MEMORANDUM

TO: File

FROM: Office of Economic Analysis

DATE: December 15, 2004

RE: Analysis of Volatility for Stocks Switching from Nasdaq to NYSE

To help evaluate comments received on the Regulation NMS proposal, this memo describes the results of an empirical examination conducted by OEA on the volatility of 91 stocks that switched from Nasdaq to NYSE between April 2001 and January 2004. For each stock, we used bid ask quote midpoints over a window of three months before and after the move to compute intraday volatility, variance ratios, and an estimate of the variance of short-term pricing errors. The main results are as follows:

- On average, stocks experience a significant decline in intraday volatility upon moving from Nasdaq to the NYSE. We find this same result regardless of whether we use 5-minute return intervals to compute volatility, 60-minute intervals, or any other interval between 5 and 60 minutes.

- We find a significant decline in the variance ratio (5-minute return variance compared to 60-minute return variance) when the stocks moved to NYSE. This suggests there is a greater tendency on Nasdaq for short-term deviations of stock prices away from their fundamental values. The variance ratio isolates the transient kind of volatility most likely to be affected by market structure. Therefore, the variance ratio is a more relevant measure than raw volatility for the purpose of analyzing potential regulations affecting market structure.

- As an alternative approach to estimating transient market volatility, we employed a technique developed in a series of papers by Joel Hasbrouck.[1] This approach involves decomposing the price series into permanent and transitory components, and using the variance of the transitory component as a measure of market quality. Consistent with the variance ratio evidence, we find that the variance of short-term pricing errors tended to decrease when the stocks moved from Nasdaq to NYSE.

- We have not investigated the reasons why the volatility may have changed when these stocks switched. It is somewhat difficult to interpret these results because we do not know why the firms chose to list on the NYSE. It is possible that switching from Nasdaq to NYSE causes volatility to decrease for one type of firm and increase for another, and the firms that choose to switch tend to be those that would benefit most. In this case, our result may be influenced by a selection bias.

[1] For example, see Hasbrouck, Joel, "Assessing the Quality of a Security Market: A New Approach to Transaction Cost Measurement," Review of Financial Studies v6 n1: pp191-212 (1993).

Data and Methodology

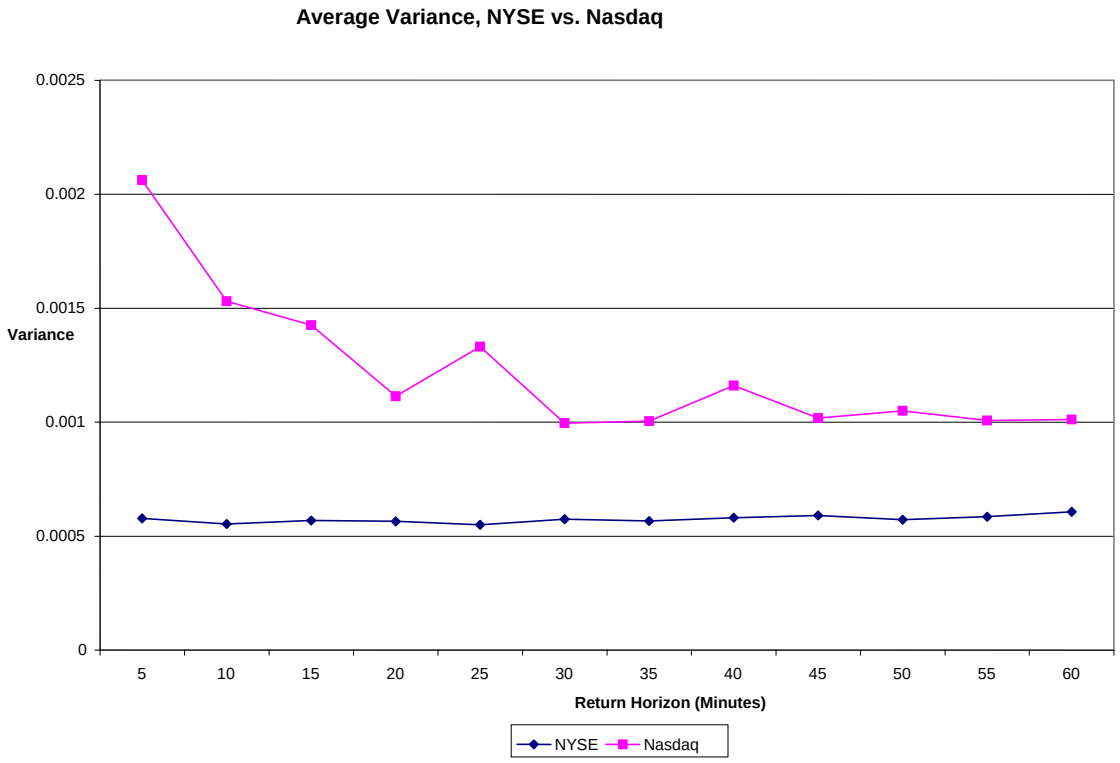
Our analysis of intraday volatility is performed using quote data reported in the Trades and Quotes (TAQ) database, which is available from the NYSE. Our study was based on a sample of 91 stocks that moved from Nasdaq to NYSE between April 2001 and January 2004. This sample includes nearly all the stocks that have switched since the move to decimalization, based on a list provided by Nasdaq. We excluded one stock due to a data availability problem, and we excluded one listing because another class of shares of the same stock was already included in our sample.

