Electronic Trading In the US Equity Markets:
Friend or Foe?
An Empirical Analysis of New Rules Adopted Under
Regulation National Market System

by

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Abstract

This thesis examines the impact of new regulations imposed by the SEC in the United States in 2007. The new rules attempted to improve competition among markets competing for equity securities and among orders through price protection measures. Both goals had the potential to greatly alter the efficiency of the stock market.

In particular, this thesis studies changes in quote competition, changes in trade aggressiveness, changes in trading costs, and changes in returns during the pilot phase implementation period of the new price protection measures. It assesses the impact of the new rules for both NYSE and NASDAQ pilot phase stocks subject to the new rules. NYSE stocks exhibit less quote competition and negative abnormal returns following the implementation of the new rules. Order flow for NYSE securities is also more fragmented among markets. NASDAQ stocks exhibit no change in quote competition, but decreasing trading costs following implementation. Order flow for NASDAQ securities is also more fragmented among markets.

This is an important topic and the results contribute to the literature in this field.

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1 Introduction

The purpose of this thesis is to examine aspects of the new National Market System (NMS) imposed by the U.S. Securities and Exchange Commission (SEC) on the U.S. equities market in recent years. The new regulations are intended to improve competition in the marketplace for equity securities by further automating the trading process. The SEC believed that the new regulations would increase competition among the various markets and among individual orders.

The need for new regulations was perceived as necessary to modernize and strengthen the technological infrastructure used to connect the regulated exchange market venues for competitive trading purposes. This structure favored the NYSE and the NYSE specialist and created barriers to entry for alternative market venues like electronic communication networks (ECNs) and NASDAQ market makers. For instance, the NYSE specialist was given a 30-second option to execute incoming orders, and was therefore able to assess quoting behavior in other markets, meet or beat the best price, and capture the trade. This gave the specialist a competitive advantage, and caused technical problems for electronic communication networks whose trading platforms required high speed execution and electronic access. To eliminate this inequity the SEC stipulated that only automated quotes are protected under the new rules, removing the advantage of the NYSE specialist in quote and trade competition.

In addition to the electronic connectivity issues, the new regulatory structure was perceived by the SEC as necessary because of an uneven application of the Order Protection Rule, which applied to NYSE/AMEX listings, but not to NASDAQ listings. The Order Protection Rule required brokers, dealers and other market makers to execute

trades at the best available price in the national market at the time of the trade, or to route trades to the venue posting the best price. To address this inequity, the SEC had two options. They could either eliminate the Order Protection Rule altogether or extend it to all listings. It was this aspect of the new regulations that created the greatest controversy. Even though two SEC commissioners and many market participants opposed the extension of the Order Protection Rule, the SEC proceeded with the extension and the new rule was equally applied to all equity listings as part of the new regulations.

It is likely that the effect of the new rules will significantly affect the trading environment. With improvements in electronic connectivity, it is foreseeable that competition for quotes and trades among market venues may increase, especially for NYSE listings, and could reduce the costs associated with trading. The speed of trading may also increase and innovations in market mechanisms, such as new order types and advanced algorithmic trading, may become more popular as electronic trading matures. On the other hand, there also exists the possibility that the Order Protection Rule may have unintended anticompetitive consequences and inhibit the competitive nature of the marketplace by dictating trade practices for all trades and traders. In addition, it is also possible that the role of the specialist is important for trade purposes and provides necessary market stability needed to moderate volatility. Furthermore, it is possible that the new regulations may cause dispersion, fragmenting the order flow, causing problems with the price formation process previously controlled and centralized on the floor of the NYSE. The existing literature points to some of these dilemmas. For instance, previous studies find that the centralized specialist market (NYSE) is relatively more efficient and cost effective than the NASDAQ market which is more dispersed (Christie & Huang

(1994), Huang & Stoll (1996), Laplante & Muscarella (1997)).

It is important to examine these matters for several reasons. As mentioned, the Order Protection Rule was highly controversial and many believed it was unnecessary. Many commentators argued that there wasn't sufficient empirical evidence to justify the need for order protection (Glassman and Atkins, 2005). It is important to add to the body of literature to provide the empirical results to support our understanding of the issues surrounding the new rules and the affect on trading and the marketplace. Perhaps more important is the issue of moving to a more electronic trading environment. For instance, it is likely that the speed of trading will increase as electronic trading grows in popularity, and without measures to stabilize the market (like an uptick rule or circuit breakers), highly volatile periods (such as the flash crash in May of 2010) will cause marketplace inefficiencies to occur. At present, few safeguards exist to prevent large swings in the marketplace. Finally, most of our society is affected by the level of efficiency of our modern day capital markets. It is important to examine the pros and cons of the electronic structure of the marketplace and the prevailing ideology regarding market efficiency in a more electronic environment to ensure that the interests of all market participants are safeguarded. After all, one of the market's primary functions is to provide a source of capital for corporate capitalization, and the efficiency of the price formation process is critical in determining the appropriate valuations.

This thesis will lead to additional future research possibilities. Many US firms continue to assess the viability of listing outside the US on foreign markets (Ellul, 2006). Our current regulatory structure does not have adequate provisions to protect investors outside of the US, and future regulatory changes may require global cooperation among

international markets, much like the process taken for the IFRS¹ accounting standards used in many global markets today. In addition, the regulatory structure does not fully accommodate the affect of using fast-order management systems and trading algorithms used by brokers, hedge funds, pension funds, mutual funds, proprietary trading desks, and other markets, on volatility. Finally, it is important to assess the affect of the new rules on trading costs as order flow becomes more fragmented across the various markets. These areas of research will present multiple opportunities for years to come.

This thesis focuses specifically on two of the most important objectives of the new regulations: 1) to balance the competitive powers among market venues (the exchange operations) competing for equity trades, and, 2) to balance and improve the price protection available to investors. The approach taken in this thesis is to examine changes in competition by examining quoting patterns, trading costs, abnormal returns, and volume for NYSE and NASDAQ listings involved with the pilot phase implementation period of the new rules. The SEC selected 100 NYSE listings and 100 NASDAQ listings to participate in the pilot phase program during the summer of 2007. This thesis examines before and after changes in quote competition and changes in trading costs for both the pilot phase samples as well as a matched sample of stocks, not subject to the rules. This thesis also examines market adjusted abnormal returns before and after the event date as well as long-term changes in volume among venues and among listings.

The investigation of the affect of these new rules on competition in the US equities markets continues in the following pages. Section 2 discusses the related

¹ International Financial Reporting Standards (IFRS) are designed to replace US national standards (GAAP: Generally Accepted Accounting Principles) in the near future.

literature; Section 3 examines the new rules in greater detail; Section 4 explains the testable predictions; Section 5 describes the data and sample construction; Section 6 describes the various tests and methodologies; Section 7 provides the results; Section 8 contains concluding remarks; and Section 9 discusses future research opportunities and final remarks.

2 Related Literature

2.1 Evolution of the Market Place

The structure of the market place has changed dramatically since 1975 due primarily to advances in electronic trading and to regulatory changes that support competition among markets. As a result, it is important to review the evolution of the operating environment and the regulatory changes as it concerns this thesis.

For instance, one could assume that a reference to the NYSE/AMEX/NASDAQ in the early literature was also a reference to a NYSE/AMEX/NASDAQ listing. This is not necessarily the case in today's market. In addition, in the early literature it was understood that each market had its own niche (the NYSE floor is auction based and the NASDAQ is dealer based), and each specialized in certain types and sizes of corporations. Historically, the NYSE has attracted the larger, more prestigious firms and the NASDAQ has attracted the smaller, less prestigious firms as well as the technology sector. To a degree, these differences still exist; however, increased competition and growth in the technology sector have improved competition for listings and the resulting trading costs paid by investors. The lines that differentiate the various markets are less distinct.

As mentioned, the NYSE exchange is a specialist/auction based market. The NYSE subcontracts to organizations that focus, or *specialize*, in firms listed on the NYSE market. These *specialists* have sole responsibility for making a fair and orderly market in the firms under their charge and frequently communicate with the firm's executives with respect to the performance of the stock. They create a direct link between the firm and the

marketplace. Although the specialists have access to an electronic trading system (SuperDot), floor based trading is considered manual. The NASDAQ market, on the other hand, is an electronic dealer market. There is neither a floor, nor a specialist with exclusive rights to sell the stock. The NASDAQ market is still an electronic dealer market, but it has evolved over the years in response to increased competition and fewer regulatory restrictions. Up until recently, the NYSE had changed very little. The NYSE held a monopoly for NYSE listings, and has lagged behind in electronic innovation relative to other markets in both the domestic and international markets.

An important transition that occurred in the market structure relates to the existing electronic connectivity, or trading platform used by the NYSE and by AMEX for competitive trading purposes. Prior to the new regulations studied in this thesis, the NYSE and the AMEX used an electronic platform called the Intermarket Trading System (ITS). This platform was frequently criticized as antiquated, and is partially to blame for creating the monopoly in NYSE listings by the specialists.² Other market venues found the ITS incompatible with their more sophisticated trading platforms and as result, were unable to fairly compete for NYSE listings.³

Another important change occurred in 1994 when the SEC passed new order handling rules which required NASDAQ dealers to recognize quotes posted by all NASDAQ market makers as well as quotes posted by the ECNs. As a result, the increase in competition for orders for NASDAQ listings improved the cost, speed, depth, quote

² See Opening Statement by SEC Chairman Donaldson, April 6, 2005.
<http://www.sec.gov/news/speech/spch040605whd-nms.htm>

³ See Comment Letter issued by Bloomberg
<http://www.sec.gov/rules/proposed/s71004/kbang012505.pdf>

competitiveness, and transparency of trading, and spurred innovation in trade services (Weston, 2002; Fink, Fink & Weston, 2006; Goldstein et al., 2007). Trade competition for NASDAQ listings is still extremely intense and innovative trading services continue to define and differentiate the various market venues competing for all listings.

2.2 Execution Costs

Early empirical studies focus on comparing trading costs⁴ between the NYSE, AMEX, regional exchange operations, and the NASDAQ market. Christie & Huang (1994) examine the change in trading costs for firms that choose to move their listings from the NASDAQ to a specialist system (AMEX and NYSE) and find average trading cost reductions of 4.7 cents per share for firms that moved from NASDAQ to the NYSE and 5.2 cents per share for firms that moved from NASDAQ to AMEX.

Huang & Stoll (1996) also employ a wide range of trading cost measures, including the quoted half-spread, the effective half-spread, and the realized half-spread (see Appendix G for a review of these empirical measures). In every measure, execution cost is higher on NASDAQ than on the NYSE. The quoted half spread averages 49.2 cents on NASDAQ and 25.8 cents on the NYSE. The proportional differences for the other measures are at least as great as the differences in the quoted spread. Van Ness, Van Ness & Hsieg (1999) compare 97 NASDAQ listed securities that trade on both the NASDAQ and Chicago Stock Exchange (similar to NYSE) and find that trading costs as measured by spreads are significantly lower on the Chicago Exchange.

LaPlante & Muscarella (1997) use an alternative approach to comparing execution

⁴ Computed, in this case, as the absolute difference between the trade price and the mid-point of the standing bid-ask quotes.

costs among venues by investigating block trades (large trades). They measure the price affect (also described in Appendix G) of block trades by assessing price movement following the trades and find a significant difference in the average price change in the two markets of 0.14% (0.32% on NASDAQ versus 0.18% on the NYSE). This difference results in extra costs to block traders of approximately \$157 million per NASDAQ firm on a present value basis. Keim & Madhavan (1996) also find similar results. The price affect on NASDAQ is significantly larger than comparable trades on the NYSE. Benston (2007) confirms that the higher spreads on NASDAQ are due to price affects. A few stocks with higher spreads (thinly traded, small capitalizations) cause the difference and these stocks are subject to higher price affects on the NASDAQ market, causing higher spreads.

