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March 28, 2005

U.S. Securities and Exchange Commission
450 5th Street, N.W.
Washington, DC 20549-0609

Attention: Mr. Jonathan G. Katz, Secretary

Re: File No. S7-10-04, Regulation NMS, Release No. 34-50870 (December 16, 2004) (the "NMS Release")

Ladies and Gentlemen:

I am writing on behalf of Fidelity Investments, as investment adviser to the Fidelity family of mutual funds, with regard to the proposed trade-through rule, which forms part of the Commission's proposed Regulation NMS. Although the Commission has not yet made a formal announcement under the Government in the Sunshine Act, we understand that the Commission intends to hold a public meeting on or about April 6, 2005 to put Regulation NMS, including the proposed trade-through rule, to a vote.

As we have urged in prior comment letters, Fidelity, as have other institutional investors such as TIAA-CREF and Calpers, strongly urges the Commission either to refrain from adopting a trade-through rule or, if a trade-through rule is adopted, to allow informed investors to opt-out of the rule and continue to exercise their fiduciary judgment in choosing the market to which their orders will be sent.

We believe, in any event, that it is premature for the Commission to take action on the proposed trade-through rule, particularly in view of the questionable economic study conducted by the Commission's Office of Economic Analysis, dated December 15, 2004, addressing purported trade-throughs. We understand that this study is the primary economic underpinning for the Commission's views regarding the extent, if any, that trade-throughs confer economic disadvantage on investors. Notwithstanding the initial proposal of Regulation NMS in February 2004, the Commission afforded interested parties little more than one month to

comment on the OEA's study, first made available to the public on December 16, 2004. We respectfully submit that the truncated comment period for the OEA's study leaves the Commission without an adequate foundation to reach economic judgments about the need for a rule that would deprive informed investors of the freedom to choose the markets to which to send their trades.

The methodology followed by the OEA study has drawn well-founded questions, and criticism, from academic economists and others. Fidelity is submitting, with this letter, a copy of an analysis carried out by Professor Robert Battalio, at the University of Notre Dame, and Professor Robert Jennings, at Indiana University. Fidelity engaged Professors Battalio and Jennings to conduct their analysis, but they independently reached the conclusions expressed in their report. **The Battalio-Jennings study concludes that "serious methodological flaws undermine the reliability of the OEA's Trade-through Study"** and recommends that the OEA be directed to re-conduct its analysis by drawing upon more reliable trade data – namely, the order audit-trail data submitted to the Commission by the various market centers in connection with their quality of execution filings under Rule 11Ac1-5. The data are readily available to OEA and it is unclear to us why the OEA did not, in the first instance, look to this source to inform its analysis.

Among the flaws cited by Battalio and Jennings, set forth in their Executive Summary and discussed in the body of their report, are the following:

- The OEA likely erroneously characterized many, if not most, purported "trade-through" trades by failing to take into account that the clocks of the different market centers may vary from one another by up to seven seconds (up to 3 seconds preceding and 3 seconds following the time of the National Institute of Standards and Technology's clock.).

- While the OEA claimed to follow a "conservative" estimate that trades are reported within 8 seconds of execution, there is little basis for this assumption. Battalio and Jennings cite a recent report that finds that 64% of Nasdaq trades, in a sample of Nasdaq firms, were reported with delays of 14 seconds or more. In addition, a recent study suggests that only 56% of large NYSE trades can be matched to trade reports occurring within 10 seconds of execution. **Because of these time differentials, it is erroneous for the OEA, in quantifying the level of trade-throughs in any market, to assume that quotes that were "live" for only 5 (or 8) seconds were available to be acted upon by investors who sent their orders to other markets.**

- The OEA commits a fundamental error in presuming that an investor incurs economic harm by choosing to engage in a block trade, in search of a favorable "all-in price," rather than subjecting itself to volatility risk by breaking its trade up in smaller parts and seeking to capture the most favorable prices at different times during the course of one or more trading

days. (**Indeed, the OEA's erroneous assumption is contradicted by the Commission's own observation in its February, 2004 release (at p. 23) that "large traders may … want the ability to execute a block immediately at a price outside the quotes, to avoid parceling the block out over time in a series of transactions that could cause the market to move to an inferior price.")**

- The OEA disregards the likely probability that many, if not most, retail sized limit orders that are superior to the prices at which trades occur on competing markets will themselves be executed within seconds of those trades on other markets.

In addition to their analysis of the methodological flaws that undermine the OEA's study, Battalio and Jennings demonstrate in the final section of their study (beginning at p. 27), that the Commission, in its December, 2004 re-proposing release (at p. 60), lacked a sound empirical basis for assuming that institutional investors who engage in block trades are "free-riding" on the price discovery brought about by retail-sized limit orders. Battalio and Jennings conclude (at p. 2 of their Summary) that:

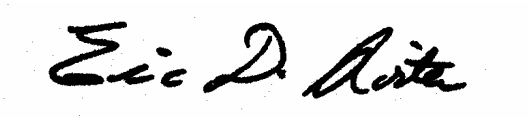
> **"Institutional investors provide the majority of the trade-based price discovery in equity markets. We find nearly unanimous academic evidence that institutional trades permanently affect prices while retail trades have virtually no impact on prices."**

We believe that this is a crucial point for the Commission to take into account, since the Commission, in deleting the "opt-out" right for informed investors in its re-proposal of the trade-through rule last December, appears to have relied upon a fundamental mischaracterization of the role played by institutional investors in the price discovery process.

* * *

We appreciate the opportunity to raise these questions with the Commission. If members of the Commission or the staff wish to discuss these matters, please call either me (617-563-7000) or our counsel, Roger D. Blanc (212-728-8206).

Respectfully submitted,



Attachment

cc (w/att.): The Hon. William H. Donaldson, Chairman
The Hon. Paul S. Atkins, Commissioner
The Hon. Cynthia A. Glassman, Commissioner
The Hon. Harvey J. Goldschmid, Commissioner
The Hon. Roel C. Campos, Commissioner
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March 28, 2005

Analysis of the Re-proposing Release of Reg NMS and the OEA's Trade-through Study

by

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Comments on the Re-proposing Release of Reg NMS and the OEA's Trade-through Study

Executive Summary

I. Serious methodological flaws undermine the reliability of the OEA's Trade-through Study of December 15, 2004, which is relied upon by the SEC to support its re-proposal of a trade-through rule on December 16, 2004.

A. The OEA's flawed methodology is likely to have led to the erroneous characterization of many, if not most, trades identified as trade-throughs in the OEA's study.

- The OEA's methodology does not adequately address the fact that market centers are **only required to be within ±3 seconds** of the National Institute of Standards and Technology (NIST) clock during the OEA's sample period.

- The OEA's methodology does not take into account the empirical evidence suggesting that **trades are frequently reported with lags exceeding the most 'conservative' 8-second window used by the OEA**. A study by Ellis, Michaely, and O'Hara (2000) finds that fully 64% of the trades for a sample of Nasdaq firms are reported with delays exceeding 14 seconds.

- In unpublished work, we find that **only 56% of a sample of large NYSE trades in an audit-trail database can be matched to prints in the trade data used by the OEA** within a 10-second window.

- Thus, on both major equity markets, the OEA's most 'conservative' approach may correctly match little more than half of the trades to the appropriate execution-time quotes.

- Since actively-traded stocks have volatile quotes, the failure of the OEA to properly match trades to the appropriate execution-time quotes introduces considerable room for error in the OEA's trade-through rate calculation.

B. Even if the OEA's unreliable estimates of trade-throughs were assumed to be accurate, the OEA grossly overstates the economic harm, if any, incurred by investors who purportedly trade-through superior quotes on other markets.

- **The OEA study fails to recognize that it is economically rational, in light of the volatility of the equity markets, for an informed investor seeking the best all-in price for a large trade, to engage in a block trade and thereby avoid parceling out its order over an extended period of time.**

- Even if one were to ignore the economic rationality of an institutional investor who chooses to engage in a block trade, the OEA assumes that traded-through quotes have unlimited depth in its 'high-end' estimation of the 'losses' arising from trade-throughs. For example, assume that an institutional investor chooses to engage in a block trade to buy 10,000 shares at 10am at a price of $10.01 per share. If a second market displayed a limit order to sell 500 shares at $10.00 per share at 10am, the OEA estimates that the buyer incurred a 'loss' of up to $100. This is clearly not the case – only 500 shares were offered by displayed limit orders at $10.00 per share. The 'loss' to the buyer, if any, on this trade is $5.00.

C. Furthermore, by design, the OEA's analysis fails to accurately address the economic harm, if any, that trade-throughs impose on retail investors who place limit orders in equity markets.

- **The OEA disregards the very likely probability that many, if not most, of the retail limit orders that are traded-through are filled at their limit order prices within seconds of trades occurring on other markets at inferior prices.**

- Only when a traded-through limit order remains unfilled for several minutes after it is traded-through is there an opportunity for economic harm. Academic work by Harris and Hasbrouck (1996) provides a framework for evaluating the economic costs incurred by these traded-through limit orders.

II. We also address the supposition expressed by the SEC in its December 16 release that institutional investors engaging in block trades somehow are 'free-riding' on prices discovered by retail trading interests (Release at p. 60). The economic literature does not support this supposition. Rather, institutional investors, acting typically as informed traders, are the primary contributors to price discovery in equity markets.

- Institutional investors provide the majority of the **trade-based price discovery** in equity markets. We find nearly unanimous academic evidence that institutional trades permanently affect prices while retail trades have virtually no impact on prices.

- Recent academic evidence demonstrates that most **quote-based price discovery** occurs on markets where institutions dominate.

III. The Commission should make informed decisions on the re-proposed release of Reg NMS only after conducting an analysis that (i) accurately identifies trade-throughs, (ii) provides realistic estimates of the economic costs that trade-throughs impose on liquidity demanders, and (iii) examines whether the retail limit orders that are traded-through are economically harmed.

