0.160	0.250	**-0.090**	112	0.331	0.503	**-0.171**
5000-9999 Shares	151	0.120	0.218	**-0.098**	52	0.274	0.525	**-0.252**	60	0.653	0.851	**-0.198**
Marketable Limit Orders												
0100-0499 Shares	222	0.010	-0.009	**0.019**	227	0.010	-0.018	**0.029**	225	0.012	-0.039	**0.051**
0500-1999 Shares	222	0.014	-0.002	**0.016**	227	0.015	0.000	**0.016**	222	0.024	0.001	**0.023**
2000-4999 Shares	222	0.020	0.014	**0.006**	227	0.029	0.044	**-0.015**	213	0.052	0.092	**-0.040**
5000-9999 Shares	219	0.025	0.037	**-0.012**	215	0.056	0.105	**-0.049**	201	0.094	0.152	**-0.058**

The differences reported in **bold** indicates that the difference in means is significantly different from zero at the 5 percent level based a two-tail t-test.

Table 8: Quoted Spread

	Quoted Spread (Cents)											
	Large Market Capitalization				Medium Market Capitalization				Small Market Capitalization			
OrderSize	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference
Market Orders												
0100-0499 Shares	222	2.737	2.791	-0.054	207	3.994	3.862	**0.131**	172	3.765	3.977	**-0.211**
0500-1999 Shares	221	2.839	2.935	-0.096	180	3.521	3.555	-0.034	176	3.901	3.999	-0.099
2000-4999 Shares	203	2.699	2.792	-0.093	125	2.833	3.096	**-0.264**	112	3.162	3.707	**-0.545**
5000-9999 Shares	151	2.440	2.506	-0.066	52	2.165	2.699	**-0.534**	60	2.638	2.826	-0.188
Marketable Limit Orders												
0100-0499 Shares	222	2.124	1.899	**0.225**	227	3.213	2.618	**0.595**	225	4.114	2.978	**1.136**
0500-1999 Shares	222	2.400	2.012	**0.388**	227	3.560	2.850	**0.710**	222	4.281	3.358	**0.923**
2000-4999 Shares	222	2.396	2.287	0.108	227	3.505	3.323	0.182	213	3.916	3.537	**0.380**
5000-9999 Shares	219	2.332	2.292	0.040	215	3.176	3.224	-0.048	201	3.604	3.521	0.083

	Quoted Spread (Pct)											
	Large Market Capitalization				Medium Market Capitalization				Small Market Capitalization			
OrderSize	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference
Market Orders												
0100-0499 Shares	222	0.077	0.081	**-0.004**	207	0.166	0.167	-0.001	172	0.324	0.354	**-0.030**
0500-1999 Shares	221	0.079	0.084	**-0.005**	180	0.162	0.166	-0.004	176	0.342	0.359	-0.018
2000-4999 Shares	203	0.077	0.083	**-0.005**	125	0.160	0.171	**-0.011**	112	0.358	0.404	**-0.046**
5000-9999 Shares	151	0.071	0.076	**-0.005**	52	0.165	0.198	**-0.033**	60	0.398	0.399	-0.001
Marketable Limit Orders												
0100-0499 Shares	222	0.059	0.056	**0.003**	227	0.133	0.113	**0.020**	225	0.293	0.229	**0.063**
0500-1999 Shares	222	0.066	0.059	**0.006**	227	0.147	0.121	**0.025**	222	0.310	0.257	**0.053**
2000-4999 Shares	222	0.066	0.067	0.000	227	0.146	0.141	0.005	213	0.299	0.277	**0.022**
5000-9999 Shares	219	0.065	0.067	-0.002	215	0.139	0.143	-0.004	201	0.296	0.296	0.000

The differences reported in **bold** indicates that the difference in means is significantly different from zero at the 5 percent level based a two-tail t-test.

Table 9: Execution Speed

	Execution Speed (seconds)											
	Large Market Capitalization				Medium Market Capitalization				Small Market Capitalization			
OrderSize	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference
Market Orders												
0100-0499 Shares	222	1.240	13.200	**-11.960**	207	1.420	19.087	**-17.667**	172	1.749	16.846	**-15.097**
0500-1999 Shares	221	4.500	15.164	**-10.665**	180	4.117	19.502	**-15.385**	176	6.290	17.561	**-11.271**
2000-4999 Shares	203	11.484	20.789	**-9.304**	125	11.501	24.802	**-13.301**	112	13.691	24.888	**-11.197**
5000-9999 Shares	151	32.369	27.537	4.832	52	21.429	34.137	**-12.708**	60	44.907	40.325	4.582
Marketable Limit Orders												
0100-0499 Shares	222	1.465	9.254	**-7.788**	227	2.410	13.433	**-11.023**	225	4.163	17.824	**-13.661**
0500-1999 Shares	222	5.319	19.447	**-14.127**	227	14.596	40.048	**-25.452**	222	22.454	72.924	**-50.470**
2000-4999 Shares	222	24.730	83.317	**-58.587**	227	45.710	157.467	**-111.757**	213	85.252	211.346	**-126.094**
5000-9999 Shares	219	50.295	141.716	**-91.421**	215	141.404	231.216	**-89.812**	201	206.463	514.906	**-308.443**

The differences reported in **bold** indicates that the difference in means is significantly different from zero at the 5 percent level based a two-tail t-test.

Table 10: Percentage of Shares Executed

	Executed Shares (Pct)											
	Large Market Capitalization				Medium Market Capitalization				Small Market Capitalization			
OrderSize	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference	Number of Observation	NASDAQ	NYSE	Difference
Market Orders												
0100-0499 Shares	222	100.0	98.2	**2.9**	207	99.9	98.5	**1.5**	172	99.5	99.2	0.4
0500-1999 Shares	221	96.6	97.9	**-1.3**	180	96.0	97.5	**-1.4**	176	96.9	98.1	-1.1
2000-4999 Shares	203	91.3	97.5	**-6.2**	125	94.3	96.9	**-2.6**	112	95.3	98.4	**-3.1**
5000-9999 Shares	151	87.2	97.3	**-10.1**	52	90.9	97.8	**-7.0**	60	95.6	98.2	-2.6
Marketable Limit Orders												
0100-0499 Shares	222	72.4	68.2	**4.2**	227	79.0	72.4	**6.6**	225	78.2	75.9	**2.3**
0500-1999 Shares	222	52.9	71.4	**-18.5**	227	55.9	74.8	**-18.9**	222	57.8	76.8	**-19.0**
2000-4999 Shares	222	36.0	71.6	**-35.6**	227	35.0	66.1	**-31.1**	213	40.6	68.7	**-28.1**
5000-9999 Shares	219	20.2	66.2	**-45.9**	215	22.0	58.2	**-36.2**	201	26.2	59.6	**-33.4**

The differences reported in **bold** indicates that the difference in means is significantly different from zero at the 5 percent level based a two-tail t-test.