Since the fall of 2001, SEC Rule 11Ac1-5 (Dash 5) has required US market venues to report various standardized measures of execution quality for orders below 10,000 shares in nearly all publicly traded securities. Compared with the traditional approach in the literature of estimating execution costs, order based information (like that provided in Dash 5) does not require the use of approximate algorithms to determine trade direction (i.e., an algorithm to determine whether a trade is a buy or a sell trade for instance) and the timing of benchmark quotes (for the purpose of matching trades to quotes for spread measurement purposes). In addition, Rule 11Ac1-5 requires venues to report the average order execution speed, or the period between order receipt and execution. Using the Dash 5 execution reports, Boehmer (2005) studies a sample of 2,000 common stocks from November 2001 through December 2003 and finds that small orders (below 2,000 shares) execute at a lower cost on the NYSE, but substantially faster on

NASDAQ. Boehmer (2005) also finds that this result reverses for larger orders between 2,000 and 9,999 shares. These execute more cheaply on NASDAQ, but faster on the NYSE. Thus, the difference between spreads on NASDAQ and the NYSE seems inversely related to the difference in execution speed. Boehmer (2005) further states that the observed negative relationship between spreads and speed is based on institutional differences between NASDAQ and NYSE. He argues that large NYSE market orders are likely to come from informed traders (those with inside information looking to take profits). As a result, the specialist executes large NYSE market orders against published quotes or limit orders rather than taking them for/from inventory and taking a possible loss. In contrast, small NYSE orders are likely to be uninformed (for portfolio rebalance purposes for instance), and the specialist has an incentive to improve on the price perhaps taking the order for their own account. This takes longer to execute but makes execution of small NYSE orders relatively cheap as discovered in the spreads. Boehmer (2005) also finds that for NASDAQ securities, large orders are not sent to the dealer. Instead they are usually split up and submitted to several execution venues as small orders, a practice known as shredding. Boehmer (2005) argues that this makes small NASDAQ orders risky for dealers, who respond with higher prices, as also discovered in the spreads (similar to what occurs on NYSE for informed traders). On the other hand, Boehmer (2005) finds that large orders sent to the NASDAQ market are generally uninformed (the dealer knows who is trading and why). As a result, dealers are willing to compete on price and may take trades for their own account. This takes more time (slows execution speed), but leads to smaller spreads as compared with large NYSE orders.

Consideration of speed, order size, and trader preferences provide a much more

sophisticated understanding of execution cost differentials between markets. Boehmer's (2005) analysis illustrates the necessity of further research to help explain trader preferences and competition among markets and the importance of considering alternative variables such as speed, innovation, and institutional differences among markets. What is unclear from the literature is how the new rules will affect the institutional characteristics, and how, if at all, these markets will respond to the new regulations as electronic connectivity evolves.

Although many of the studies discussed above document larger spreads on NASDAQ than on NYSE (at least for certain trade sizes), evidence does exist to the contrary. Jones & Lipson (1999) find that when firms are listed on NASDAQ, quoted prices adjust quite slowly to trades as compared to when they are listed on NYSE or AMEX. This is extremely important for measuring price affect. Price affect is calculated as the difference in quote midpoints immediately after a transaction to quote midpoints just before the transaction. After accounting for the time difference, they find that the price affect does not reliably differ across markets.

More recent studies find that average NASDAQ spreads are now comparable to average NYSE spreads; however, firms that switch their listings from the NASDAQ to the NYSE continue to experience excess returns. Jain & Kim (2005) examine the variables that determine a firm's decision to list, and find that the reputation of the market and investor recognition explain much of the resulting change in spreads.

Another angle in the literature is examined by Broom, VanNess & Warr (2007). They examine the microstructure effects of the QQQ⁵ Exchange Traded Fund (ETF) which underwent a listing change in 2004 from the AMEX to NASDAQ. They found that

⁵ The QQQ is the Nasdaq 100 Index Tracking Stock.

even though the ETF traded on both venues before and after the listing change, NASDAQ gained a substantial increase in order flow for QQQ at the expense of AMEX by quoting more aggressively. This resulted in a reduction in trading costs and consolidation in order flow (from nine exchanges to six)⁶, resulting in less fragmentation of the order flow for the QQQ. The dominant exchanges (NASDAQ, Island ECN, and Archipelago ECN) increased their total market share from 79% to over 96% of total volume. This change also caused a 32% increase in the Herfindahl Index, a measure of market concentration among exchange operations. The resulting reduction in trading costs is primarily attributed to the consolidation of the order flow. Other factors include reduced use of the Intermarket Trading System, and to revenue received by NASDAQ dealers obtained from trades reported to the consolidated tape⁷.

Recent competition by ECNs has improved spreads and execution costs as well as transparency for NASDAQ listings (Weston, 2002; Fink, Fink & Weston, 2006). In addition, recent NASDAQ technological improvements including the most recent switch to a single platform for trading in NASDAQ securities and other exchange listed securities may also improve execution costs on NASDAQ and thus its ability to attract order flow. Future research opportunities exist to explore the effects of these changes in market innovation.

2.3 The Changing Role of the Stock Market Specialist

It is expected that the recent growth in electronic trading will greatly affect the

⁶ NYSE, Boston and the Philadelphia order flow went to zero after the switch.

⁷ All market venues are eligible to receive a portion of the market revenues generated by the consolidated tape for trade reporting purposes. The allocation of revenues is based on the number of trades recorded by each venue. The new regulations also compensate the various markets for the number of quotes available on each market as well as trades executed.

volume controlled by the floor based specialist operations, especially for NYSE listings. Prior to the growth in electronic trading, early theoretical literature found that investors preferred to trade in specialist markets to reduce liquidity risk (Garbade and Silber, 1979). This line of thinking has changed significantly as technology and trading strategies have evolved. As now discussed, recent literature finds that the role of the specialist has diminished significantly and is necessary only when volume is low or when volatility is high.

An earlier study by Seppi (1997) examined order size and found that a hybrid system consisting of both a specialist and a limit order electronic market⁸ provides better liquidity to small retail and institutional trades, but a pure limit order market (like the Paris Bourse and most ECN operations) may offer better liquidity on mid-size orders. Nimalendran and Petrella (2003) compare the performance of a pure order driven market (similar to the NASDAQ market) combined with an electronic limit order book, to that of a combined specialist and limit order book. Nimalendran and Petrella (2003) find that the specialist/limit order book offers lower spreads, greater depth (quantity of shares at each price point), and lower price affects. In addition, they find that very thinly-traded stocks benefit more than active stocks from the adoption of a combined trading system both in terms of depth and spreads.

Venkataraman and Waisburd (2005) examine data from the Paris Bourse (electronic limit order market) and the reintroduction of a specialist for certain stocks. They find that electronic markets are not optimal for thinly traded securities (wider spreads) and that market quality in electronic markets can be enhanced by having a

⁸ A limit order market typically posts the 5 best bid and offer prices and the resulting depth at each price point. This is the model generally used by electronic communication networks (ECNs).

specialist. For instance, they find that the specialist resolves temporary imbalances in order flow and reduces investor price risk by increasing the likelihood that the trade will occur at a price closer to its fundamental value. They also document an increase in market valuation with the introduction of the specialist. Venkataraman and Waisburd (2005) also find that a number of electronic exchanges around the world have recently introduced specialists, or other dealers, to facilitate trading in their stocks.

Hill and Frino (2001) examine the London International Financial Futures and Options Exchange (LIFFE), the Sydney Futures Exchange (SFE), and the Hong Kong Futures Exchange (HKFE) to assess the changes in trading costs resulting from switching from an open outcry format (floor) to an electronic market. After controlling for price volatility and trading volume, spreads are lower under the electronic trading regimes. However, they also find that the bid-ask spreads become wider (more costly) in response to higher price volatility under electronic trading, relative to floor trading.

Goldstein and Kavajecz (2004) study the trading strategies of NYSE brokers by analyzing their choice of venue, order type, and timing during the turbulent October 1997 period. They found that the costs of the electronic limit order book (SuperDot) became very high (spreads are wide) and brokers withdrew depth from the book, opting instead for floor trading. The results reveal that the uncertainty caused brokers to change their behavior effectively shutting down the liquidity of the electronic book (SuperDot) in favor of the floor. Floor trading reached record transaction volume as a result. These findings are important for the viability of ECNs and electronic limit order books during turbulent periods as well as for regulation aimed at maintaining the orderly working of markets during crisis periods.

This thesis attempts to examine the changing role of the NYSE floor stock market specialist under new Regulation NMS. One aspect studied is an examination of the number of quotes that are the best quotes available in the system, but are unprotected (and therefore ignored) under the new regulations. In addition, a long-term analysis of volume since the start of the new regulations will reveal changes in the balance of competition among venues.

2.4 Trade Aggressiveness and Brokers' Duty of Best Execution

There is a possibility of obtaining an inferior price when a security can be traded on more than one market. When a broker agrees to execute a customer's order, the broker has a fiduciary duty⁹ of best-execution to execute the order at the best available price and to avoid **trade-throughs**¹⁰ and violations of price priority as prohibited under the Order Protection Rule (Rule 611 discussed in the next section). The execution of an order by a broker for a customer, smaller than the quote size at a price outside the best quotes violates the Order Protection Rule (also referred to in the literature as the trade-through violation), and can give rise to a trade-through complaint. Prior to the new regulations, the existing Order Protection Rule applied to NYSE and AMEX listings. Under the new regulations the Order Protection Rule is extended to include all listings, including NASDAQ listings.

Of importance in this thesis is not necessarily the issue of trade-through compliance, but rather the issue of trade aggressiveness as measured by the percentage of

⁹ Derives from the common-law agency duty of loyalty and obligates the broker as an agent to exercise reasonable care to obtain the most advantageous terms for the customer.

¹⁰ A trade-through is a trade made at a price outside of (inferior to) the best price available (outside the NBBO). For a sell trade, the price would be less than the bid price available. For a buy trade, the price would be greater than the ask (offer) price available.

trades occurring inside, outside or at the national best bid/ask spread. The national best bid/ask spread, better known as the national best bid and offer (NBBO), is the best bid (sell) price available and the best ask (or offer) price available in the national market. It is important to know if the new regulations do more to protect the interest of investors, or if on the contrary, the existence of such provisions actually allow for brokers and their associated dealers/specialists to gain a competitive advantage on investors. Since brokers are only required to ensure trades occur at the best posted quotes, there is little incentive for the dealers/specialist who executes the trades to transact at a better price inside the best posted quotes. Under the “old” system, the specialist had the option to stop the order flow, meaning that the specialist would guarantee the order at the best quoted price, but could improve upon it by trading inside the quotes (not by posting new quotes, but by trading within the quotes). It is not yet clear how this price improvement will occur under the new regulations when the specialist is ignored and limit orders establish the spread. As a result, it is possible that the new regulations may act to discourage quote competitiveness inside the spread especially for NYSE listings. For the NASDAQ listings, the Order Protection Rule and the trade-through provision is now a requirement for trading and as a result presents a unique opportunity to study the change in quoting behavior and trading costs as a result of the application of the new rules.