- **The OEA can produce this analysis by altering their methodology and by using the order-audit trail data that market centers use to produce their 11Ac1-5 reports (data that are readily available to the OEA) in their analysis.**

The purpose of this document is to demonstrate the inaccuracies and inconsistencies in the following passages, taken from the Commission's reproposal of reg NMS, and to provide additional perspective that is missing from the reproposal as currently written.

> "In sum, relevant data supports the need for an intermarket rule to strengthen price protection and improve the quality of trading in both Nasdaq and exchange-listed stocks. The arguments of some commenters that competitive forces alone are sufficient to achieve these objectives fail to take into account two structural problems – principal agent conflicts of interest and "free-riding" on displayed prices."

> "Agency conflicts occur when brokers may have incentives to act otherwise than in the best interest of their customers. Customers, particularly retail investors, may have difficulty monitoring whether their individual orders miss the best displayed prices at the time they are executed. Given the large number of trades that fail to obtain the best displayed prices (e.g., approximately 1 in 40 trades for both Nasdaq and NYSE stocks, or approximately 98,000 trades per day in Nasdaq stocks), the Commission is concerned that many of the investors that ultimately received the inferior price on these trades may not be aware that their orders did not, in fact, obtain the best price. The re-proposed Trade-Through Rule would backstop a broker's duty of best execution by prohibiting the practice of executing orders at inferior prices, absent an applicable exception."

> "Just as importantly, even when market participants act in their own economic self-interest, or brokers act in the best interests of their customers, they may deliberately choose, for various reasons, to bypass (i.e., not protect) limit orders with the best displayed prices. For example, an institution may be willing to accept a dealer's execution of a particular block order at a price outside the NBBO, thereby transferring the risk of any further price impact to the dealer. Market participants that execute orders at inferior prices without protecting displayed limit orders are effectively "free-riding" on the price discovery provided by those limit orders. Displayed limit orders benefit all market participants by establishing the best prices, but, when bypassed, do not themselves receive a benefit, in the form of an execution, for providing this public good. This economic externality, in turn, creates a disincentive for investors to display limit orders, particularly limit orders of any substantial size."

We begin our comment letter by demonstrating that the Office of Economic Analysis (OEA) did not use the best available data or the most appropriate methodology for accurately assessing whether trade-

throughs are a problem for liquidity demanders in our equity markets. For these reasons, the results of the OEA's trade-through study should not be used to make public policy. We show that most (if not all) of the trade-throughs documented in the OEA analysis may be attributed to an inability of the OEA's methodology to address the severity of the trade reporting delays, and to a lesser extent, the latencies in quote reporting, that are inherent in the publicly available intraday trade and quote data used in the OEA's study. Fortunately, we believe that many of the data errors in the OEA's study can be avoided by using the data executing venues produce to comply with SEC Rule 11Ac1-5. Since these data are readily available, we encourage the OEA to conduct a second trade-through analysis with these audit-trail data and an improved methodology. If the point of this analysis is to examine the frequency with which marketable orders are executed at seemingly inferior prices, then we suggest the OEA make several modifications to the methodology used in their trade-through analysis. We suggest an entirely different methodology if the goal is to investigate whether the retail limit orders that are traded-through are economically disadvantaged.

We also address the supposition expressed by the SEC in its December 16 release that institutional investors engaging in block trades somehow are 'free-riding' on prices discovered by retail trading interests by drawing on the large empirical finance literature arguing that institutions and/or other professional traders do not consistently free-ride off prices discovered by retail limit orders.[1] Indeed, even in the explicit case of a trade-through, it is not clear whether the trade or the (presumably stale) quote that is being traded-through is discovering price. Finally, we note that the Commission's reliance on disclosure, competition, and the threat of regulation to achieve complex policy objectives has worked well in the past and encourage the Commission to consider a similar course of action with respect to trade-throughs.

[1] Presumably the SEC is not worried about institutions and/or market professionals trading through each others' limit orders.

I. Publicly available trade data are inappropriate for use in trade-through studies.

Why do we need a trade-through rule? The OEA's trade-through analysis suggesting that violations of price priority frequently occur in domestic equity markets is being used to justify the need for a market-wide trade-through rule. In the words of the SEC, "a 'Trade-through Rule' would require trading centers to establish, maintain, and enforce written policies and procedures reasonably designed to prevent the execution of trades at prices inferior to protected quotations displayed by other trading centers." As is often the case with new regulation, the proposed trade-through rule will be costly to implement, maintain, and police. Perhaps more important, the proposed trade-through rule may have negative unintended consequences. Given the apparent significance that has been attached to the OEA's trade-through study, we next examine whether the data and the methods used to produce the trade-through rates documented in the OEA's trade-through study withstand academic scrutiny.

We begin this section of our comment letter by defining what a trade-through is. We next illustrate how delays in reporting trades and other common data issues can lead researchers to incorrectly label trades as trade-throughs after the fact. Next, we provide evidence from the finance literature suggesting that there are substantial reporting delays in the publicly available databases used in the OEA's trade-through analysis.[2] We conclude this section by demonstrating that in today's volatile markets, these reporting delays have the potential to produce large rates of apparent trade-throughs, especially in the most actively traded stocks. Even if there were *no* trade-throughs on the four days used in the OEA's analysis, researchers using the publicly available intraday trade and quote databases would document significant

[2]While the OEA recognizes the possibility of small trade reporting delays, the empirical academic evidence and the rules regarding clock synchronization suggest that the OEA's most conservative methodology is extremely aggressive.

trade-through rates. Thus, the trade-through rates documented in the OEA's trade-through study represent loose upper bounds on the true frequency of trade-throughs in US equity markets.

A. The relationship between delayed trade reporting and inferred trade-through rates.

The SEC's re-proposing document defines a trade-through as follows:

> "A trade-through is defined in Rule 600(b)(77) as the purchase or sale of an NMS stock during regular trading hours, – either as principal or agent, at a price that is lower than a protected bid or higher than a protected offer."

In a world where trades are immediately printed and quotes are immediately recorded, it is relatively easy to determine when a trade-through occurs. For example, consider the two scenarios below in which two markets are competing to provide liquidity in stock ZZZ. Market Hi-Tech is an electronic limit order book and Market Floor-Based is a floor-based market.

Scenario 1: At 9:59:40 a market order to buy 120 shares of ZZZ arrives at the Floor-Based market. At 10:00:00 the Floor-Based market executes market order at a price of $19.00 per share.

At 10:00:00, the market for ZZZ was as follows:

Market	Time of Quote	Bid Price	Bid Size	Offer Price	Offer Size
Hi-Tech	9:59:59	$18.98	200 shares	$19.01	200 shares
Floor-Based	9:58:00	$18.97	10,000 shares	$19.00	1,000 shares
NBBO		$18.98	200 shares	$19.00	1,000 shares

Since trades and quotes are reported as they occur and since publicly available data do not reveal whether trades are buyer or seller initiated, researchers determining whether this trade is a trade-through ask whether the execution price of $19.00 is outside of the National Best Bid and Offer prevailing when the trade executes and is reported to the database (by assumption, in this example these times are one in the same). Researchers using the OEA's methodology would correctly infer that a trade-through did not occur on this

trade. In other words, there is not a better posted price when the Floor-Based market executes the market order to buy 120 shares at a price of $19.00 per share at 10:00:00.

Scenario 2: At 9:59:59 a marketable limit order to buy 200 shares of ZZZ at a price no higher than $19.05 per share arrives at the Hi-Tech market. At 10:00:00 the Hi-Tech market executes the marketable limit order at a price of $19.01 per share.

At 10:00:00, the market for ZZZ was as follows:

Market	Time of Quote	Bid Price	Bid Size	Offer Price	Offer Size
Hi-Tech	9:59:59	$18.98	200 shares	$19.01	200 shares
Floor-Based	9:58:00	$18.97	10,000 shares	$19.00	1,000 shares
NBBO		$18.98	200 shares	$19.00	1,000 shares

Since trades and quotes are reported as they occur and since publicly available data do not reveal whether trades are buyer or seller initiated, researchers determining whether this trade is a trade-through ask whether the execution price of $19.01 is outside of the National Best Bid and Offer prevailing when the trade executes and is reported to the database (as before, in this example these times are assumed to be the same). Researchers using the OEA's methodology would correctly infer that a trade-through did occur on this trade. In other words, when the marketable limit order to buy 200 shares executes at a price of $19.01 per share on the Hi-Tech market at 10:00:00, there was a better price posted on the Floor-Based market.

Unfortunately, in the real world, trades are not reported in real time. It takes time to process and validate trades within a trading venue and it takes further time for trade information to travel from market centers to SIAC, the entity ultimately responsible for reporting trades to the world, and be disseminated.[3] On trading venues where human interaction is used to facilitate trades, many seconds can elapse between the time a trade executes and the time a trade report leaves the trading venue. These time lags are shorter for ECNs (or other electronic markets). However, since all trading venues route trade reports to SIAC, all trade reports (and quote updates) are delayed by the amount of time it takes them to travel from the executing venue to SIAC. Depending upon the trade and quote traffic on the lines, this delay can be a few seconds.

To see why it is important that the data used for a trade-through study have the correct execution time, we consider a third scenario in which trades are reported to publicly available databases with a five-second delay (below, we argue that delays well in excess of five seconds are commonplace).