Using the listing dates and ticker symbols provided by Nasdaq, we extracted from TAQ all quotes for a period of three calendar months before and three months after the switching date. We discarded quotes that occurred during the first half-hour of trading, to ensure that our results are not driven by differences in the opening mechanisms on the two markets. We also discarded any quotes that were stamped after the close, and performed other standard screens for data errors.

Based on the quotes originating from each exchange, we computed the NBBO quote midpoint at five-minute intervals throughout each day in the sample. We used these midpoints to compute intraday stock returns, and then computed the time-series variance of these returns, on a stock-by-stock basis. For each stock, we computed one variance for the pre-event (Nasdaq) sample and one for the post-event (NYSE) sample. We then repeated this entire procedure using a 10-minute return interval, a 15-minute return interval, and so on up to a 60-minute return interval. The variance estimates were then standardized to make them comparable across intervals. The table below reports the median and mean standardized variance across the 91 stocks in our sample for the Nasdaq period and the NYSE period. As the table demonstrates, the mean and median was substantially higher under Nasdaq than under NYSE, for all return intervals.

Daily Standardized Variance Medians of the Midpoint of Bid/Ask			Daily Standardized Variance Means of the Midpoint of Bid/Ask		
Return Horizon	Nasdaq Median	NYSE Median	Return Horizon	Nasdaq Mean	NYSE Mean
5	0.000761	0.000364	5	0.002063	0.000578
10	0.000692	0.000347	10	0.001531	0.000553
15	0.000632	0.000365	15	0.001426	0.000568
20	0.000607	0.000373	20	0.001114	0.000564
25	0.000556	0.000359	25	0.001331	0.00055
30	0.000591	0.000379	30	0.000995	0.000575
35	0.000545	0.000347	35	0.001004	0.000566
40	0.000595	0.000367	40	0.001161	0.00058
45	0.000599	0.000376	45	0.001018	0.00059
50	0.000563	0.000375	50	0.00105	0.000572
55	0.000549	0.000368	55	0.001007	0.000585
60	0.000588	0.000386	60	0.001012	0.000606

The means reported in the above table are graphed below. In addition to showing that the average volatility was higher under Nasdaq, the graph clearly demonstrates that on Nasdaq, the variance computed using short-term intervals is substantially higher than the variance computed using longer intervals. This is symptomatic of "transitory" variance, or short-term price fluctuations away from the fundamental or "true" value of the stock. In contrast to fundamental volatility, which is a natural consequence of new information becoming incorporated into prices, transitory volatility represents departures from fundamental value, and may be interpreted as a measure of market quality, with high transitory variance being a characteristic of a poor market. By way of contrast, no similar pattern is observed for the NYSE subperiod.



To look at the data another way, the table below reports mean and median variance ratios for Nasdaq and NYSE subperiods. In the absence of excess volatility, we would expect the ratio to equal one. We find that the ratio exceeds one for the Nasdaq period at shorter horizons. Using various statistical tests including a means test and a Wilcoxon test, we find the variance ratios to be statistically higher for Nasdaq than NYSE for horizons below thirty minutes (holding constant the denominator horizon at sixty minutes).