Blume & Goldstein (1991) studied trade aggressiveness for NYSE stocks traded through the Intermarket Trading System. They find that the NYSE had the best bid 86.94% of the time and the best ask/offer 84.40% of the time.¹¹ They also find that there is more price improvement (trades inside the best bid/ask quotes) on the NYSE than on

¹¹ Hasbrouck (1995) also studies NYSE price discovery using the thirty DJIA for the three-month period August through October, 1993. The results suggest the price discovery appears to be concentrated at the NYSE: the median information share is 92.7%.

other markets for NYSE listings. Overall, execution on the NYSE improves price by 0.79 cents per share over execution on a non-NYSE market. They also find that the average price improvement from trading on the NYSE varies according to the price of the stock and the size of the transaction. On a 100-share transaction of a 40-dollar stock, the price improvement on the NYSE is on average 1.5 cents greater than that on a non-NYSE market. In a later study, Bessembinder & Kaufman (1997) document that most trades in stocks listed on the NYSE, that are executed off the NYSE occur when the executing exchange is posting inferior quotes, indicating that the trade location is often determined for reasons other than the best quote. (This issue is explored in greater detail in the next section of the literature review: preferencing agreements.)

Bessembinder & Kaufman (1997) also find that traders pay higher average execution costs when trades are executed off the NYSE. The differentials in effective bid/ask spreads are moderate, averaging 0.05% of trade value for large-firm trades, 0.08% for medium firm trades, and 0.18% for small firm trades. The realized spreads¹², however, are two to three times larger for trades executed off the NYSE than for NYSE trades.

Stoll & Schenzler (2006) conduct an empirical analysis of trade aggressiveness on a sample of NASDAQ listings and a sample of NYSE listings over the period 1993 to 2001. Early in the sample period, they find that the percentage of trades occurring outside of the quotes was fairly small for both types of stocks (0.39% for NASDAQ and 0.16% for NYSE). When spreads narrowed in the late 1990's due to new order handling rules and decimalization, the percentage of trades occurring outside of the quotes increased

¹² Realized spreads capture the non-informational component of the effective spread and are calculated as the effective spread (actual cost of the trade) minus the price impact of trades (change in price due to order flow imbalance). These measures are more fully discussed in Appendix G.

significantly for NASDAQ listings (99.62% for NASDAQ vs. 1.33% for NYSE). Upon further investigation, they show that three features of the market mechanism cause these trade-throughs to appear in the NASDAQ data. First, reporting delays caused trades to appear outside the quotes even though they were not. Second, they found evidence of a dealer look-back option that caused trades to occur outside the quotes. The look-back option is held by the dealer who delays execution of incoming market orders and creates an option to trade at the original quote when the order first arrived or at the best quote after the order has been held. SEC regulations allow 2 minutes between trade execution and trade reporting (at the time of this study). Third, they found evidence of trades outside the quotes due to orders which exceeded the posted depth. As mentioned, there was no trade-through rule for NASDAQ securities, and large trades are regularly executed by one dealer at prices that trade-through the quotes of other dealers (as evidenced in the 99.62% of trade-throughs cited above).

More research is necessary to more fully understand the affect of the new regulations and nature of the current environment on trade-aggressiveness. This thesis studies changes in trade aggressiveness under the new regulations by assessing trades occurring inside, at and outside the bid/ask spread before and after the implementation of the new regulations around the pilot phase period of implementation.

2.5 Order Prefencing Agreements

Frequently brokers and dealers enter into agreements to purchase order flow. This practice increased dramatically in the late 1980s, to the point that the NYSE estimated that 35% of small trades were lost to these agreements and were tied to the growth and

popularity of the discount broker. A study conducted by NASD (1991) found that most payment for order flow agreements (which promised to match the NBBO) provided 1 to 2 cents per share for specific stocks, required a minimum order flow of at least 100,000 shares per month, and limited the acceptable transaction size (Easley, Kiefer & O'Hara, 1996). Lee (1993) finds that the practice began on a large scale in 1988, and grew dramatically in 1989 and 1990. Lee (1993) also notes that order purchase agreements also typically refuse limit orders, program trades, or any institutional orders.¹³ (Also see **Appendix E** for a current example of a preferencing contract.)

When competition for order flow among market venues is intense, preferencing agreements become a competitive mechanism to help dealers increase their volume and profits without having to directly compete for orders in the open market. Open market competition is beneficial as it allows for price improvement inside the NBBO by the specialists or by other market makers. Since orders executed under preferencing agreements do not interact with the market's order flow or compete on price, execution costs are generally higher (Easley, Kiefer & O'Hara (1996), Huang & Stoll (1996), Bessembinder & Kaufman (1997), Bloomfield & O'Hara (1998), Porter & Thatcher (1998), and Chung, Chuwonganant, & McCormick, (2004).

Although preferencing agreements are beneficial to the dealer, brokerage firms also benefit from these arrangements. These benefits include reduced search costs, faster executions, guaranteed fills, payments for order flow, and lower commissions. Discount brokerage firms are especially attracted to preferencing agreements since they generally reduce trade and search costs (Stoll, 2001). Since execution costs under preferencing

¹³ An excellent description of the regulatory changes that led to the development of this practice is given in Huang and Stoll (1996).

agreements are generally higher than that of open orders, these agreements are only beneficial to traders if the cost savings are passed along to them in the form of lower commissions.

Preferencing agreements are also affected by the trade-through provision. For NYSE and AMEX stocks, preferencing agreements were required to comply with the original Order Protection Rule. As already mentioned, NASDAQ securities were not required to comply. As a result, the NASDAQ market has experienced a higher trade-through rate than the NYSE market, and most researchers attribute this to preferencing agreements (Chung, Van Ness & Van Ness, 2002). It is important to note that even though the new regulations may reduce the number of trade-throughs on NASDAQ, an increase in competition among orders remains unresolved.

Another issue that relates to trader differences is whether the trader is informed or uninformed. A complication that has evolved in the literature is how one defines an informed/uninformed trader. Some papers define an informed trader as a block trader since larger trades tend to create more price affect than smaller trades. However, block traders may not be trading on information as much as they are trading for portfolio rebalancing purposes. More recent research finds that small trades (which could also be large trades that have been parceled out) are more informative in today's trading environment (Choe & Hansch, 2006; Goldstein et al., 2007). Informed traders generally prefer to trade in fully consolidated¹⁴ anonymous¹⁵ markets, so that they cannot easily be

¹⁴ Consolidated or centralized order flow means that orders are posted on a small number of electronically (at least) connected markets; as opposed to fragmented order flow where orders are posted across multiple markets with minimal connectivity.

¹⁵ Anonymous implies that the traders and the market makers are unable to identify each other's quotes. It is very difficult to identify who's who on most of the electronic markets. One can't tell if a quote is posted by a large institution, a hedge fund, or a small trader for instance.

identified, and can find the volume necessary to fill their order(s) as they attempt to take profits. Today's more integrated anonymous electronic markets favor informed traders. Uninformed traders, on the other hand, especially small uninformed traders that demand immediacy, are arguably the most vulnerable group of traders. They have the least amount of buying power and generally have to pay the bid/ask spread and incur transaction costs to execute a market order. By signing a preferencing agreement, small traders may find that some of their perceived risk declines. Preferencing agreements offer several benefits such as immediacy, payments for order flow, and reduced transaction costs. Although difficult to prove, order preferencing agreements may be just the right tool for balancing the costs of trade for small uninformed traders.

As already mentioned, several studies suggest that order preferencing agreements lead to higher trading costs (Easley, Kiefer & O'Hara (1996), Huang & Stoll (1996), Bessembinder & Kaufman (1997), Bloomfield & O'Hara (1998), Porter & Thatcher (1998), and Chung, Chuwongnant, & McCormick, (2004). According to Easley, Kiefer & O'Hara (1996), order preferencing seeks only to divert small, uninformed retail trades to the market sponsoring the agreement, leaving the larger, potentially informed trades that tend to be more expensive, to the NYSE to handle (Easley, Kiefer & O'Hara, 1996 call this cream-skimming). Evidence suggests that the brokers/dealers responsible for executing the agreements are able to make substantial profits, even after paying agreed upon rebates and other commission concessions to the brokers.

Easley, Kiefer & O'Hara (1996) developed a test of cream-skimming. They compare stocks traded on the NYSE with stocks traded on the Cincinnati Stock

Exchange¹⁶ and find evidence of cream-skimming (more expensive on Cincinnati). A second implication relates to the affect of these agreements as they grow in popularity. As more orders are diverted from the NYSE, the price formation process becomes less efficient allowing even greater profits to be made on trades executed under these agreements. They suggest that this practice has the potential of continuously diverting the amount of order flow, but that it is highly dependent on competition between dealers and the exchange operations in attracting order flow.

Some observers argue that preferenced order flow is collusive behavior that is designed to extract higher profits and eliminates incentives to quote aggressively as a method of competing (Godek (1996), Dutta & Madhavan (1997), Kandel & Marx (1999), Huang & Stoll (1996), Bloomfield & O'Hara (1998), and Klock & McCormick (2002). Dutta & Madhavan (1997) develop a game-theory model of dealer pricing to examine whether implicit collusion is possible in a dealer market. Their analysis suggests that collusion is possible and that it may be easier in actively traded stocks than in inactive traded stocks.

An experimental study by Bloomfield & O'Hara (1998) examines how order preferencing affects the competitiveness and efficiency of laboratory financial markets. Bloomfield & O'Hara (1998) state that order preferencing agreements violate the principle of time priority, which requires that orders flow to the first dealer quoting the best price. With preferencing, orders can flow to a dealer who agrees to match the best existing price. It makes sense that preferencing would act to increase spreads in dealer markets by reducing the incentive to post better prices. They found that preferencing does have a significant effect on market behavior. When preferenced orders are a large share of

¹⁶ Lee (1993) found prices on the Cincinnati Exchange were closest to that of the NYSE.

the market, or are received by virtually all market makers, collusion is more likely (and their experiments strongly suggest that it does occur).

Finally, Klock & McCormick (2002) examine dealer volume as a function of various measures of quoting aggressiveness and find that in less (more) competitive markets, increased quote aggressiveness has a lesser (greater) affect on market share. As a result, they argue that preferencing arrangements could be more harmful to public investors in markets where competition is weak.

In summary, although retail investors may pay more in the spread because of order flow agreements between brokers and dealers, they save in search and trade costs through rebates and payments for order flow agreements. Researchers recognize these tradeoffs, but find them difficult to measure. For instance, Easley, Kiefer & O'Hara (1996), Dutta & Madhavan (1997) and Chung, Van Ness & Van Ness (2004) all conclude that the costs associated with preferencing agreements are not easy to determine; however, if the revenues are passed along to customers (through a reduction in commissions, if not through prices), then these traders are better off. However, Hansch, Naik, & Viswanathan (1998) do find that preferencing reduces the transaction costs associated with costly search and trading relationships. Lee (1993), however, finds that investors whose orders are diverted are unlikely to be fully compensated for two reasons. First, unless enough traders exercise their right to direct orders, brokers are not compelled to pass on all the inducement benefits to investors. Second, even if all the inducement benefits are reflected in the commission structure, these savings are spread out across all investors, so investors who have their orders diverted still subsidize those who do not. Lee (1993) believes that the evidence suggests some investors (small traders) may be

better off not delegating the choice of a dealer to their broker. An investor could either direct an order to a particular location or “sell” this right by choosing a low-priced broker who does not allow location choices. In either case, the benefit of order flow inducements passes directly to the ultimate consumer. Lee (1993) states that these arrangements reflect the fact that order flows belong to investors, not brokers.

Although a lot has been discovered, it is still unclear from the literature whether order preferencing is harmful to investors. Order preferencing agreements allow brokers and dealers to negotiate competitive elements besides price in which to execute trades. Guaranteed execution of orders, lower commissions and trading costs, and payments for order flow can offset order flow interaction costs. Whether these funds are passed along to investors in the form of lower commissions is an important question.