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[3] As noted by Hasbrouck, Sofianos and Sosebee (1993), "Rule 11Aa3-1 of the Securities and Exchange Commission (SEC) governs the reporting and dissemination of trade information. According to this rule, all U.S. securities exchanges and the National Association of Securities Dealers (NASD) must implement SEC-approved 'transaction reporting plans' for the real-time collection, processing and dissemination of 'trade reports' for listed securities. Accordingly, the exchanges and NASD submitted and the SEC approved the Consolidated Tape Association (CTA) Plan. The Plan requires the exchanges and the NASD (the Plan 'Participants') to collect and report to the Securities Industry Automation Corporation (SIAC) for dissemination on the Consolidated Tape (the 'Tape') last sale data (symbol, trade price, size, etc.) in 'eligible securities.' Eligible securities are any common stock, right, long-term warrant or preferred stock listed on the NYSE or the AMEX as well as certain securities listed on other U.S. securities exchanges. The Plan requires each Participant to *report last sale data as promptly as possible and to ensure that, under normal conditions, not less than 90 percent of such last sale data are reported within 90 seconds after execution*. (emphasis added)"

"Each Participant is responsible for collecting last sale data on eligible securities trades executed in its market and transmitting these data to the SIAC-operated Consolidated Tape System (CTS). CTS processes these data and distributes them to visual moving tickers ('the Tape') and via high speed lines to approved subscribers of the CTS service for worldwide redistribution to their customers. CTS disseminates last sale data during the hours the Participants are open for trading."

Scenario 3: At 9:59:40 a market order to buy 200 shares of ZZZ arrives at the Hi-Tech market. At 10:00:00 the Hi-Tech market executes market order at a price of $19.01 per share.

At 10:00:00, the market for ZZZ was as follows:

Market	Time of Quote	Bid Price	Bid Size	Offer Price	Offer Size
Hi-Tech	9:59:59	$18.98	200 shares	$19.01	200 shares
Floor-Based	9:58:00	$18.97	10,000 shares	$19.02	1,000 shares
NBBO		$18.98	200 shares	$19.01	200 shares

At 10:00:05, the market for ZZZ was as follows:

Market	Time of Quote	Bid Price	Bid Size	Offer Price	Offer Size
Hi-Tech	10:00:01	$18.98	200 shares	$19.02	400 shares
Floor-Based	10:00:04	$18.97	10,000 shares	$18.99	1,000 shares
NBBO		$18.98	200 shares	$18.99	1,000 shares

Since trades are now reported with a 5 second lag while quotes are reported as they occur, researchers examining whether this trade is a trade-through would compare the execution price of $19.01 to the National Best Bid and Offer prevailing when the trade is reported to the database (at 10:00:05), not when the trade actually executes (at 10:00:00). Researchers using the OEA's methodology incorrectly infer that a trade-through occurred on this trade. The execution price of $19.01 is two cents outside of the NBBO prevailing when the trade is reported to the public.

Scenario 3 demonstrates that differential delays in reporting trades and quotes (including a positive delay for trades and a zero delay for quotes) can lead researchers to incorrectly label trades as trade-throughs if quotes change between the time that trades execute and the time when trades are reported to the public.[4] All else equal, we expect inferred trade-through rates to be increasing in the trade reporting delay

[4]To make this point more transparent, imagine a world where all marketable buy orders are executed at the execution-time National Best Offer and all marketable sell orders are executed at the execution-time National Best Bid. Further assume that every even second, the market is $10.00 to $10.01 and every odd second, the market is $10.01 to $10.02 and assume that every second a marketable buy order arrives and a marketable sell order arrives. Finally, assume that trades are reported with a one-

and in the volatility of quoted prices.[5] Since trade reporting delays appear to be a function of trading activity, this implies that trade-through rates for actively traded, volatile securities are most likely overstated.

In its December 15, 2004 Analysis of Trade-throughs in Nasdaq and NYSE Issues, the OEA uses a methodology similar to that used by Battalio, Hatch and Jennings (2004) to negate the potential upward bias arising from using trades and quotes reported with differential delays in trade-through analyses. The intuition is as follows. Suppose that it is known that the trade-reporting delays never exceed 10 seconds and suppose that researchers want to find a lower bound trade-through rate in a given market. Researchers can simply compare each trade with the highest National Best Offer and the lowest National Best Bid prevailing in the 10 seconds leading up to the reported execution time. While this procedure will classify some trade-throughs as non-violating trades, any trade identified as a trade-through most certainly executes at a price that was outside of the execution-time quotes. Obviously, the longer the quote window the less likely it is that a market center is wrongly accused of trading through another market center's quotes. However, it is also the case that the number of trade-throughs escaping attention increases as the quote window lengthens. Thus, researchers using data in which the reporting of trades and quotes is nonsynchronous (as is the data used in the OEA's trade-through study) must work to balance these trade-offs when choosing the appropriate quote window. The OEA examines windows that begin one, four, and six seconds before the

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second lag and that quote updates are reported with no lag. If the market is open for 6 ½ hours, there would be 46,800 trades. The 11,700 sales that occur at a price of $10.00 would be considered trade-throughs since they would be compared to an NBBO of $10.01 to $10.02. Similarly, the 11,700 purchases that occur at a price of $10.02 would also be considered trade-throughs since they would be compared to an NBBO of $10.00 to $10.01. Thus, in this stylized example, researchers looking for trade-throughs in a market where there are none would document a 50% trade-through rate because trades are reported with a lag and quotes are volatile.

[5] It is interesting to note that if we alter our example and assume that every second the buy (sell) order is executed at a price that is $0.01 higher (lower) than the execution-time National Best Offer (Bid), researchers with trades that are reported with a one second lag would conclude the 11,700 sell orders executed at $10.00 (when the National Best Bid was $10.01) and the 11,700 buy orders executed at $10.02 (when the National Best Offer was $10.01) were not trade-throughs. Hence, the inferred trade-through rate of 50% would be lower than the actual trade-through rate of 100%.

trade report time through one second after the trade's report time and argues that the three second window (from one second before through one second after the trade report time) is conservative.[6] We draw on academic research to demonstrate that even the eight second window (from six seconds before through one second after the trade report time) is anything but conservative. Fortunately, as we argue later, the OEA has at its disposal data which are largely free from trade-reporting delays and thus, are much more appropriate for trade-through analyses.

B. How severe is the delayed trade reporting in practice?

The academic literature has many papers in which authors obtain and use proprietary audit-trail order data in their analyses. Several of these papers attempt to match executed orders in the audit-trail data to executed trades reported in publicly available intraday trade and quote databases such as the NYSE's TAQ database and Nasdaq's Nastraq data (both used by the OEA in their trade-through study). In each of these papers, the authors find execution times reported in the publicly available databases tend to be reported with a delay relative to the execution times in the audit-trail data. Moreover, a significant portion of executions in the audit-trail datasets cannot be matched to corresponding executions in the publicly available datasets within the 3 (or even the 8) second quote window centered on the publicly available execution time that is predominately used by the OEA in their trade-through study. We also note that for market makers and floor-based trading systems, the most conservative quote window used by the OEA, the window starting 6 seconds prior to the execution time found in the publicly available data, is totally inappropriate. We briefly describe the findings of these papers below.

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[6] Note that a separate problem with timing is whether the many clocks providing time stamps are synchronized. Industry standards appear to require that all clocks be within three seconds of the time kept by the National Institute of Standards and Technology during the OEA's sample period. This would imply a minimum of a seven second (standard time plus and minus three seconds) window before addressing differential delays between trade and quote reporting.

Ellis, Michaely, and O'Hara (2000), hereafter EMO, obtain proprietary transactions data taken from the NASD's Market Data Server for 313 Nasdaq stocks that begin trading following their initial public offering between September 27, 1996 and September 29, 1997. Thus, if a stock began trading on December 2, 1996, the database contains all of the intraday trades and quotes for the stock for each day from December 2, 1996 through September 29, 1997. For comparison purposes, the average stock in the EMO study has a lower market capitalization than the average Nasdaq stock during this period ($172 million versus $322 million, respectively), while the median sample firm has a larger market capitalization ($112 million) than the median Nasdaq firm ($66 million).

The transaction times in the EMO audit-trail database always appear with the time that the trade was entered into the Automatic Confirmation Transaction Service (ACT). If a trade occurs through SOES, SelectNet, or ACES (other systems reporting trades to the consolidated tape), then the actual execution time is reported and appears on the NASD audit trail. Trades reported outside of the allowed 90 second delay have their actual execution time. Thus, EMO note that the transaction times on the NASD audit trail data are a mix of ACT times (if no alternative execution time is reported) and the more accurate execution times (for automatically executed trades and for trades reported late). Conversely, the execution times reported in the database used by the OEA for their trade-through analysis are based solely on the ACT times. EMO examine the difference between the execution times reported in their proprietary database and the execution times reported in the TAQ database by matching their trades with trades in TAQ on the basis of trade size, trade price, and time priority. EMO begin with 2,479,093 trades on the NASD database and with 2,494,926 trades on the TAQ database and are able to match 96.85% of the trades on the NASD database to trades in TAQ. Before describing the matching results, it is interesting to note that the 3.15% error rate in matching trades (using a methodology that looks for matches in a 20-minute window centered on the reported execution time) exceeds the 1.8% trade-through rate (for trades) documented by the OEA using the 3-

second window for Nasdaq stocks. The table below is taken from the EMO study and documents the lag between trade execution and trade reporting.

Panel A of Table 8 in Ellis, Michaely, and O'Hara (1990) – Time Delay for Trades

Time Delay	Frequency	%	# with quote update in between	# with quote update in between as a percentage of trades with this delay	# with quote update in between as a percentage of all trades
-10 minutes	1,377	0.06	917	66.59	0.04
-1 minute	1,061	0.05	404	38.08	0.02
< -1 minute	6,569	0.28	517	7.87	0.02
Same time	61,088	2.59	0	0.00	0.00
1 second	292,260	12.41	14,418	4.93	0.61
2 seconds	146,342	6.21	11,641	7.95	0.49
3-14 seconds	315,858	13.41	44,363	14.05	1.88
15 seconds	743,896	31.58	81,967	11.02	3.48
16 seconds	636,182	27.01	76,778	12.07	3.26
17-60 seconds	133,335	5.66	20,398	15.30	0.87
1-10 minutes	15,896	0.67	5,035	31.67	0.21
More	1,720	0.07	1,078	62.67	0.05
Total	2,355,584	100.00	257,516		10.93

Perhaps the most important finding is that more than 64.99% of the trades in their audit-trail data are reported with delays in excess of the 8 second window used in the OEA's trade-through analysis. This suggests that using the SEC's most conservative approach, more than 65% of the trades in the EMO sample would potentially be matched to the wrong execution-time quotes! Indeed, 12.1% of the trades for which the matched trade in TAQ has an execution time that is 15 or more seconds after the execution time in the NASD's audit-trail data have quotes that change during the delay. This implies that at least 7.86% (64.99%

multiplied by 12.1%) of the trades in the EMO sample would have been matched to incorrect execution-time quotes using the OEA's most conservative approach! This is larger than most of the trade-through rates documented in the OEA trade-through study.