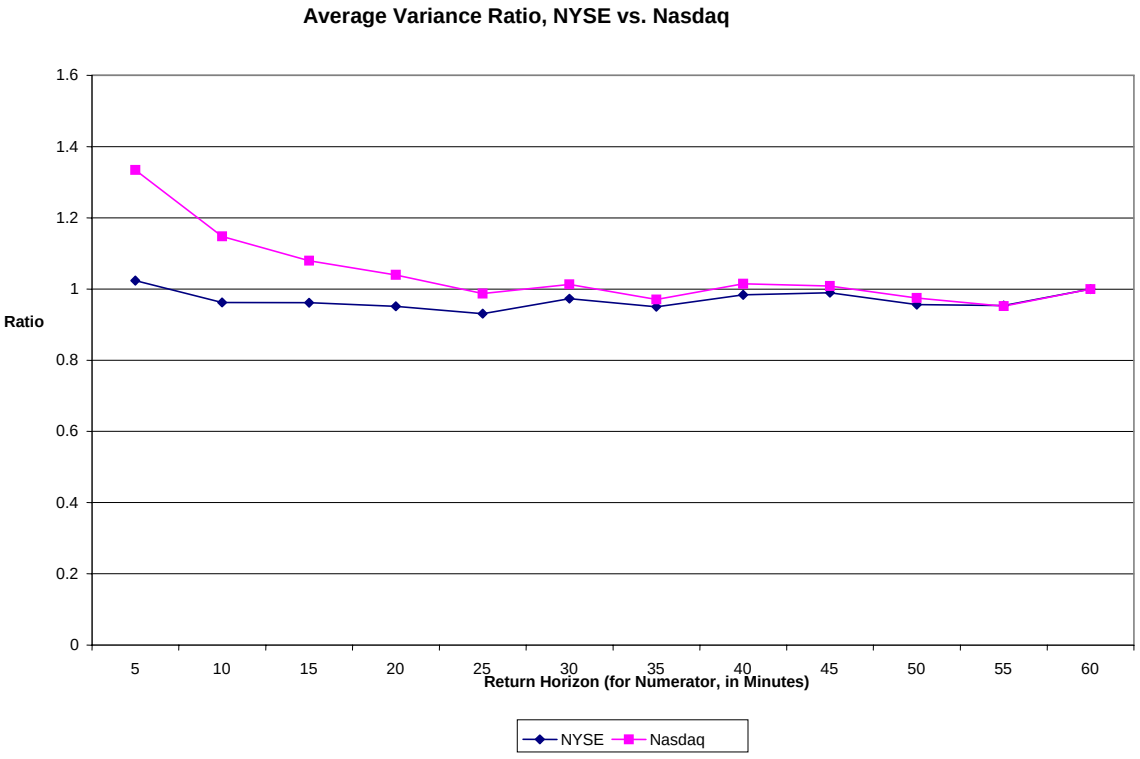
Daily Variance Ratio Medians of the Midpoint of Bid/Ask			Daily Variance Ratio Means of the Midpoint of Bid/Ask		
Return Horizon	Nasdaq Median	NYSE Median	Return Horizon	Nasdaq Mean	NYSE Mean
5	1.210717	0.964522	5	1.334467	1.023632
10	1.071844	0.939235	10	1.148025	0.962268
15	1.052498	0.934075	15	1.079541	0.961458
20	1.032874	0.934300	20	1.039711	0.951314
25	0.982546	0.916496	25	0.987263	0.930664
30	0.998243	0.957854	30	1.012814	0.972955
35	0.968050	0.940545	35	0.970464	0.950262
40	1.006645	0.973900	40	1.014651	0.983616
45	1.000742	0.997529	45	1.008414	0.989496
50	0.970665	0.954155	50	0.974976	0.956296
55	0.942557	0.947104	55	0.951873	0.953525
60	1.000000	1.000000	60	1.000000	1.000000

The average variance ratios from the above table are reproduced in the graph below.

The variance ratio is just one way to measure transitory volatility. A more academically rigorous approach to isolating and measuring transitory volatility has been developed by Joel Hasbrouck and others. This technique uses time-series regressions to decompose the price of each stock into “permanent” and “temporary” components. The permanent component is interpreted as the “true” or “efficient” price, and the temporary component represents short-term pricing “error.” The pricing error is thought to encompass all structural inefficiencies related to transaction methods, and its variance is viewed as a measure of market quality.

In order to check the robustness of our variance ratio results, we implemented this technique for the sample of stocks that switched from Nasdaq to NYSE, and these results confirm our prior conclusion. The average decrease in the variance of the pricing error was 64%, and the median decrease was 13%.

In summary, our evidence indicates that for the sample of stocks that switched from Nasdaq to NYSE, the move was associated with a decrease in total volatility, and also with a decrease in the tendency for stock prices to experience temporary fluctuations away from their fundamental values. As an important caveat, we have made no effort to explain why the Nasdaq structure should be associated with higher volatility, or to address the question of whether the type of changes envisioned by Reg NMS would be likely to affect volatility.


Average Variance Ratio, NYSE vs. Nasdaq
Ratio
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
5
10
15
20
25
30
35
40
45
50
55
60
Return Horizon (for Numerator, in Minutes)
NYSE
Nasdaq