Under the new Order Protection Rules, modifications to the pricing structure related to preferencing agreements concerning NASDAQ stocks may change, and could cause the percentage of trades outside the quotes to decline in favor of trades *at* the quotes. As seen in the literature, the NASDAQ market has traditionally had a higher trade-through rate than the NYSE market, and most researchers have attributed this to preferencing agreements (Chung, Van Ness & Van Ness, 2002).

In the future, electronic communication networks may help eliminate the need for preferencing agreements since they also offer low cost and quick execution in trades. In fact, it seems as though ECNs would provide traders with a superior option to trade. ECNs offer faster execution, lower commissions and the potential to obtain a better price. ECNs also offer payment for posting liquidity and anonymity. An important future research question is whether electronic trading is a substitute for order preferencing

arrangements.

2.6 The Literature on ECNs and Competition for US Equities

ECNs have grown dramatically since 1994 when the SEC instituted new order handling rules requiring NASDAQ dealers to take limit orders posted by ECNs into full account. Current estimates find that ECNs account for about 75% of the trading volume for NASDAQ stocks (Anderson & Dyl, 2007). Most ECNs are regulated as brokers, and many are owned or controlled by investment banks and brokerage houses. ECNs were one of the first to display the top-five best-buy-and-sell prices and quantities (depth of book), and they work by disseminating customer orders to third parties and dealers. Orders are typically executed within seconds on the ECN network, circumventing costly dealer/broker costs and commissions. ECNs are also capable of attracting new pools of liquidity both by providing affordable remote access to investors and by retaining unexecuted orders in a consolidated order book for possible matching with future orders (Jain, 2005).

The ECN environment differs from the legacy NASDAQ environment in which dealers are on one side of the transaction, and from floor-based specialists who buy/sell from their own inventory to balance client orders. The ECN environment also differs in the types of orders that get placed. In the traditional environment, *market orders* were the most popular order type; ECNs favor *anonymous limit orders*. The anonymous order feature has become extremely popular especially with large institutional investors (including the banks), hedge funds, brokers, and other traders.

Until recently, trading in NYSE and AMEX securities off-exchange never

materialized to any great degree due to access problems created by the Intermarket Trading System (ITS) and the original Order Protection Rule, i.e. the trade-through provision imposed by the SEC. As discussed, the ITS system was developed in the late 1970s and early 1980s to electronically link the NYSE, AMEX, and regional stock exchange operations and was primarily designed to assist with compliance to the trade-through provision. The market on the receiving end had up to 30 seconds to respond, giving them a 30-second option to execute ITS orders. ECNs, (which are automated) and match orders which are based on strict price-display-time priority, could not wait for execution by specialists in manual markets and usually refused to trade all stocks in which a specialist offered a better price. This is the main reason why NYSE listings have traded primarily on the NYSE market previous to the implementation of new regulations. Even before new the regulations, the SEC recognized the problems and tried to address these concerns by issuing exemptions to the trade-through rule (August 28, 2002; effective September 4, 2002). The exemption applied to three of the largest ETFs (DIA, QQQ,¹⁷ and SPY), and it allowed firms and trading venues to trade-through the NBBO by, at most, three cents (Hendershott & Jones, 2005). Now, the new regulations open the door for ECNs to compete more directly for all order flow by allowing ECNs to ignore all manually posted quotes and by dismantling the ITS.

2.7 ECN Execution Costs

Research on ECNs generally finds tighter quoted and effective bid-ask spreads, greater depths, and less concentrated markets for NASDAQ stocks (Weston, 2002; Fink, Fink & Weston, 2006). Several early studies focused on examining execution costs

¹⁷ Now QQQQ

following the new SEC order handling rules (1994) which required NASDAQ dealers to recognize quotes posted by all NASDAQ market makers as well as quotes posted by the ECNs. Barclay et al. (1999) assessed trading costs after the new rules and found quoted and effective spreads declined by approximately 30%. The reduction in trading costs is greatest for stocks whose spreads were relatively wide prior to the new SEC rules and among smaller trades. The incorporation of limit orders as required under the new rules and the consolidation of quotes on NASDAQ appear to have significantly narrowed the difference in trading costs for NASDAQ stocks.

In a more recent study, Nguyen, Van Ness & Van Ness (2007), analyze three exchange traded funds (ETFs) before and after new SEC order handling rules. They find that in the pre-order handling period, spread and fragmentation were not related. In the post-order handling period, however, fragmentation is associated with lower spreads: the additional competition created by the new order handling rules reduces trading costs. These results highlight the desirability of incorporating a limit order book in the markets' design. Wei & Bennett (2003), Sapp & Yan (2003), Weston (2000), Bessembinder (1999), Conrad, Johnson & Wahal (2003), Biais, Besiere & Spatt (2003), and Van Ness, Van Ness & Nguyen (2003) find strong evidence that the reforms improved competition on the NASDAQ, but they also document that a differential between the markets still exists. Even though differences continued to persist, the SEC's order handling reforms significantly transitioned the NASDAQ market to a more efficient, more competitive trading environment.

The new order handling rules also required the NYSE floor-based specialists to disclose public limit orders. Boehmer, Saar & Yu (2005) study the introduction of

NYSE's OpenBook service that provides limit order book information to traders off the exchange floor. They find that the specialist participation rate in trading declined following the introduction of OpenBook and that the specialists reduced the depth they add to the quote beyond that in the limit-order book. They also find that depth in the book increased somewhat following the introduction of OpenBook. Most of the increase, however, is in prices away from the current quote. They also find that effective spreads declined with the improvement in pre-trade transparency, and that costs incurred by traders decreased with the introduction of OpenBook. From the evidence, it is apparent that improvements in transparency lower transaction costs for investors.

Goldstein, Shkilko, Van Ness & Van Ness (GSVV, 2007) analyze a sample of 100 stocks that comprise the NASDAQ-100 market index in the second quarter of 2003 across four different market venues: NASDAQ (aka Super Montage), Archipelago, Island and Instinet. Overall, the ECNs' costs are lower than those on Super Montage, but they vary substantially across the three networks. Effective half-spreads on Island average 1.30 cents per share, followed by Archipelago with 1.23, and Instinet with 1.17 cents. Super Montage is the most expensive venue with an average effective spread of 1.35 cents. Thus, although ECNs provide the benefit of cheaper executions, the difference in costs among the ECN groups, are substantial. While ECNs charge their customers access fees¹⁸ that are not included in the data, they do not find that these fees substantially affect trading costs (the standard fee was only about 3 millicents). In addition, according to Shkilko, Van Ness & Van Ness (2008) access fees are often partly rebated to the liquidity

¹⁸ This is an important difference between ECNs and traditional dealers. ECNs make most of their money by charging fees, whereas traditional dealers make most of their money through the spread.

providing orders.¹⁹

Goldstien et al. (2007) also examine execution times. They find that market orders receive faster executions on the ECNs. An average market order takes only a half-second to be executed on Instinet, 2 seconds on Archipelago, and 7.7 seconds on Super Montage. When organized by order size, execution times increase. While market orders smaller than 500 shares execute in a time range from 0.3 to 1.7 seconds, market orders in the largest reported category take much longer, with execution times ranging from 1 to 32 seconds.

Other papers investigate the relationship between volatility and various measures of activity for ECNs. Hasbrouck & Saar (2002) obtained data from Island ECN and found that higher volatility is generally associated with a lower proportion of limit orders in the incoming order flow, a higher probability of limit order execution, and a shorter expected time to execution. In addition, they found that Island's market share for a given firm is positively related to the overall level of NASDAQ trading in the firm, and they document substantial use of hidden limit orders (submitter has opted to forgo display of the order). They also document that over one-quarter of the limit orders submitted to Island are canceled within two seconds or less. As discussed in their paper, the extensive use of these "fleeting" orders is at odds with the view that limit order traders (like dealers) are "patient" providers of liquidity.

Frijns & Schotman (2004) examine Island and Instinet ECNs and three dealers for 20 actively traded NASDAQ stocks with varying liquidity (volume). Their results suggest that volatility does not increase with the duration between quote updates and that longer

¹⁹ In addition to ECNs that offer rebates for adding liquidity to the book, regional and national exchange operations also engage in similar efforts.

quote durations lead to lower price discovery. In terms of price discovery they find that ECNs tend to dominate the liquid stocks, whereas dealers dominate the less liquid stocks.

Finally, the ECN literature has studied the affect automation has on the cost of equity capital. Although many firms are concerned with transparency of trading, cost of equity capital research finds that electronic trading lowers the cost of equity for listed firms due to improvements in liquidity and transparency (Jain, 2005). Jain's study examines the announcement and introduction dates of electronic trading by the leading exchanges of 120 different countries and finds that the decline in the cost of equity is 0.03% in dividend yields, 0.16% per month according to the dividend growth model, and 0.49% per month according to the ICAPM. In addition, he finds that the reduction is more pronounced in emerging markets than in developed markets. This study supports the notion that electronic trading enhances the liquidity and transparency of stock markets leading to a reduction in the cost of capital.

3 SEC Regulation NMS

The Securities and Exchange Commission was charged by the United States Congress (1975) to facilitate the establishment of a National Market System (NMS). Congress requested the SEC to use the opportunities created by electronic processing and communications technologies to strengthen the securities markets. The new rules adopted under NMS are important for furthering these objectives.

The recent changes to NMS were a result of mounting pressure from the marketplace on the SEC to equalize the regulatory structure which favored the traditional exchange operations as discussed previously. After several years of public debate and extended periods of public comments, the SEC finally adopted the new rules under Regulation NMS. The new rules were adopted in June of 2005 and gradually phased-in over the period October 2006 to October 2007, providing time to adapt to the new trading environment.

This section provides the implementation dates of the new NMS regulations, and an overview of the rules important to this thesis. It examines potential implications of the new rules, and reviews the dissenting opinions written by SEC Commissioners Glassman and Atkins (2005).

3.1 Implementation Dates

- October 16, 2006, the *Specifications Date*, was designated as the final date for the publication of technical specifications for those trading centers intending to qualify their quotations for trade-through protection under Rule 611 (Order Protection Rule

requiring trade-through protection) during the Pilot Phase and All Stocks Phase (as defined below).

- March 5, 2007 [originally February 5, 2007], the *Trading Phase Date*, was designated as the final date for full operation of compliant trading systems intending to qualify quotations for trade-through protection under Rule 611 during the Pilot Stocks Phase and All Stocks Phase (as defined below). The period from March 5, 2007 to July 9, 2007 was the *Trading Phase*.
- July 9, 2007, the *Pilot Stocks Phase Date*, was designated as the start of full industry compliance with Rule 610 and Rule 611 for 250 NMS stocks (100 NYSE stocks, 100 NYSE stocks, and 50 Amex stocks). The period from July 9, 2007 till August 20, 2007 was the *Pilot Stocks Phase*.
- August 20, 2007, the *All Stocks Phase Date*, was designated as the start of full industry compliance with Rule 610 and Rule 611 for all remaining NMS stocks. The period from August 20, 2007 to October 8, 2007 was the *All Stocks Phase*.
- October 8, 2007, the *Completion Date*, was designated as the completion of phased-in compliance with Rule 610 and Rule 611.

3.2 Overview of Rules 610 and 611

The Rule 610 (Access Rule) sets forth new standards governing access to quotations in NMS stocks²⁰. Rule 610 is designed to promote access to quotations in two

²⁰ The NMS encompasses the stocks of more than 5000 listed companies which represent more than \$14 trillion in US market capitalization. (Federal Register/Vol. 70, No. 124/Wednesday, June 29, 2005/Rules and Regulations, p. 37497)

ways. First, it enables the use of private linkages offered by a variety of connectivity providers to facilitate access to quotations (rather than dictating a collective linkage facility as was done under the Intermarket Trading System (ITS)). Second, Rule 610 generally limits the fees that any trading center can charge for accessing its protected quotations to no more than \$0.0003 per share. The purpose of the fee limitation is to ensure the fairness and accuracy of displayed quotations by establishing an outer limit on the cost of accessing the quotations.