On page 3 of its trade-through analysis, the OEA seemingly acknowledges that the data used in its analysis is flawed when it notes that "the comparatively low ArcaEx trade-through rate (1.6% of the Nasdaq trades reported on the ArcaEx) likely reflects their electronic trading model that evaluates prices across markets and routes or executes orders accordingly." If one starts with the presumption that the ArcaEx electronic trading model precludes the possibility of trading through superior quotes on other markets, the 1.6% trade-through rate found by the OEA suggests their methodology is not even conservative (or appropriate) for all-electronic markets. Indeed, if we presume that 1.6% represents an error rate, then the lowest estimated trade-through rates on Nasdaq and the NYSE both may not be statistically different than zero.

Hendershott and Jones (2005) provide evidence regarding the delays with which trades on Island are reported to the TAQ database. Hendershott and Jones obtain a sample of time-sequenced messages of trade and quote activity from Island (i.e., ITCH data) for DIA, QQQ, and SPY during normal trading hours from August 16, 2002 through October 31, 2002. Hendershott and Jones try to match the Island trades in their ITCH database to corresponding Island trades in the TAQ database as follows. They begin with trades reported to TAQ by the Cincinnati Stock Exchange and by the NASD's Intermarket, the two trading venues to which Island reports its trades. They match trades by execution day, execution price, and execution size using time lags of 2, 3, 1, 4, and 5 seconds and are able to match 99% of the trades in the ITCH database to corresponding TAQ trades. While Hendershott and Jones do not provide a detailed description of the outcome of their matching procedure, it stands to reason that they had the most success using a 2 second lag, and then the 3 second lag, and so on. These results have two implications for the OEA's trade-through

analysis. First, the 3 second quote window centered on the TAQ execution-time is even inappropriate for all-electronic trading venues like Island. Second, the fact that 1% of the ITCH data are not matched to corresponding TAQ trades within 5 seconds of the TAQ execution time suggests that the most conservative window used by the OEA in its trade-through analysis does not even reduce to zero the possibility of spurious trade-throughs due to trade-reporting latencies on all-electronic trading venues.

As earlier noted, most trade reporting on the NYSE is done through the Display Book. Once a trade is reported to the Display Book, the data travel to the Exchange's Market Data System (MDS). The MDS validates the data and then forwards the information to the CTS. Bacidore, Sofianos and Ross (2003) note that for their sample of NYSE SuperDot orders taken from April of 1999, once a trade is reported to the Display Book it takes an average of 1.8 seconds for the execution report to arrive at MDS. Bacidore et. al. do not, however, measure the amount of time it takes for the execution report to travel from the MDS to CTS. NYSE crowd trades, for the most part, also report through the Display Book. The difference is the amount of time elapsing between the time the trade is consummated, say between two floor brokers, and its entry into the electronic reporting system. It can take quite a bit of time for trades executed on the floor to show up on the Tape. Among other things, Sofianos and Werner (2000) match the trade reports of NYSE floor brokers to trades reported by CTS. In an example, they show that a trade between two NYSE floor brokers had three different time stamps: one floor broker reported the trade executed at 9:36:00, the other reported the trade executed at 9:35:00, and the tape reported the trade occurred at 9:38:50. Consistent with this example, in unpublished work we examine a sample of limit orders for 5000 shares or more executed during the week of October 13, 2003 and are able to match only 56.55% of the trades in NYSE's SOD database to corresponding trades in the NYSE's TAQ database using lags of zero through ten seconds.

Peterson and Sirri (2003) examine SuperDOT system orders sent to the NYSE during two separate two-week periods around the NYSE's reduction in tick size from \$1/8 to \$1/16. They begin with orders

from all NYSE issues of common shares with corresponding CRSP data. After applying several filters, Peterson and Sirri attempt to match the remaining SuperDOT orders to corresponding trades in the NYSE's TAQ database. They note that the execution times in the SuperDOT database are the times that trades are reported to the Display Book while the TAQ trade times represent the times at which trades are reported to CTS. Peterson and Sirri find that the ***median*** timing delay is 2 seconds for their sample. While the authors do not present more details on the results of their matching analysis, the fact that the median SuperDOT trade is reported with a two second lag suggests that the three-second quote window used by the OEA in most of its trade-through analysis is inappropriate. Assuming the OEA's goal is to identify actual trade-throughs, a much longer quote window (or better data) must be used.

C. How volatile are quotes?

Our critique that the OEA's trade-through analysis is flawed because it does not adequately consider delays in reporting trades to the publicly available databases used in the OEA's study relies critically on the assertion that quotes change between the time trades execute and the time trades are reported. In this section of our comment letter, we present the results of an examination of quote volatility of Nasdaq and NYSE-listed stocks on October 16, 2003, one of the four trading days analyzed by the OEA in their trade-through study.

We begin our analysis by obtaining a file containing the average daily trading volume for all Nasdaq and NYSE-listed securities in September of 2003. We then obtain quote data for these stocks from the TAQ database for October 16, 2003. Next, we construct the National Best Bid and Offer for each stock throughout the day. We then conduct the following experiment. For each stock in our sample, we identify the National Best Bid price and the National Best Offer price prevailing at 10:00:00. We then compare these prices to the National Best Bid price and the National Best Offer price prevailing at 10:00:01. For each stock, if either the bid prices, the offer prices, or both the bid and the offer prices are different, we

conclude the stock's quotes first changed within one second of 10am. For those stocks with identical NBBO prices at 10:00:00 and at 10:00:01, we then compare the 10:00:00 prices to the NBBO prices at 10:00:02. For each remaining stock, if either the bid prices, the offer prices, or both the bid and the offer prices are different, we conclude that the stock's quotes first changed within two seconds of 10am. We continue this exercise until we have determined which stocks have not had a quote change between 10:00:00 and 10:01:30. We divide the NYSE-listed securities into quartiles based on their September 2003 average daily trading volume and plot the percentage of stocks whose National Best Bid or Offer prices change within 1 to 90 seconds of 10am on October 16, 2003 in Figure 1.[7]

[Insert Figure 1.]

From Figure 1 it can be seen that the 10:00:01 and the 10:00:00 National Best Bid or National Best Offer prices (or both) are different for 7.94% of the 617 most actively traded NYSE-listed securities. By the time five seconds have elapsed, 37.93% of the most actively traded NYSE-listed securities have had their National Best Bid price or their National Best Offer price (or both) change from their 10am values. By 10:00:30, more than 75% of the 617 most actively traded NYSE-listed securities have had their inside quotes change. Figure 1 also illustrates the association between trading activity and quote volatility for NYSE-listed stocks. For example, only 0.97% (4.55%) of the 616 least actively traded NYSE-listed stocks have National Best Bid or National Best Offer prices that change from within one second (five seconds) of 10am. The evidence presented in Figure 1 suggests that delays in reporting trades to publicly available databases are most likely to create apparent trade-throughs (where there are none) in the most actively traded stocks.

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[7]This analysis provides a conservative view of the association between delays in reporting trades and apparent trade-through rates since quotes are more likely to change after a trade is executed. A more careful (and time-intensive) analysis would follow Ellis, Michaely, and O'Hara (2000) and would examine quote revisions following trades. Since realized spreads tend to be far smaller than effective spreads, we expect that this analysis would show quote changes occur more frequently following trades.

[Insert Figure 2.]

Figure 2 reveals a similar story for Nasdaq stocks. Note that the 10:00:01 and the 10:00:00 National Best Bid or National Best Offer prices (or both) are different for 11.50% of the 835 most actively traded Nasdaq securities. While the most actively-traded quartile of Nasdaq stocks includes the Nasdaq 100, it also includes 735 less-actively traded stocks. Thus, it should not be surprising that a smaller percentage of Nasdaq stocks have quote changes within given time after 10 am than the percentage of the most frequently traded NYSE-listed securities with quote changes over the same time period. By the time five seconds have elapsed, 27.78% of the most actively traded Nasdaq securities have had their National Best Bid price or their National Best Offer price (or both) change from their 10am values. By 10:01:30, more than 76% of the 835 most actively traded Nasdaq stocks have had their inside quotes change. Figure 2 also demonstrates for the least actively traded quartile of Nasdaq stocks, perhaps the least actively traded stocks in the National Market System, delays in reporting trades are unlikely to materially affect trade-through rates estimated applying the OEA's methodology to publicly available trade and quote data. For example, only 4.20% of the 834 least actively traded Nasdaq stocks have National Best Bid or National Best Offer prices that change from 10:00:00 to 10:00:05. The evidence presented in Figures 1 and 2 suggest that delays in reporting trades to publicly available databases are most likely to create apparent trade-throughs (where there are none) in the most actively traded stocks. Interestingly, these results are consistent with the OEA trade-through study, which documents that trade-through rates decline monotonically in trading activity.

D. Conclusion

The eight second window beginning six seconds prior to and ending one second after a trade's reported execution time in the TAQ and Nastraq databases is not conservative. The fact that clock must be synchronized to within three seconds of the nuclear clock during the OEA's sample period suggests the most aggressive window used by the OEA should be a seven second window centered on the execution time

reported in publicly available databases. This, however, ignores the overwhelming academic evidence suggesting trades are reported with lags that are well in excess of three seconds. Nearly 65% of the Nasdaq trades in the Ellis, Michaely, and O'Hara (2000) sample have execution times in TAQ occurring more than 14 seconds after the trades are reported to Nasdaq. Our own work suggests that fewer than half of the limit orders for 5000 or more shares executed during the week of October 13, 2003 can be identified in the NYSE's TAQ database within 10 seconds of their reported execution time in the NYSE's SOD database. Most of the OEA's analysis uses a three second window that starts one second prior to and ends one second after a trade's reported execution time in the publicly available databases. Given the published academic research, it is very likely the use of this window significantly biases estimated trade-through rates upward. For example, even on the Island ECN the most frequent difference between the true (Island) execution time and the execution time reported in the TAQ database appears to be outside of the 3 second window.

In the third paragraph of their trade-through analysis, the OEA concedes that using publicly available trade and quote records to investigate trade-through rates can produce trade-through rates that are biased upward.

> "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-throughs. 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 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(s) we identify."

As noted above, we agree with the OEA that their methodology may overstate trade-through rates because of quickly changing quotes, system time lags, and data limitations. However, the OEA concludes that their data "show that the level and amount of trade-throughs is significant." We vigorously disagree. The academic literature suggests the OEA's methodology is very aggressive and has most likely arrived at trade-through rates that are grossly overestimated. The OEA's own analysis demonstrates that measured trade-through rates are highest in the most active stocks, which tend to have rapidly changing quotes, and on the trading venues where trade reporting delays have been documented to be most severe. With the data the OEA chose to use, we simply cannot conclude anything about actual trade-through rates.

Fortunately, as we argue in the next section, the audit-trail data necessary to provide significantly more accurate estimates of trade-through rates is currently used by market centers in producing the SEC mandated 11ac1-5 reports. As a result, trading venues should be able to respond to a request for these data promptly and with little cost. Given that the SEC required each of the venues trading NYSE-listed securities in 1996 to produce and provide audit trail data for their Report on the Practice of Preferencing (1997), precedence for such a request appears to have been set. In light of the estimated costs associated with the imposition of a trade-through rule and the potential for unintended consequences, we urge the OEA to revise their methodology and conduct a trade-through analysis using audit-trail data.[8] Since these data can be obtained with minimal cost and delay, and since it should not take the OEA staff more than a couple of months to conduct the analysis we propose in the next section, the benefits of analyzing audit trail data appear to dwarf the costs of making policy based on trade-through rates that may be grossly overstated.

II. Proposed methodology for a trade-through analysis using readily available audit-trail data.

[8] See Stoll (2000) for a thoughtful discussion of the tradeoffs involved in introducing new securities regulations.

In order to set the stage for the type of trade-through study we propose the OEA conduct, we briefly review another study conducted by the OEA using data we believe are necessary for a properly-done trade-through study. Section 510(c) of the National Securities Markets Improvement Act required the SEC to conduct a study of "the impact on investors and the national market system of the practice known as 'preferencing' on one or more registered securities exchanges." More specifically, the Act specifies that the study "include a consideration of how preferencing impacts the execution prices received by retail securities customers whose orders are preferenced; the ability of retail securities customers in all markets to obtain executions of their limit orders in preferenced securities; and cost of preferencing to retail securities customers." To comply with this requirement, the SEC did not simply analyze trades and quotes in the NYSE's TAQ database. Rather, the SEC obtained order audit-trail data from each of the regional stock exchanges for the four weeks from October 28, 1996 through November 22, 1996 and from the NYSE of the week of October 28 through November 1, 1996.[9] Presumably this was done to improve the integrity and accuracy of the analysis.

As suggested in the prior section of this comment letter, the primary benefit of using audit-trail level data is the elimination of the trade-reporting delays encountered when reporting trades from an executing venue to SIAC. The use of audit-trail level data was the key to establishing the frequency and the severity of the trade reporting delays documented by Ellis, Michaely, and O'Hara (2000) and others. The remaining latencies in trade reporting are the sole responsibility of the trading venues. To summarize, using

[9]The data that the SEC obtained are audit-trail level data. For example, the SEC states that "the NYSE data are taken from the System Order Database ("SOD") file;" the "BSE data are taken from the BEACON system" which "records the information about the entry and execution of market and limit orders;" the CSE data are taken directly from "six of the seven CSE preferencing dealers" and contain "orders and transactions information for those trades that execute on the CSE, as well as for unexecuted limit orders;" the PHLX data, obtained from the PHLX's market surveillance department, "consists of all electronically placed orders by brokers;" and the PCX data file "contains both order and execution information for orders received on both of the PCX's trading floors."

improved methodology (described below) to analyze audit-trail data would greatly improve the integrity of the OEA's trade-through analysis.

In 1996, the cost of complying with a request for several weeks of audit-trail data may have been nontrivial. As researchers, we had great difficulty obtaining these data electronically from those who were willing to provide it to us. For example, when Merrill Lynch agreed to provide us with audit trail data so that we could examine how their 1995 decision to reroute retail orders from the BSE and the PSX to the NYSE affected retail order flow, they sent us the NYSE data electronically but they sent the regional data in hard copy.[10] By the year 2000, however, most trading venues stored their electronic data in files that were relatively easy to transfer. Indeed, in their November 27, 2000 release adopting Rule 11Ac1-5, the SEC noted that all market centers currently retain basic order data, "such as the type and size of the order, the time of order receipt, the time of order execution, and execution price" and that many market centers were already sending their audit trail to independent companies to evaluated their execution quality. Fortunately, because each of the trading venues executing retail orders in Nasdaq and NYSE-listed securities currently must generate audit trail records to comply with Rule 11Ac1-5 (effective January 30, 2001), the marginal cost of providing audit trail records to the SEC for a careful analysis of trade-throughs is relatively small. Given the direct and indirect costs associated with the proposed trade-through rule and the possibility for unintended adverse consequences, we believe the SEC should obtain audit-trail data and conduct a second trade-through study using the modified methodology we describe below.

SEC Rule 11Ac1-5 requires executing venues to produce execution quality statistics with a lag not to exceed one month. Thus, executing venues are required to produce execution quality statistics for the month of January, 2005 no later than March 1, 2005. Given our evolving markets, we recommend the OEA

[10] See Battalio, Greene, and Jennings (1998).

obtain a sample of audit trail data from October 1, 2004 through January 31, 2005 from each of the executing venues analyzed in their December 15, 2004 study. The corresponding quote data needed for this analysis can be obtained from the NYSE's TAQ database. We encourage the OEA to analyze the entire four months of data to reduce the possibility that outliers drive results. For example, we have discovered that one of the four days used in the OEA's trade-through analysis, November 20, 2003, was a day on which Alan Greenspan gave a major speech that moved markets. If the OEA decides not to analyze the entire four-month sample, we recommend that they carefully sample days from within the four months from October 1, 2004 through January 31, 2005.

As noted by the OEA, their trade-through analysis involves the comparison of a marketable order's execution price to the quotes prevailing when the execution takes place. As noted earlier, in a world free from reporting delays, researchers could simply compare the execution price to the quotes prevailing at the time of an order's execution as reported in the audit-trail data to determine whether or not the order traded-through a superior quote elsewhere in the market. Assuming that the audit-trail data removes most, if not all, of the trade reporting latencies within market centers, we investigate the extent to which latencies in reporting quotes to the publicly available TAQ and Nastraq databases may introduce to our proposed trade-through analysis.

Version 2005-2 of the Nasdaq Quotation Dissemination Service's (NQDS) Data Feed Interface Specification, revised on February 8, 2005, notes in footnote 3 that "Nasdaq system clocks are synchronized to within two seconds of the National Institute of Standards and Technology (NIST) time as required by the NASD Order Audit Trail System (OATS) rules. In the Written Supervisory Procedures Concerning OATS Activity it states that "all computer system clocks and mechanical time stamping devices must be synchronized to within three seconds of the National Institute of Standards and Technology (NIST) atomic clock." These procedures appear to have taken affect for all Nasdaq orders subject to OATS reporting on

July 31, 2000. Thus, depending upon when the rule changed, quotes updates in Nasdaq stocks may be recorded with a three second error in the publicly available trade and quote databases used in the OEA's analysis. A regulatory bulletin issued by the Pacific Exchange dated August 23, 2002 states that in accordance with PCX Rule 6.20, "any trading or supporting electronic systems time clock used by Member Organizations must be synchronized to the NIST Clock or the USNO Master Clock" and that "the time synchronization must not deviate from the NIST or USNO Master Clock by more than three seconds at any time during a trading session." Presumably the other venues trading NYSE-listed securities are subject to similar rules.

The only published empirical evidence of delays in reporting quotes to the public of which we are aware is in Panel B of Table 8 in Ellis, Michaely, and O'Hara (2000). To produce these results, Ellis, Michaely and O'Hara examine the difference in the time-stamps for inside quote revisions on the NYSE's TAQ database and the NASD audit trail for quote revisions in 313 Nasdaq stocks that begin trading following their initial public offering between September 27, 1996 and September 29, 1997. Consistent with the hypothesis that participants in the Nasdaq market take their clock synchronization responsibilities seriously, the results of these comparisons (reported below) suggest that the trading venues providing quotes in the stocks analyzed by Ellis et. al. are typically not more than a couple of seconds away from the time assigned by SIAC to the quote updates. These results suggest that a seven second quote window centered on the execution time reported in the audit trail data would reduce most, if not all of the trades that would be falsely identified as trade-throughs if no quote window is used.