The Rule 611 (Order Protection Provision) establishes intermarket protection to prohibit trade-throughs for all NMS stocks. A trade-through occurs when a trade executes at a price that is worse than a better price available on another market. The new rule replaces the trade-through provision that was set forth in the Intermarket Trading System (ITS) which applied only to NYSE and AMEX stocks and failed to distinguish between inaccessible, non-automated quotes and immediately accessible automated quotes. The goal of the ITS trade-through provision stated that markets should avoid trade-throughs and provide an after-the-fact complaint procedure.²¹ This provision did not, however, formally restrict the occurrence of trade-throughs. The new Order Protection Rule (Rule 611) incorporates an approach to trade-throughs that is much stricter than the previous ITS provision. First, it requires trading centers to enforce written policies and procedures that are reasonably designed to prevent trade-throughs; a trading center is required to regularly check the effectiveness of its policies and procedures and to take prompt action to fix deficiencies. Second, it only applies to accessible automated quotations. SEC Chairman William H. Donaldson recognized the rule's importance: "[Shortly after

²¹ Retrieved from Federal Register/Vol. 70, No. 124/ Wednesday, June 29, 2005/Rules and Regulations, p. 37501.

announcing our intentions] ... the major floor-based exchanges announced plans to significantly increase the volume of electronic trading in their markets. The profound affect that this development will have on established ways of doing business on the floor-based exchanges has perhaps been underappreciated in the debate over the trade-through rule.”²²

The Commission adopted the re-proposed market alternative that protects only the national best bids and offers (NBBO) of the self-regulatory organizations (SROs)²³ whose members currently trade NMS stocks. When an investor sends an order, the market can either execute the order at the best price electronically accessible in the national market system, or the market must route the order to the market that is quoting the best price. There are two important implications of this rule: (1) an investor should obtain the best quoted price electronically available in the market; and (2) an investor who places an aggressive limit order on the books will not be ignored in favor of a less aggressive order. In response to Rule 611 most market venues and brokers have designed specialized trade algorithms and new order types to help investor’s trade post-NMS.

Rule 611 includes a few exceptions to ensure that the intermarket price protection works as efficiently as possible. These include an intermarket sweep exception, which allows market participants to access multiple price levels at different trading centers – a particularly important function now that decimalization (trading in penny increments) has dispersed liquidity across multiple price levels. An ISO allows the broker/dealer to

²² Statement by SEC Chairman: Opening Statement at Commission Open Meeting of April 5, 2006, Re: Regulation NMS.

²³ Self-Regulatory-Organizations (“SROs”) include the following exchanges: American Stock Exchange; Boston Stock Exchange; CBOE Stock Exchange; Chicago Stock Exchange; International Stock Exchange; NASDAQ Stock Market, LLC; National Stock Exchange; NYSE and NYSE Arca, Inc.; and the Philadelphia Stock Exchange.

immediately route any incoming order identified as an ISO by first taking out any protected quotations at the NBBO and then completing the order at price points inferior to the NBBO. In addition, under the new rules if the order size is larger than the best-quoted size, the market maker must only transact at the best quote up to the size of that quote, after which the market maker can complete the order at prices inferior to the best quote. In this way, only the volume at the best quotes is protected under the new rules. All other quotes outside the best quotes are unprotected and unregulated under the Order Protection Rule. Since inferior quotes are not protected under the new rules, most market centers will tend to complete orders from quotes placed internally rather than from quotes placed on other market centers, even if better price points exist.

The intermarket sweep exception also enables trading centers to execute those orders immediately, without waiting for better priced quotations in other markets to be updated. In addition, Rule 611 provides exceptions for the quotations of trading centers experiencing a *material delay* in providing a response to incoming orders, as well as for *flickering quotations* with prices that have been displayed for less than one second. Both exceptions serve to limit the application of Rule 611 to quotations that are truly automated and accessible.

3.3 Several Affects of 610 and 611

Rule 610 eliminates the need for the Intermarket Trade System (ITS) previously used by the NYSE, the AMEX and the regional exchange operations. Each market venue has the flexibility to design, implement, and use the latest in technology in order to link to other venues in the marketplace for posting quotes and routing trades. The ITS dictated

the process for quoting and routing trades and as a result stifled innovative practices in the traditional markets. Under the new rules, each venue has control over its trade quoting and routing systems, and innovative services (i.e., specialized order types and full book matching techniques). Services can be used as competitive tools to attract and retain order flow. Rule 611 further specifies that in order for a quote to be considered for trading purposes, it must be immediately and electronically accessible. As a result, manual quotes, posted by the specialist, can be ignored for trade routing purposes. Finally, Rule 611 also equalizes the application of the trade-through provision to all national market stocks, including NASDAQ stocks. These two rules have radically changed the structure and design of the US equities market. The marketplace is significantly faster and more automated, benefiting those in a position to trade electronically.

3.4 Dissenting Views Regarding Rule 611

Although the new regulations were adopted, many market centers²⁴ as well as certain dissenting SEC Commissioners²⁵ (Glassman & Atkins, 2005) believed that Rule 611 (the trade-through provision) would be anticompetitive and create barriers to entry among market centers. Commissioners Glassman & Atkins examined several studies that assessed the affect of the trade-through provision. In particular, they cite a SEC study,²⁶ which documents overall trade-through rates on NYSE and NASDAQ of 7.2% and 7.9%, but point out that their study failed to account for the displayed quote size. In other words, an order was considered to have been traded-through at its full size even if the

²⁴ See <http://sec.gov/spotlight/regnms.htm> for several written responses to trade-through provision requirements established under new REG NMS.

²⁵ <http://sec.gov/rules/final/34-51808-dissent.pdf>

²⁶ SEC Release No. 34-51808 page 37507

order was for a larger number of shares than were available in the market. In addition, they point out that the original SEC study failed to account for two exemptions in the ITS trade-through provisions: (1) large block transactions (10,000 shares or greater) which account for about 50% of the trade-throughs and (2) 100-share quotations. When all of the corrections were factored in, trade-through rates dropped dramatically to 1.2% for NYSE and 1.9% for NASDAQ stocks. Although the SEC still seemed to believe that this amount is significant, Commissioners Glassman & Atkins point out that it amounts to less than 1/100th of one percent of the dollar value of trading on both markets.

In addition, Atkins and Glassman (2005) argued that the trade-through provision allows dealers to trap or tie up order flow by using the NBBO provision to prevent full competition among orders. In other words, the securities market is composed of multiple market centers, which as a result of the new rules, are not required to compete beyond the NBBO²⁷. Dealers are only required to match the best price, and competition beyond that is not necessary under the new rules. They argue that the structure and design of the new SEC provisions encourage greater competition among market centers than among market orders. As a result, the new provisions may encourage the use of questionable practices, such as preferencing agreements, to secure order flow from brokers and other large institutional traders. In fact, Atkins and Glassman (2005) argue it could even lead to collusion among dealers across markets to quote less aggressively thereby widening the NBBO available in the overall market.

Three very important points can be discerned from their paper. First, at the time of the SEC studies, the NASDAQ was not subject to a trade-through provision. The trade-

²⁷ Most international markets maintain one exchange operation to ensure the maximum competition among orders.

through rate, although slightly higher for the NASDAQ market, was not significantly greater than the NYSE trade-through rate. It is questionable whether a 0.7% difference is worth regulating the other (99+%) of the order flow. Second, these studies failed to recognize that trade-throughs can occur for multiple reasons. Perhaps there are other reasons for trading at inferior prices (most trade-throughs occurred within \$0.01 of the NBBO). Price is just one element in overall execution quality. Perhaps speed of execution, lower commissions, the likelihood of completion, order size and lower search costs drive the decision to pay a price inferior to the NBBO. Or perhaps market mechanisms such as delays in reporting and dealer look-back options can cause trade-throughs to occur (Stoll & Schenzler, 2006). Third, these studies failed to account for the potential that the trade-through provision may prevent full competition among orders and dealers may not have the incentive to compete inside the quoted spread to secure trades. These trades may actually be price-inferior as compared to what might have occurred when orders are free to compete across markets. In essence, the trade-through provision may actually have the opposite effect and increase transaction costs as opposed to the protection desired by the SEC to ensure an investor obtains the best available price.

Both new rules, Rule 610 and 611 are critical for moving the US equities market to an electronic format, and Rule 611 is especially critical as it removes the prior advantage of the specialist in tying up order flow on the floor and equalizes the application of the trade-through provision. After reviewing the literature and the specific information related to the new rules, it is clear that an examination of the affect of the new provisions is necessary to improve our understanding of the current market and its affect on market centers and traders. The next section outlines the proposed hypothesis

and the testable predictions.

4 Testable Predictions

The literature provides a framework for understanding many of the implications of the new regulations. This thesis examines, in particular, the changes in quote competition, trade aggressiveness, changes in trading costs (spreads and returns), and changes in volume as a result of the new regulations. As such, it adds to the body of literature that focuses on changes in quoting behavior and trading costs, and the changing role of the stock market specialist.

The null hypothesis is:

- **H₀. There will be no change in quote competition resulting in no change in trade aggressiveness, trading costs, returns, or volume following the pilot phase period implementation of the new rules.**
- **H_{A1}. Quote competition will decline, trading costs will rise, and returns will fall following the implementation of the pilot phase implementation of the new rules. Following the implementation of the new rules all NASDAQ listings are subject to the trade-through provision. Previous work suggests that the trade-through provision is anti-competitive leading to increased trading costs. In addition, the Rule 610 permits the electronic exchange operations to ignore slow quotes (the specialist) for trade-through compliance. Previous work indicates that the specialist has historically provided the best quotes and lowest execution costs for all NYSE listings. If the specialist is unable to compete for trades, market quality may decline.**
- **H_{A2}. Competition and market quality, including returns, will improve following the pilot phase implementation of the new rules. Previous work suggests that**

trades outside the best quotes are more prevalent for NASDAQ listings (Chung, Van Ness & Van Ness, 2002). Rule 611 requires all trades to be executed at the best available quotes. As a result, trading costs may decline and thereby improve market quality. In addition, previous work suggests that competition improves market quality when electronic markets are able to compete. For NYSE listings, the specialist had a competitive advantage preventing the electronic markets from directly competing for trades. Rule 610 allows the electronic markets to ignore the specialist and should therefore improve competition and market quality for NYSE listings.

5 Sample Selection and Data

A review of the sample construction and the data used in the analysis is discussed in the following paragraphs.

5.1 Sample Selection and Data

This thesis focuses on the period of time chosen by the SEC to conduct a pilot phase implementation of the new rules: event date Monday July 9, 2007. The stocks were selected by the primary listing market, in consultation with the SEC, to be “reasonably representative” securities of all listings. The stocks cover a wide range of industries, including technology, healthcare, restaurants, banking, retail, manufacturing, oil and gas, communications, utilities, transportation, pharmaceuticals, wholesale, insurance, real estate and services. The NYSE sample includes 55 large caps, 27 medium caps, and 5 small caps. The NASDAQ sample includes 3 large caps, 29 medium caps, and 62 small caps. As a result of the wide range of industries and the balance of firms i.e. their size characteristics, both samples are considered random and representative of the entire sample of firms within each listing.

For this thesis, the NYSE and the NASDAQ sample stocks represent the two main samples used to study the affect of the new rules. In addition, two control samples are constructed consisting of stocks not participating in the pilot phase study. The control samples are constructed by matching each pilot phase stock to a control stock based on industry, market capitalization, stock price, and average daily traded shares. The control sample is designed to check the robustness of the results of the pilot phase stocks. Additional details regarding the pilot phase stocks, as well as the control samples, are

presented in **Appendix A, B, C and D**. The Compustat database was used to identify firms for the matching sample based on the selection criteria defined above.