Panel A of Table 8 in Ellis, Michaely, and O'Hara (1990) – Time Delay for Trades

Time Delay	Frequency	%
More than - 10 minutes	420	0.1
- 10 minutes to -31 seconds	167	0.0
-5 to -30 seconds	120	0.0
-2 to -4 seconds	14,061	2.4
-1 second	69,990	11.8
Same second	391,431	66.0
1 second	60,635	10.2
2 to 4 seconds	51,259	8.6
5 to 30 seconds	4,021	0.7
31 seconds to 10 minutes	1,038	0.2
More than 10 minutes	202	0.0
Total	593,344	100.0

Before matching trades to execution-time quotes, we suggest the OEA apply the usual screens to the trade and quote data (see Bessembinder (2003)). The OEA should then match audit-trail execution reports to the appropriate execution-time benchmark quotes. Based on the preceding discussion, the appropriate benchmark quotes are the lowest National Best Bid price and the Highest National Best Offer price (and the lowest displayed depth at those prices) prevailing in the seven seconds centered on the time of the execution as recorded in the audit-trail data. Any trade for which the benchmark bid price equals or exceeds the benchmark offer price should be eliminated from the analysis since the failure of these two quotes to interact with each other during the entire seven seconds surrounding the audit-trail execution time suggests one or both of the quotes was not valid.

The OEA should examine each trade in their dataset and label a trade as a trade-through if the execution price is outside of the execution time benchmark quotes. After all trades have either been identified as trade-throughs or as non-trade-throughs, the OEA can compute trade-through rates for any subsets of trades they see fit. The OEA should identify the number of shares traded-through by taking ***the minimum*** of the number of shares traded and the number of shares available at the price that is traded-through. It is inappropriate to consider the volume in excess of the shares available at the traded-through price as shares traded-through since the firm quote rule only applies to ***displayed liquidity***.[11] Finally, it may be appropriate to measure the dollar cost of *an individual trade-through* that occurs when a market order is executed outside of the execution time benchmark prices by multiplying the number of shares traded-through by the absolute value of the difference between the execution price and the price of the quote that was traded-through.

There are, however, at least three reasons that it is inappropriate to aggregate this cost across all trade-throughs to arrive at a total dollar cost of trade-throughs as is done by the OEA in their trade-through study. First, suppose a bid price of $100 with a depth of 500 shares is traded-through by three 500 share trades each with execution prices of $99.95. The OEA's computation assumes that each of the three orders could have interacted with the 500 shares bid for at $100. This is clearly not true. Implicit in the OEA's analysis is the assumption that a second (and a third) bid to buy 500 shares at $100 would have arrived after the first (and the second) bid is hit. The OEA should consider each share that is traded-through only once. Second, the OEA's study fails to recognize that it is economically rational, in light of the volatility of the

[11] The OEA's high-end estimation of the losses arising from trade-throughs assumes traded-through quotes have unlimited depth. For example, assume that an institutional investor chooses to engage in a block trade to buy 10,000 shares at 10:00am at a price of $10.01 per share. If a second market displayed a limit order to sell 500 shares at $10.00 per share at 10:00am, the OEA estimates that the buyer incurred a 'loss' of up to $100. This is clearly not the case – only 500 shares were offered by displayed limit orders at $10.00 per share. The 'loss' to the buyer, if any, on this trade is $5.00.

equity markets, for an informed investor seeking the best all-in price for a large trade, to engage in a block trade and thereby avoid parceling out its order over an extended period of time. Third, and perhaps more problematic, is the implicit assumption in the OEA's computation that a retail investor is harmed and a professional trader is advantaged on every trade-through. This is clearly false. On the INET ECN, there are no intermediated trades. Thus, trading on INET is a zero sum game – for every retail investor that is 'harmed' by a trade-through there is a retail investor that is 'advantaged' by a trade-through. While ECNs are admittedly a limiting case, Harris and Coughenour (2003) find the NYSE specialist participates in only 8.3% of the shares traded for a sample of large stocks following the final decimalization of prices on January 29, 2001. Indeed, even Nasdaq market makers are unable to take the other side of every liquidity demanding order they receive because they must yield time and price priority to their limit order books.

III. Proposed methodology for a study investigating the economic welfare of traded-through quotes.

Implicit in the call for a rule prohibiting trade-throughs is the presumption that on-the-quote retail limit orders are economically disadvantaged by trade-throughs. Unfortunately, while a careful analysis of trade-throughs may reveal whether or not quotes (and on-the-quote limit orders) are traded-through, the existence of trade-throughs does not reveal whether or not the parties whose quotes are traded-through are economically disadvantaged.[12] To the extent that the motivation for the proposed Trade-Through Rule relies on the economic harm that trade-throughs impose on trading interests reflected in displayed quotes, we recommend the OEA conduct a study designed to investigate the economic costs that trade-throughs impose on displayed liquidity.

[12] An on-the-quote limit order is a limit order to buy (sell) shares at a price that equals or establishes the National Best Bid (the National Best Offer).

Since order submission strategies are endogenously determined, we cannot design a study that will definitively determine the economic costs that trade-throughs impose on displayed liquidity. We can, however, construct a study that focuses on the fate of on-the-quote limit orders that are traded-through. Specifically, we can determine how many of these orders eventually fill, how many of these orders are cancelled before filling, and how many expire without being filled. This analysis requires the 'readily available' audit-trail data described in the prior section from all market centers.

We would begin by identifying trade-throughs and the limit orders that were traded-through using the trade-through methodology proposed in the prior section. For the traded-through limit orders that were either filled or actively cancelled, we suggest computing the distribution of the time elapsing from when they are submitted and/or traded-through until the fill or the cancellation. If it is the case that traded-through limit orders fill relatively quickly after they are traded-through, on average, then the concern that 'isolated' limit orders are economically disadvantaged is lessened as the traded-through market would not have been permanently disadvantaged. Likewise, we might have a less negative interpretation of the trade-through if the traded-through limit order is cancelled quickly. This would be indicative of a market in which liquidity is fleeting, and a finding that liquidity demanders avoid fleeting quotes would not be surprising. Finally, we propose an analysis similar to that conducted by Harris and Hasbrouck (1996) for traded-through limit orders that expire unfilled or are cancelled several minutes after they are traded-through. This approach assumes that each traded-through limit order executes the minimum of the size of the trade-through and the number of shares requested by the traded-through limit order at the limit price. The opportunity cost imposed on the limit order trader of being traded-through is simply the profit earned assuming the position is unwound at the midpoint of the closing NBBO. The economic costs incurred by the limit orders that were traded-through and were subsequently unfilled can be estimated by aggregating their opportunity costs.

Two items in the above paragraph seem worth additional analysis. First, we would like to know how frequently the traded-through market is "permanently" disadvantaged. For example, if the trade-through was for one cent, then the traded-through market is "made whole" when the traded-through limit order fills. If the trade-through is for two cents, then both the limit order traded-though and any trading interest two cents better on the traded-through market must fill to make the traded-through market whole. For these, we might like to know if the trading interests below top-of-book eventually fill as well.

Second, we might wonder if there are reasons why the trading-through marketable order transacts where it does. Is there more depth behind the top-of-book? For a large marketable order, it might be better to ignore a penny better quote for a few hundred shares in order to get a large order done quickly rather than try to chase the small quote and risk losing the ability to fill the size desired. Is the traded-through quote displayed on a market with historically poor execution quality? If the broker has no confidence in the quality of the fill provided by some markets, then trading-through them might be more understandable. Does the traded-through market have high quality linkage making it easy to get the quote? Again, if the broker has no confidence that the quote is reachable, then trading through might be less objectionable. A similar statement could be made for quotes that "flicker" regularly. How does the broker know the quote will be there when an order is routed to such a market? An example of such an automated order routing system is that of Archipelago. In addition to considering the quote relative to other quotes, ARCA's system considers historical experience in obtaining the displayed quotes when routing to the market in question.

In summary, if the real reason for proposing the trade-through rule is to remedy the economic harm done to the limit orders that are traded-through, we believe it is imperative to conduct a study designed to examine the fate of traded-through limit orders. If these orders are usually filled quickly after they are traded-through, it is hard to argue they were made materially worse off. If the traded-through limit orders are quickly cancelled, the trade-through may have been justified. Only when the traded-through limit orders

remain unfilled for several minutes after they are traded through is there an opportunity for economic harm. We implore the OEA to investigate the frequency and the degree to which traded-through limit orders are economically disadvantaged before traded-through limit orders are used as the justification for a trade-through rule.

IV. Prices are not discovered by retail investors.

Implicit in the statement that institutions free-ride off of prices discovered by (retail) limit orders is the assertion that the displayed top-of-book limit order provides price discovery relevant to institutional investors. In this section of our comment letter, we discuss the large academic literature concluding that institutions play a dominate role in equity-market price discovery and argue that it is likely that the posted top-of-book limit order is free-riding off a larger displayed trading interest that is more relevant to institutional investors. We begin by summarizing the extensive literature investigating the relation between institutional trades and subsequent prices. This literature consistently shows that institutional trades typically have permanent market impact – they tend to move prices to new, permanent levels. Conversely, we argue that the trades of retail investors do not predict future prices. Next, we summarize the empirical work investigating the informativeness of quotes posted by the venues competing to trade NYSE-listed and Nasdaq stocks. Drawing from the market microstructure literature, we argue that the venues where prices are discovered are those where institutional orders, not retail orders, are routed. We conclude this section with a discussion of empirical work demonstrating that the best limit price is frequently a professional trader's order free-riding off a more substantial displayed trading interest (probably by an institution) and argue that the price where size can be traded is the price most relevant to institutional traders.