All stock quotes (bid and ask price quotes including size), trade prices, trade volume, the number of trades, and trade size are extracted from the New York Stock Exchange's Trade and Quotes (TAQ) database. The Bid quote is the sell price to the trader, (buy price to the market maker), and the Ask quote is the buy price to the trader (sell price to the market maker). The TAQ data base contains only the best quotes available per second. A total of 486,682,109 quotes and 81,251,618 trades are extracted from the database for all sample stocks. Only trades and quotes that are time stamped during regular NYSE trading hours (9:30 am to 4:00 pm) are used in the sample resulting in the elimination of 225,694 trades and 7,525,087 quotes from the sample. Although this is common practice in the literature, this thesis follows the practice primarily because of its focus on analyzing the affect of the new rules on the NYSE stock market specialist. As a result, the data of interest only occurs during regular trading hours. In addition, a total of 73,442 trades and 16,155,252 quotes were eliminated on the basis of several error filters. These error filters are also commonly used in the literature (Bessembinder, 2003; Chung, Van Ness & Van Ness, 2002; and Huang & Stoll, 1996). Several errors are easily identified in the TAQ database (TAQ Quote Codes 4, 7, 9, 11, 13, 14, 19, 20, 27, & 28) TAQ Quote Code 4 indicates a regulatory halt used when important news influencing the stock is disseminated. Trading is suspended until the impact of the news has been assessed. TAQ Quote Code 7 indicates an order imbalance, in either direction, where trading is temporarily suspended to prevent a disorderly market. TAQ Quote Code 9 indicates a regulatory halt used when the level of activity in a security creates a situation

where the exchange cannot disseminate the information quickly enough to reflect current market conditions. TAQ Quote Code 11 indicates a regulatory halt or delayed opening due to an expected news announcement. TAQ Quote Code 13 indicates a non-regulatory halt used when an event pertaining to one security creates a reaction in another security (e.g., a tender offer). TAQ Quote Code 14 indicates a non-regulatory halt used matters that affect the common stock of a company may affect the trading activities of other classes of stock for the same firm. TAQ Quote Code 19 indicates a regulatory halt used when news relating to one security affects trading in an associated security such as preferred stock. TAQ Quote Code 20 is the same as Code 19 but refers to expected news. TAQ Quote Code 27 indicates a regulatory halt or delayed opening used if more disclosure information for the security is requested by the exchange. TAQ Quote Code 28 indicates a regulatory halt or delayed opening if more disclosure information is requested for a related security. In addition, TAQ trade codes 2, 7, 8, 9, 10, 11, and 12 as well as codes A, C, D, N, O, R and Z²⁸ are eliminated. TAQ Trade Code 2 indicates a symbol correction which is out of time sequence. TAQ Trade Code 7 indicates the trade is cancelled due to error. TAQ Trade Code 8 indicates that the trade is cancelled. TAQ Trade Code 9 indicates that the trade is cancelled due to symbol correction. TAQ Trade Code 10 indicates that the record is cancelled (associated with 8). TAQ Trade Code 11 indicates and error record (associated with 7). TAQ Trade Code 12 indicates a correction record. TAQ Trade Code A indicates that all trading in that issue for the day is on a “cash only” basis. TAQ Trade Code C indicates a transaction which calls for the delivery and payment of securities on the same day the trade took place. TAQ Trade Code D indicates all trading in that issue for that day is for next day settlement only. TAQ Trade Code F

²⁸ See Appendix H for a detailed description of the TAQ trade and quote error filters.

indicates a trade that is exempt from Rule 611: trade-through provision. TAQ Trade Code N indicates the delivery of securities on the first business day following the day of the contract. TAQ Trade Code O indicates an opening trade that occurs in sequence but is reported to the tape at a later time. TAQ Trade Code R indicates that the delivery date is specified by the seller and must be between two and sixty calendar days following the day of the contract (but not the third business day after the trade which is considered regular). TAQ Trade Code Z indicates a transaction that is reported to the tape at a time later than it occurred and when other trades occurred between the time of the transaction report time. Overall, the quote codes result in 29 quote eliminations and the trade codes result in 73,428 trade eliminations.

Other practices in the literature (Bessembinder, 2003; Chung Van Ness & Van Ness, 2002) remove all price/size quotes and trades less than or equal to zero (8,949,372 quote eliminations, 14 trade eliminations) as well as all quotes with spreads (Ask price – Bid price) greater than 4 or less than zero (crossed) resulting from timing errors (7,205,851 quote eliminations).

Two additional filters are applied to TAQ data based on several new codes available as a result of the new rules. The first of these codes concerns the specialist quotes which are referred to as **slow quotes** (codes 5, 15 and 22 in the TAQ database)²⁹. The availability of these codes allows for an examination of the specialist during the pilot phase implementation period.

The second code now available in the database (code F as described in Appendix H) identifies Intermarket Sweep Orders (ISO), or trades that are exempt from trade-through compliance regulations. This code was not commonly used until the new

²⁹ See Appendix H for a detailed description of the TAQ codes.

regulations went into effect on March 5, 2007. This exemption to the trade-through provision allows brokers as well as exchange operations to legally trade outside the quotes without violating the inter-market trade-through rule (see Appendix F: Goldman, Sachs & Co. Policy Statement). Intermarket sweep orders (ISOs) are usually initiated by brokers trying to fill customers' large orders. Insufficient depth exists at the NBBO, and accessing additional price points is necessary to fill the order. In either case, the broker agrees to be responsible for best execution. Inferior quotes are not protected under the new rules; therefore, most market centers will access internal quotes first, even if better price points exist at other markets. These trades are not in compliance with the trade-through provision, so they are excluded from the trades file for analysis purposes.

Finally, the pilot phase implementation date (Monday, July 9, 2007) coincides with two other dates that may have an influence on the data and therefore, on the results. The first date of concern is the National Independence Day which occurred on Wednesday, July 4th of the previous week. The second date of concern is the previous Friday, July 6th, which marked the beginning of the elimination of the uptick rule related to short sale transactions. Since this study involves not only the pilot phase sample of stocks, but also the matching sample of stocks, any system wide variations as a result of the holiday and the elimination of the uptick rule, should be discernable in both samples.

6 Methodology

This section outlines the various tests to examine quote competition and trading costs, including returns, surrounding the pilot phase implementation period. As previously mentioned, the pilot phase implementation date is July 9, 2007 (the event date). In keeping with the practice in the literature (Hendershott and Jones, 2005), the pre-phase period of analysis includes 5 trading days prior to the event date and 5 days following the event date for a total of 11 days of analysis (event date is considered day zero).

6.1 Examination of Slow Quotes by Sample

Tables 1.1 through 1.3 describes the information regarding the median number of NYSE slow quotes and the median number of NYSE total quotes pre- and post- event for the NYSE pilot and NYSE matching samples. Q-Q plots for the file indicate the normality assumption is violated. As a result, median differences and related non parametric tests (the sign test and the Wilcoxon test) are used. (See Appendix I for details regarding the formulas and assumptions related to the various statistical tests used in this thesis.)

To capture changes surrounding the event date, three pre/post pairings are created. The first pairing compares medians during the period 5 days before and after the event date. The second pairing compares medians 3 days before and after the event date. The final pairing compares medians 1 day before and after the event date. In addition, the data for both the pilot and the matching samples is further divided into three time periods: from market open at 9:30 am to 10:00 am; from 10:00am to 3:30pm; and from 3:30pm

until market close at 4:00pm. Early empirical research on intra-day patterns finds high variance of returns at the beginning and at the end of the trading day (McInish and Wood, 1990 and Wood, McInish and Org, 1985). Foster and Viswanathan (1990) find a U-shaped pattern in the variance of price changes by hour of the day. Finally, Jain and Joh (1988), Foster and Viswanathan (1990), and Gerety and Mulherin (1992) find evidence of a U-shaped pattern in intra-day volume. Segregating the data, allows for an inspection of changes pre- and post-event within the three time slices. Since the beginning and the end of the day trading exhibits patterns of increased volatility unrelated to normal trading, the second time slice is considered more relevant for assessing the impact of the new rules.

6.2 Quoting Behavior

Table 2.1 through 2.16 describes the information regarding the quoting behavior during the pre-phase and post-phase periods. As mentioned, the TAQ quotes file contains only the best quotes that occur at each time stamp by venue. (The finest increment of time in the database is a second.) One complication that can arise in the database is the existence of multiple quotations from the same venue within the same second (time stamp), which raises the question as to which quotation is “in effect” moving forward. This thesis adopts the same convention as others in this line of research (Bessembinder, 2003), and recognizes the last quotation reported in the database as the quote going forward in time. The National Best Bid of Offer (NBBO) is then constructed at each time stamp. It is important to note that the best bid quote can come from one venue and the best ask quote from another. It is also possible to construct a negative, or crossed NBBO,

as a result of the construction and selection process.³⁰ In this study, 0.19% of the pre-phase NBBOs were crossed, 0.20% of post-phase NBBOs were crossed. To prevent negative quoted spreads in the sample, these NBBOs were dropped and eliminated for trade comparison purposes. See Appendix J Crossed NBBOs with Volume for more detailed information regarding crossed NBBOs.

Once the NBBO is established, changes in quoting behavior can be studied. To study quote competition, four pre/post pairings are created. The first pairing compares medians during the period 5 days before and after the event date. The second pairing compares medians 3 days before and after the event date. The third pairing compares median 1 day before and after the event date, and the final pairing compares medians 1 day before and the actual event date (day 0). As before, results are provided for three time slices (9:30am – 10:00am; 10:00am – 3:30pm; and 3:30pm to 4:00pm). During each pairing/time slice, the following information is assessed for both the number of quotes and for the volume in shares: 1) the percentage of time the quotes are at both the best bid and the best ask; 2) the percentage of time the quotes are at the best bid (but not best ask); 3) the percentage of time the quotes are at the best ask (but not the best bid); 4) the percentage of time the quotes are inside the best bid and offer; 5) the percentage of time the quotes are outside the best bid and offer; 6) the percentage of time the quotes are alone at both the best bid and ask; 7) the percentage of time the quotes are alone at the best bid only; and 8) the percentage of time the quotes are alone at the best ask only. These statistics are captured for the pre-phase period for each of the four samples, as well as the post-phase periods. The analysis will assist in interpreting changes in quoting

³⁰ Market makers in reality, however, are required to report each trade immediately after the transaction is complete in real time.

behavior as a result of the new rules during the pilot phase implementation period.

6.3 Trade Aggressiveness and Trading Costs

The new rules allow market centers to specify trades as being exempt from the trade-through provision and these trades can be identified in the database (F-trades). As a result of their easy identification, the four samples are further screened to separate these trades from the data before conducting any further analysis on the trades file.

Table 3.1 – 3.16 describes the total trade volume, trade size and average trade price for each sample during the pre-phase and post-phase periods, for each time slice and the four set of pairings (5-day pairings, 3-day pairings, and 2, 1-day pairings). These tables assist in observing changes in trade volume and trade activity during the sample period.

Table 3.1 – 3.16 also describes the trade competition and trade aggressiveness during both the pre-phase and post-phase periods. The various panels of the table include 1) the percentage of buy trades; 2) the percentage of sell trades; 3) the percentage of trades inside the NBBO; 4) the percentage of trades outside the NBBO; 5) the percentage of buy trades at the ask price; and 5) the percentage of sell trades at the bid price. As mentioned previously, the NBBO is constructed by selecting the best bid and ask quote available on the market (from all market centers) for each second. This analysis assists in understanding changes in trade aggressiveness as a result of the new rules. An increase in trade aggressiveness would provide evidence of an increase in competition as a result of the new rules.