Researchers typically decompose trading costs into two components: explicit costs and implicit costs.[13] Explicit costs include direct trading costs that are relatively easy to measure, such as brokerage commissions and taxes. Implicit costs include the costs associated with buying at the offer and selling at the bid, price impact costs, and the cost of foregone opportunities. The price impact cost, which for an individual order is a measure of the difference between the transaction price and an estimate of the price at which the security would have traded had the trade of interest not occurred, typically is decomposed into temporary and permanent components. In their review, Keim and Madhavan (1998) note that the unperturbed price often is defined to be the previous transaction price or the prior day's closing price. The difference between the execution price and the estimate of the unperturbed price is the trade's *total price impact*. Researchers typically decompose the total price impact into two components by comparing the transaction price to an estimate of the new, post-trade equilibrium price. Keim and Madhavan (1998) define the difference between the post-trade price and the pre-trade price to be the *permanent price impact* while the difference between the transaction price and the post-trade price is defined as the *temporary price impact*. Intuitively, the temporary price impact is a measure of the price liquidity demanders must pay for immediacy, while the permanent price impact reflects the information content of the trade. For example, an investor seeking to buy 100,000 shares of XYZ stock will more than likely pay more than the National Best Offer price to get her order filled. Assuming XYZ is not one of the most actively traded stocks in the National Market System, the investor will be forced to make price concessions to elicit additional liquidity. After the trade is complete, liquidity suppliers replenish liquidity. They might be reluctant, however, to provide that liquidity at the same price at which they were willing to provide liquidity prior to the large trade. The fact that someone was willing to pay more than the offer price might suggest there is favorable

[13] See, for example, Harris (2003) and Kiem and Madhavan (1998).

information about the stock. The following example, taken from Keim and Madhavan (1998), illustrates how the total, temporary, and permanent price impact of a trade are computed.

Decomposing price impact into permanent and temporary components:

Example 2 from Keim and Madhavan (1998)

Suppose a trader sells a block at $97 and the pretrade price (e.g., the previous closing price) is $100. The price impact of the trade is -3%. If the posttrade price (e.g., the next day's closing price is $99, the total price impact can be decomposed into a permanent component (which reflects the information content of the trade) of -1% and a temporary component (associated with the discount demanded by the block broker to accommodate the trade) of -2%.

Early research, conducted before the advent of transaction-level data, demonstrates that the price impact of block trades increases in trade size and decreases in the liquidity of the stock being traded.[14] Both of these results appear intuitive. As formalized by Easley and O'Hara (1987), the larger a given trade, both in absolute terms and relative to average daily volume, the more likely it is that the trade is motivated by private information regarding the value of the underlying asset. More recently, Chan and Lakonishok (1995, 1997) examine the trades of 37 large institutional money management firms and find that the average permanent price impact (the average price change from the opening price on the day the order is initiated and the closing price on the day the order is completed) is nearly +100 basis points (bps.) for purchases and -35 bps. for sales. Consistently with earlier work, they find that the permanent price impact is increasing in trade size and is decreasing in the stock's liquidity.[15] In a careful study of large institutional orders arranged in the upstairs market between 1985 and 1992 obtained from a passive investment management firm, Dimensional Fund Advisors, Keim and Madhavan (1996) find that the permanent price impact ranges from

[14] See Kraus and Stoll (1972), Loeb (1983), Holthausen, Leftwich and Mayers (1987, 1990), and Gemmill (1996).

[15] Keim and Madhavan (1997) find similar results for institutional orders obtained from Plexus, a consulting firm that measures transaction costs, between 1991 and 1993.

160 bps. to 466 bps. depending on the choice of the pre-trade and post-trade benchmark price. They find the permanent price impact is smallest when the pre-trade (unperturbed) price is the closing price on the day before the trade and the permanent price impact is largest when the pre-trade price is the closing price three weeks before the trade. Keim and Madhavan attribute this difference "to information leakage arising from the process by which large blocks are shopped in the upstairs market." If this is true, then the authors reason that the estimates of permanent price impacts for block trades in other studies, which use the closing price on the day before the trade as the benchmark price, are downwardly biased. More recently, Chiyachantana, Jain, Jiang, and Wood (2004) obtain institutional trading decisions made in international stocks in 1997, 1998, and 2001 from Plexus and find significant permanent price impacts (using the closing price on the day before the trade as the pre-trade benchmark) ranging from between 31 and 45 basis points. To summarize, the empirical literature suggests institutional trading decisions have an economically significant permanent price impact on equity prices.[16] More generally, these results suggest that on average, institutions are informed traders.

Conversely, there is wide agreement both in the finance literature and in practice that retail trades do not predict prices (i.e., have low information content for the price discovery process). Beginning with Bernard L. Madoff Investment Securities in the early eighties, executing firms have been selectively purchasing and executing marketable retail orders at prices no worse than the prevailing order-receipt time National Best Bid (sell orders) or Offer (buy orders). Easley, Kiefer, and O'Hara (1996), Bessembinder and Kaufman (1997), Battalio (1997), Battalio, Greene, and Jennings (1997), Peterson and Sirri (2003) and others have shown that information-less retail orders in NYSE-listed stocks rarely are routed to the NYSE. Indeed, Battalio, Jennings and Selway (2001) cannot find a national discount broker that does not sell,

[16] These results are also consistent with work by Daniel, Grinblatt, Titman, and Wermers (1997), who show that mutual funds do exhibit some ability to pick stocks, work by Wermers (1999), whose results are consistent with the assertion that mutual fund herding speeds up the price adjustment process, and work by Wermers (2000), who provides empirical evidence supporting the claim that actively managed mutual funds add value.

internalize, or preference its order flow.[17] The information-less, retail orders are purchased, internalized, or preferenced by the NYSE's competitors, such as the regional exchanges and Nasdaq market makers. Conversely, approximately 85% of the NYSE's share volume is institutional. It is generally accepted in the finance literature that executing venues that purchase, internalize, or preference retail orders do so because these orders are information-less, which implies that market prices do not, on average, rise (fall) after retail buy (sell) orders arrive.[18] This allows the executing venues to earn, on average, one-half of the bid/ask spread when executing marketable retail orders.[19] Easley, Kiefer, and O'Hara (1996) and Bessembinder (1997) find trades routed to the NYSE have a significantly higher information content than trades routed away from the NYSE, and Chakravarty (2001) finds evidence suggesting institutional-sized trades executed on the NYSE are the trades that discover prices. Together, this research suggests that most (if not all) retail order flow is routed to trading venues pursuant to prearranged payment for order flow, internalization, or preferencing arrangements.

Since retail brokers typically route orders on a stock by stock basis, their limit orders also flow to trading venues that purchase, internalize, or preference orders.[20] This suggests that ECNs do not typically receive retail limit orders (unless they are placed there by purchasing, internalizing, or preferencing dealers), since ECNs do not take proprietary positions against incoming orders. Consistently with this

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[17]Payment for order flow occurs when a dealer or specialist pays a broker for certain types of orders. Internalization occurs when a broker also acts as a dealer for an order. Preferencing occurs when a broker routes orders to dealers independent of whether those dealers are quoting the best prices when the orders are routed.

[18]Barber and Odean (2000) "Individuals who hold common stock directly pay a tremendous performance penalty for active trading. Of 66,465 households with accounts at a large discount broker during 1991 to 1996, those that trade the most earn an annual return of 11.4%, while the market returns 17.9 percent. Battalio and Holden (2001) note that it is common for dealers that purchase, preference, and/or internalize orders to monitor the profitability of their order flow.

[19]Battalio, Selway, and Jennings (2001) verify this for Knight Securities, a large purchaser of order flow.

[20]Battalio, Greene, Hatch and Jennings (2000) demonstrate that retail limit orders in NYSE-listed stocks routed to internalizers of order flow on the Pacific and the Cincinnati Stock Exchanges and by purchasers of orders on the Philadelphia Stock Exchange are executed no less frequently than similar orders routed to the NYSE.

argument, Barclay, Hendershott, and McCormick (2003) find that trades on ECNs are more informative than trades with market makers for Nasdaq stocks. They attribute this result to the fact that "the market makers' preferencing and internalization agreements allow them to retain the less-informed retail orders."

Price discovery can occur through trading ('informed' investors trading to profit from perceived mispricing) or by traders willing to display trading interests in the form of quotes. In the preceding paragraphs, we argue that academic research clearly demonstrates that institutional-sized trades are the trades that discover price. Here, we argue that the markets centers dominated by institutions are the markets providing the lion's share of price discovery via quoting. Consistent with the assertion that retail order flow is information-less and institutional orders discover prices, Hasbrouck (1995) finds that a preponderance of quote-based price discovery for NYSE-listed securities takes place at the NYSE. In his sample, over 90% of the price discovery occurs on the NYSE. As institutions tend to dominate NYSE trading, this suggests that institutions dominate price discovery via quoting. These results are reinforced by Huang (2002), who examines the informativeness of quotes posted by market makers and by ECNs in Nasdaq-listed securities and finds ECNs post the most informative quotes. Huang attributes his results to the fact that institutional traders, market makers, and day traders place their proprietary orders on ECNs while retail order flow is routed to market makers. To summarize, it is well-documented in the finance literature that retail trades contribute little, if any, to the price discovery process and that the market centers dominated by institutional traders also dominate the price discovery achieved via quotes.

We also question exactly how many top-of-book, displayed limit orders discover price and how many are from retail investors. After the decimalization of U.S. equity markets, the problem of traders "stepping in front of" displayed trading interests increased. Battalio and Jennings (2002) study the frequency of pennying (both trading and quoting) after decimalization. Penny quoting is defined as the frequency with which an existing NYSE quote that is setting the NBBO is improved by a single tick. The

number of pennying quotes increases as time passes after decimalization, indicating that penny-jumping became a more widely-used practice as time elapsed following decimalization. Thus, the top-of-book price was less likely to be discovering price and more likely to be free-riding on an existing displayed trading interest. The tendency to be pennied increases somewhat as the size of the first-displayed quote increases. Of possibly more interest than the frequency of penny quoting is the source of the pennying quotes. As time passed after decimalization, more of the pennying quotes came from off of the NYSE floor (via system orders) and more of those orders were classified as principal rather than agency. This suggests that the top-of-the book is more frequently set by a professional trader free-riding off another quote in today's market than in the past.