6.4 Trade Execution Costs

Two measures are used to assess execution costs: the quoted half-spread and the effective half-spread. Spreads are stated in both absolute terms (\$ spreads) and percentage spreads since spreads may vary with the level of stock prices. For each stock-day, the mean quoted half-spread (\$ and %) and the mean effective half-spread (\$ and %) are determined. Following Bessembinder & Venkataraman (2007) the quoted half-spread, QS_{it} is defined as

$$QS_{it} = (Ask_{it} - Bid_{it}) / 2 \quad (1)$$

or as a percent:

$$\%QS_{it} = 100 * (Ask_{it} - Bid_{it}) / (2 * M_{it}) \quad (2)$$

where Ask_{it} and Bid_{it} are the posted NBBO ask price and bid price for security i at time t , respectively, and M_{it} , the quote midpoint or mean of Ask_{it} and Bid_{it} , is a proxy for the true underlying security value.

For many trades, the quoted spread is just a starting point for negotiations between buyers and sellers trading securities, and many trades occur at prices inside and also outside the posted quotes. For instance, orders may execute at prices inside the quotes when the specialist on the NYSE floor decides to improve on the quote (Ready, 1999)³¹.

In addition, quoted prices pertain only to the quoted depth; larger orders may need to “walk-the-book”, executing against limit orders at prices higher than the best quotes, leading to a weighted-average trade price outside the quotes. A better measure of trading costs when trades occur either *inside* or *outside* the quotes is the effective half-spread and

³¹ Electronic markets have *hidden limit orders* that are entered at prices inside the NBBO. The Nasdaq market recently disclosed that 20% of their order flow is non-displayed. Retrieved November 15, 2008 <http://www.nasdaqtrader.com/Trader.aspx?id=DarkLiquidity>

the percentage effective half-spread which is based on the actual trade price. The effective half-spread is calculated as:

$$ES_{it} = D_{it} * (P_{it} - M_{it}) / 2 \quad (3)$$

or as a percent:

$$\%ES_{it} = 100 * D_{it} * (P_{it} - M_{it}) / (2 * M_{it}) \quad (4)$$

where P_{it} is the transaction price for security i at time t , D_{it} is an indicator variable that equals one for customer buy orders and negative one for customer sell orders,³² and M_{it} is the midpoint used as a proxy for the true underlying value of security i at time t . The effective half-spread calculates the difference between the actual price and the true underlying value of the security. It can also be viewed as an estimate of the actual cost paid by traders and the gross revenue earned by liquidity providers. The D_{it} indicator variable is determined as follows: if the trade is more than the NBBO quoted midpoint $((\text{Bid} + \text{Ask})/2)$, the trade is marked as a buy. If the trade is less than the midpoint, the trade is marked as a sell. If the trade is at the midpoint, the trade is marked according to the tick rule: If the trade is above (below) the previous price, then it is a buy (sell). If there is no price change but the previous tick change was up (down), then the trade is a buy (sell) (Lee and Ready, 1991).

Then for each stock, a trade-weighted quoted spread and a trade-weighted effective spread is calculated following Chung, Van Ness and Van Ness (2002) and Stoll & Schenzler (2006). An average of all stocks is then computed for each day of the sample

³² Following Bessembinder (2003), trades are designated as reflecting customer buy or sell orders using the algorithm recommended by Ellis, Michaely, and O'Hara (EMO, 2000). As recommended by EMO and by Bessembinder (2003), trades are compared to quotes in effect at the trade report time, without any adjustment to time stamps to allow for possible reporting delays. Bessembinder (2003) tests his results by allowing for trade reporting lags ranging from 5 to 20s. (Lee and Ready, 1991, recommend a 5s delay.) Bessembinder (2003) reports that adjusting trade time stamps did not alter any of the conclusions reported and reports results based on a zero time-stamp adjustment.

period.

Tables 3.1 – 3.16 also describes quoted and effective spreads for each day of the sample for all trades subject to the trade-through provision. The pre- and post- differences are also assessed for the four pairings and for the three time slices.

6.5 Event Study of Returns Surrounding Pilot Phase Implementation Period

As an alternative test, an event study is conducted to assess wealth changes in NYSE and NASDAQ stocks that participated in the pilot phase period for trade-through compliance. An efficient framework to explore the effects of Rule 611 is the dummy-variable regression model introduced by Karafiath (1988):

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \gamma D_{i,t} + \varepsilon_{i,t} \quad (5)$$

$R_{i,t}$ = return to security i on observation t

α_i = the ordinary least squares (OLS) estimate of the intercept

β_i = the ordinary least squares (OLS) estimate of the slope or measure of systematic risk

$R_{m,t}$ = the return to the market on observation t

γ = the estimated coefficient on dummy variable $D_{i,t}$, or abnormal return to security i on observation t

$D_{i,t}$ = a dummy variable that is equal to one on observation n and is zero elsewhere

$\varepsilon_{i,t}$ = the residual for security i on observation t .

The equation developed above is estimated for the event period in a single step over the $T + N$ observations in the estimation period (100 days prior to the event period). The event period includes 15 days before and 15 days after the event date of July 9, 2007 for a total of 31 days. This procedure will provide results identical to the traditional two-

step method used by many researchers. Each $\gamma_{i,t}$ coefficient will be equal to the actual minus forecast value, or the abnormal return for each observation in the event period (Karafiath, 1988). An additional modification to the regression includes a correction for heteroscedasticity (when error terms have uncommon variances) using the Newey-West modification which maintains the least squares estimation but corrects standard errors to account for heteroscedasticity.

Output from the regressions includes all excess returns ‘AR_{jt}’ (the $\gamma_{i,t}$ coefficient for each observation). Similar to the Boehmer, Musumeci & Poulsen (1991) test statistic, the estimate used to determine the t -statistic is

$$t_{BMP} = A\sqrt{n} / s \quad (6)$$

where A is the average of the standardized abnormal returns (SAR_{it}) over each event day of n firms. The SAR_{it} is equal to the AR_{it} divided by (or standardized by) the standard deviation. The SAR is calculated for all firms (i) over all days in the event window (matrix of standardized returns). S is the standard deviation of the standardized abnormal returns. Event study methods that are based on using standardized abnormal returns outperform studies based on non-standardized returns (Kolari and Pynnonen, 2005), especially when volatility is a concern.

Traditional event study methodology assumes that the abnormal returns are not cross-sectionally correlated. This assumption is only valid when the event day is not common to the firms in the sample. If the event day is the same for all firms, a situation referred to as clustering is said to occur. Unfortunately, the event day is common to all firms in this sample, and several firms are within the same industry as well.³³ As a result,

³³ Brown and Warner (1980, 1985) show that even in the case when the event day is common, if the firms are not from the same industry, cross correlations reduce to zero. They also employ the market model

the test statistic above can understate the standard errors and can lead to severe over-rejection of no-event-effect when it is true (Type I error). In the event of a rejection, an adjustment to the Boehmer, Musumeci & Poulsen (1991) test statistic is necessary to account for clustering (Kolari and Pynnonen, 2005). This test statistic is defined as:

$$t_{\text{adj}_{\text{BMP}}} = t_{\text{BMP}} \sqrt{\{(1 - r)/[1 + (n - 1)r]\}} \quad (7)$$

where r is the average of the sample correlations of estimation period residuals. If the return correlations are zero, the modified statistic reduces to the original statistic.

Another complication to the regression occurs as a result of the mixture of trades occurring under regulation NMS. Regression results may be ambiguous as daily returns include both trades executed under the new rules as well as trades executed under exceptions like the Intermarket Sweep Order (ISO). If a large percentage of trades execute outside of Rule 611 (by using the ISO exceptions), regression results may not adequately reflect the effect of the trade-through provision. In addition, expectations for NASDAQ securities are even more difficult to discern than for NYSE securities due to conflicting effects. First, it is possible that NASDAQ securities experience positive abnormal returns as trades outside the quotes decline due to the use of preferencing agreements (previously executed at prices outside the best quotes). On the other hand, trades inside the spread may decline as a result of the trade-through provision. Regression results will help provide insight regarding the direction of the total affect of Rule 611 on NASDAQ securities. For NYSE securities, negative abnormal returns are expected since the specialists can be ignored under the new rules and trades inside the spread may decline.

to conduct the event study rather than the regression technique used in this study.

7 Results

7.1 Examination of Slow Quotes by NYSE sample

As mentioned, Q-Q plots indicate the normality assumption is violated. As a result, median differences and the related non parametric tests are interpreted. Non-parametric results are distribution free tests and are therefore used to determine the nature of the results. Mean results and t-tests for paired samples are provided in Appendix K. Tables 1.1 through 1.3 describe median results for the average number of slow quotes posted by the specialist and average number of total quotes (best quotes) posted by all market makers for both the NYSE pilot phase sample and the NYSE matching phase sample. Three data pairings (5-days, 3-days and 1-day) are created to compare data before and after the event date. In addition, three time slices are presented to track changes during the day and to isolate known volatility at the beginning and the end of the day. The first time slice is from 9:30 to 10:00am. The second time slice is from 10:00am to 3:30pm, and the third and final time slice is from 3:30pm to 4:00pm. Volatility during the beginning and end of day are generally higher. Start of day volatility is due to the nature of the price setting process including the incorporation of news and information since the previous close. End of day pricing is affected by hedge fund traders and other institutional traders who generally wait to place portfolio rebalancing trades at the end of the day. For this thesis, the second time slice is most relevant in inferring changes as a result of the new rules. This period of time is least volatile and if the new rules cause changes in quotes and trades, the second time slice is less apt to reflect confounding effects.

Table 1.1 provides the results for 5-day medians and resulting sign and Wilcoxon

tests for pilot phase and matching phase samples. Results for the pilot sample, 5-day pairings, indicate a significant increase in the average number of slow quotes posted during the second and third time slice only. In addition, results for the NYSE pilot phase sample, 5-day pairings, for the average number of total quotes indicates a significant increase in median results for all time slices. Results for the 5-day matching sample are the same as the pilot phase sample for both the slow and total quotes. As a result, it is unlikely that the increase in the average number of slow and total quotes in the pilot phase sample is due to the new rules.

Results for the NYSE pilot sample (Table 1.2), 3-day pairings, indicate significant increases in median results for both slow and total quotes (at the 5% level; the first time slice at the 10% level) The matching sample, 3-day pairings, indicate a significant increase in median results for both slow and total quotes, second and third time slice only. The first time slice indicates a significant result, but the medians are the same. This result may occur when there is a change in the distribution rather than a change in location of the median.³⁴ This situation arises in other tables, but is relatively infrequent in occurrence. In conclusion, the 3-day sample provides little support for an increase in the average number of slow quotes and total quotes in the pilot phase sample as a result of the new rules.

Results for the NYSE pilot sample (Table 1.3), 1-day pairing, with the exception of the median number of slow quotes in the third time slice, are not significant. Total quotes, on the other hand, reflect a significant increase. Similarly the matching sample, 1-day pairings, for slow quotes are not significant either (with exception of the Wilcoxon 3rd time slice). Total quotes, just like the pilot sample, reflect a significant increase.

³⁴ Mean results indicate an increase of 0.90 (t-test = 0.016 p-value; pre = 2.64 and post = 3.54).

In conclusion, the evidence does not support any conclusive changes in slow quotes or total quotes in any of the three pairings surrounding the event date related to the new rules.