V. Disclosure, competition, and the threat of regulation.

When passing Rule 11Ac1-5, which requires executing venues trading national market system securities to make available to the public monthly electronic reports that include uniform statistical measures of execution quality, and Rule 11Ac1-6, which requires brokers that route orders in national market system securities to reveal on a quarterly basis where they route customer orders for execution, the SEC stated that "by making visible the execution quality of the securities markets, the rules are intended to spur more vigorous competition among market participants to provide the best possible prices for investors."[21] Later, the SEC notes that these "rules should significantly improve the opportunity for public investors to evaluate what happens to their orders after they submit them to a broker-dealer for execution." Ultimately, "by increasing the visibility of order execution and routing practices," the SEC writes that these

[21] SEC Release No. 34-43590; File No. S7-16-00.

rules should “empower market forces with the means to achieve a more competitive and efficient national market system for public investors.”

In the reproposal of reg NMS, the SEC suggests that their attempts to empower investors have failed when they state that “customers, particularly retail investors, may have difficulty monitoring whether their individual orders miss the best displayed prices at the time they are executed.” Given the recent evidence by Boehmer, Jennings, and Wei (2005) suggesting that market centers producing superior (inferior) execution quality statistics attract more (less) order flow in subsequent months and given the scrutiny these statistics receive in the business press, this statement may be a bit premature. Given the apparent success of Rules 11Ac1-5 and 11Ac1-6, perhaps the SEC should include trade-through statistics in the 11Ac1-5 reports rather than pass a trade-through rule. It certainly would be cheaper. Our opinion, guided in part by our own empirical work, is that competition, disclosure, and improved technology (perhaps with the threat of regulation) can create a national market system that facilitates efficient transactions and allows brokers to obtain ‘best execution’ for their customers *without* the costs and the potential unintended consequences of increased regulation.

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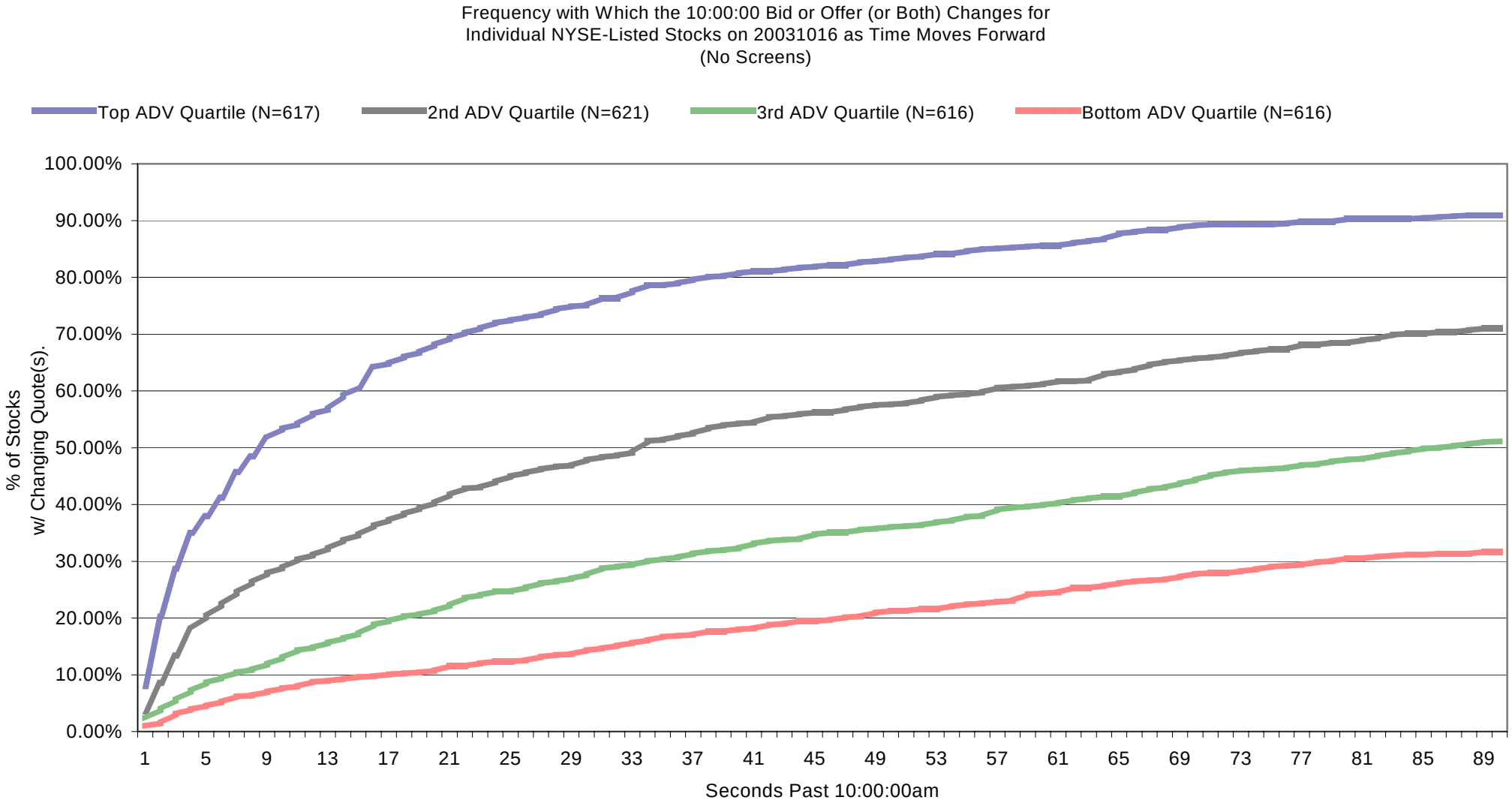
Frequency with Which the 10:00:00 Bid or Offer (or Both) Changes for
Individual NYSE-Listed Stocks on 20031016 as Time Moves Forward
(No Screens)
Top ADV Quartile (N=617)
2nd ADV Quartile (N=621)
3rd ADV Quartile (N=616)
Bottom ADV Quartile (N=616)
% of Stocks
w/ Changing Quote(s).
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
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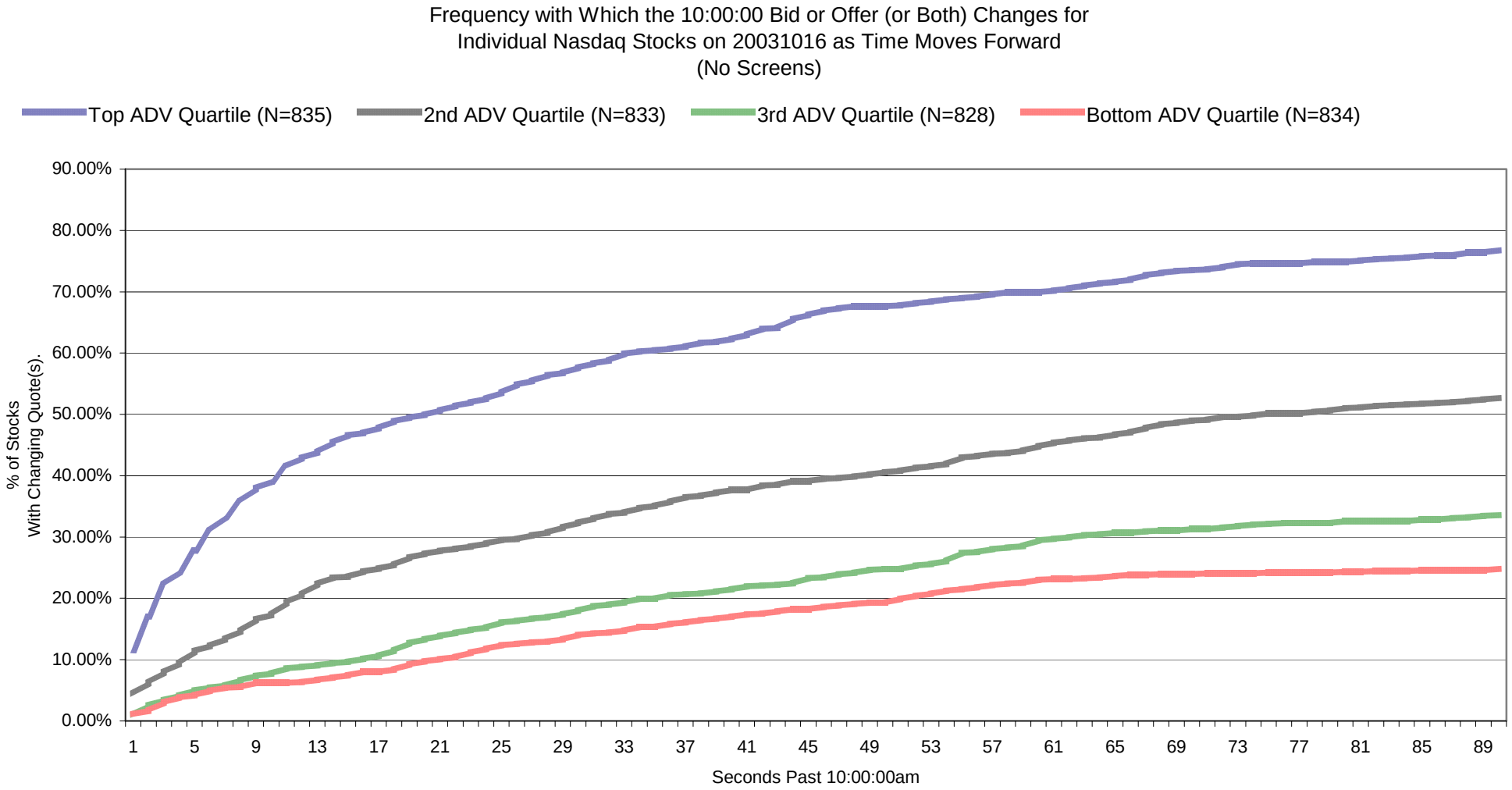
Seconds Past 10:00:00am

Figure 1

Figure 2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(No Screens)
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2nd ADV Quartile (N=833)
3rd ADV Quartile (N=828)
Bottom ADV Quartile (N=834)
% of Stocks
With Changing Quote(s).
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
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