(INSERT TABLES 1.1 – 1.3 HERE)

7.2 Examination of Quoting Behavior

Similar to the data distributions observed above, Q-Q plots for the quotes files indicate the normality assumption is violated. As a result, median differences and the related non parametric tests are interpreted. Again, mean results and related t-tests for paired samples are provided in Appendix K. Tables 2.1 and 2.8 describe the median results and non parametric tests for the NYSE pilot phase and NYSE matching sample for four pairings: 5 days, 3 days, 1 day (+1 to -1) as well as 1 day (+0 to -1). Tables 2.9 – 2.16 describe the median results for the Nasdaq pilot and Nasdaq matching sample for the four pairings.

As before, three time slices are presented to track changes during the day: 9:30am – 10:00am, 10:00am – 3:30pm, and 3:30pm – 4:00pm. Results for the second time slice are most important in assessing the affect of the new rules. To assess quote competitiveness, statistics related to the number of quotes relative to the NBBO are assessed. For instance, an increase (decrease) in the number at or inside indicates an increase (decrease) in quote competitiveness. An increase (decrease) in the number of quotes outside indicates a decrease (increase) in quote competitiveness. Both the number of quotes and volume at the quotes (depth) is assessed and compared.

NYSE Stocks (Pilot and Matching Sample)

Tables 2.1 and 2.2 describe the median results and non parametric statistics for the NYSE pilot and matching samples for the 5-day pairings. For the first time slice, the NYSE pilot phase sample indicates a significant decrease of 5.65% in the median percentage of quotes at the NBBO and a corresponding increase of 1.55% in the median percentage of quotes outside the NBBO (significant Wilcoxon). In addition, there is a significant decrease of 3.02% in the number of quotes alone at the NBBO and alone at the bid (sell price; 0.21%). Changes in volume follow similar trends. For instance, there is a significant decrease in the median volume at the NBBO (although a small change overall; 0.23%) and an increase of 1.59% in volume outside the quotes (approaching 5% significance i.e. Wilcoxon). There is also a significant decrease of 3.48% in the volume alone at the NBBO. Overall, statistical evidence exists to support the hypothesis that quote competition has declined during the earliest time slice for the 5-day pairings for pilot phase stocks.

Further support is found in the matching NYSE sample as described in Table 2.2. Results for changes in quote competition at the NBBO and outside the NBBO are not significant. Other results are mixed. There is a statistically significant decrease of 2.27% in the number of quotes alone at the NBBO, and alone at the ask (-0.04%). Volume at the NBBO decreased 1.71% (approaching 5% significance i.e. Wilcoxon), volume at the ask increased 0.39%, volume alone at the NBBO (-2.01%) and volume alone at the ask (-0.04%). In conclusion, statistical evidence supports declining quote competition during the first time slice for those stocks involved in the pilot, subject to the new rules; not as conclusive to the matching sample.

The second time slice (10:00am to 3:30pm) also reveals differences between the

pilot and matching phase sample. There is a significant decrease of 1.75% in the number of quotes alone at the NBBO and also a significant decrease of 4.86% in the volume at the NBBO. Matching sample results are almost all insignificant with the exception of a slight decrease of 0.74% in the number of quotes alone at the NBBO (approaching significance i.e. Wilcoxon), an increase (0.23%) in the volume of quotes outside (Wilcoxon only). Overall, there is more statistical support for a decrease in quote competitiveness in the NYSE pilot phase sample than evident in the matching sample for the second time slice.

For the third time slice, pilot phase sample, there is a significant increase of 1.39% in the number of quotes outside the NBBO. There is also a significant increase of 0.48% in the number of quotes alone at the bid and 0.23% increase in the alone at the ask. In terms of volume, there is a statistically significant increase of 1.56% in volume at the ask (buy) and volume alone at the bid (0.43%). However, matching sample results are much stronger. There is a significant decrease of 1.73% in the number of quotes at the NBBO, a significant increase of 0.84% in quotes at the ask (buy), and a significant increase of 2.16% in the number of quotes outside the NBBO. Volume results are similar (1.48% decrease in volume at the NBBO, 1.05% increase in volume at the ask, and a 2.95% decrease in volume outside the NBBO). In conclusion, matching sample results indicate a strong reversal at the end of the day not evident in the pilot phase sample. The matching sample indicates a statistically significant decrease in quote competition at the end of the day.

As stated, the second time slice is considered most relevant in assessing the affect of the new rules. For this time slice and pairing, quote competition has decreased for the

pilot phase sample; not evident in the matching sample.

(INSERT TABLES 2.1 – 2.2 HERE)

Tables 2.3 and 2.4 describe the median results and non parametric statistics for the NYSE pilot and matching samples for the 3-day pairings. Results are similar to the 5-day pairings. For the first time slice, the NYSE pilot phase sample indicates a significant decrease of 3.11% in the median percentage of quotes at the NBBO and a corresponding increase of 1.22% in the median percentage of quotes outside the NBBO. In addition, there is a significant decrease 3.46% in the number of quotes alone at the NBBO. Changes in volume follow similar trends. For instance, there is a significant decrease of 1.35% in the median volume at the NBBO and an increase of 0.36% in volume outside the quotes. There is also a significant decrease of 4.16% in the volume alone at the NBBO. Overall, statistical evidence existence to support the hypothesis that quote competition has declined during the earliest time slice for the 3-day pairings for pilot phase stocks. Further support is found in the matching NYSE sample as described in Table 2.4. Results for changes in quote competition at the NBBO and outside the NBBO are not significant. Other results are mixed. There is a statistically significant decrease of 2.87% in the number of quotes alone at the NBBO, as well as volume statistics at the NBBO (-3.21%), volume at the bid (+1.04%), volume at the ask (+0.94%), and volume alone at the NBBO (-4.01%). In conclusion, statistical evidence supports declining quote competition during the first time slice for those stocks involved in the pilot, subject to the new rules; not evident in the matching sample.

The second time slice also reveals differences between the pilot and matching phase sample. There is a significant decrease of 5.17% in the number of quotes at the

NBBO, a slight increase of 0.54% in the number of quotes at the bid, an increase of 0.55% in the number of quotes outside the NBBO, a decrease of 3.25% in the number of quotes alone at the NBBO, as well as a slight increase in the number of quotes alone at the ask (0.15%). Volume statistics also following a similar pattern. There is a significant decrease of 6.14% in volume at the NBBO, an increase of 1.03% in volume at the bid, an increase of 0.81% of volume outside, as well as a decrease of 2.32% of volume outside at the NBBO. Matching sample results are mixed. There is little evidence of a change in the number of quotes with the exception of quotes alone at the NBBO (-2.63%). Volume statistics for the matching sample, however, are more in line with the pilot. Volume at the NBBO decrease 3.67%, volume outside increased 0.59%, and volume alone at the NBBO decrease 4.00%. Overall, there is more statistical support for a decrease in quote competitiveness in the NYSE pilot phase sample, not evident in the matching sample.

For the third time slice, both the pilot phase sample and the matching phase sample show strong statistical support for declining quote competitiveness. However, the matching phase sample shows greater percentage change, or differences in the medians, to a greater degree than the pilot phase sample at the end of the day.

In conclusion, there is statistical evidence that the stocks subject to the new rules (the pilot sample) experienced a significant decrease in quote competitiveness during the 3-day matching time period of analysis. Matching sample stocks on the other hand, do not exhibit the same patterns until the end of the day, at which point the results are even stronger than the pilot. Second time slice results indicate a decrease in quote competition not evident in the matching sample.

(INSERT TABLES 2.3 – 2.4 HERE)

Tables 2.5 and 2.6 describe the median results for the 1-day (day +1 matched to day -1) pairings. Although similar to the 3-day pairing, it is evident that the strength of the results increases as the number of days' pairings increases, indicating that it takes a few days for traders to incorporate the differences created under the new rules. The pilot phase sample reflects decreasing quote competition, especially in the earliest time slice. The matching phase sample, on the other hand, is much stronger end of day. Further evidence of the time delay (that is, incorporating the affect of the new rules), is apparent in the fourth pairing (day 0 matched to day -1) in the tables 2.7 and 2.8. Very little change is evident between the pilot and matching phase sample.

(INSERT TABLES 2.5 – 2.8 HERE)

NASDAQ Stocks (Pilot and Matching Sample)

Tables 2.9 and 2.10 describe the median results and non parametric statistics for the NASDAQ pilot and matching samples for the 5-day pairings. For the first time slice, the NASDAQ pilot sample is not significant, with the exception of two small changes in volume. The volume at the bid increased 0.44% and the volume alone at the bid increased 0.29% (both significant i.e. Wilcoxon). For the matching sample, the number of quotes at the NBBO decreased 0.16% (sign test significant only) and the number of quotes outside the NBBO increased 0.03% indicating a slight decrease in quote competition during the first time slice. There are corresponding changes in volume as well. For instance, the volume at the NBBO decreased 1.95% and the volume outside the NBBO increased 0.20% also supporting an overall decrease in quote competition for the matching sample, not evident in the pilot for the first time slice. In addition, the number of quotes alone at

the NBBO increased 0.40% and volume alone at the bid and volume alone at the ask increased slightly (0.33% and 0.06% respectively).

For the second time slice, pilot sample, results are not significant. For the matching sample the number of quotes alone at the NBBO increased 1.46% and the corresponding volume alone at the NBBO increased 3.72%, both supporting an increase in quote competition not evident in the pilot.

The third time slice, pilot sample, shows more evidence. For the pilot, the number of quotes at the ask increased 2.4%, a corresponding increase of 0.46% in volume at the ask, and an increase of 4.93% in volume alone at the NBBO all reflect an increase in quote competitiveness for the pilot sample in the third time slice. For the matching sample, third time slice, there is a decrease of 1.03% in volume at the NBBO (sign test only), and there is a slight increase in volume at the ask of 0.89%.

Overall, the differences between the two samples are fairly weak, with the exception of the first time slice. There is clearly a decrease in quote competition related to the matching sample. NASDAQ pilot stocks are now subject to the trade-through provision under the new rules. Evidence in the first time slice for the 5-days pairings, indicates some stability in the quoting behavior not seen in the matching sample. Since the pattern reverses for the matching sample during the second time slice, it is unclear whether this difference is meaningful.

(INSERT TABLES 2.9 – 2.10 HERE)

Tables 2.11 and 2.12 describe the NASDAQ pilot and matching sample for the 3-day pairings. For the pilot, results are insignificant for the first time slice. Matching sample results for the first time slice indicate an increase of 0.86% in the number of

quotes at the NBBO (sign test only), a decrease (-0.04%) in the number of quotes outside the NBBO, a decrease of 2.83% in volume at the NBBO, a decrease of 0.63% in volume outside the NBBO and an increase of 0.28% in volume alone at the bid (sign test only). Overall, the matching sample indicates an increase in quote competition not evident in the pilot.

For the second time slice, the pilot sample results are also insignificant (with the exception of a slight decrease in the number of quotes alone at the ask of -0.23%, and a slight decrease of 0.09% in volume alone at the ask). Matching sample results are also minor. There is an increase of 0.70% in the number of quotes outside the NBBO a decrease of 0.14% in the number of quotes alone at the ask (Wilcoxon only) and an increase of 1.23% in the volume at the ask (sign only). Overall, there does not appear to be a significant difference in the samples for the second time slice.

For the third time slice, however, there are several significant results. The most relevant includes a decrease of 4.98% in the number of quotes at the NBBO for the pilot sample, with a simultaneous increase of 1.03% in the number of quotes outside the NBBO. Volume statistics for these particular variables are also significant. Volume at the NBBO decreased 1.39% and volume outside the NBBO increased 1.95% (significant sign test only). These results indicate that quote competition has decreased during the third time slice for the Nasdaq pilot phase sample, 3-day pairings. The matching sample, third time slice also has multiple changes. Similar to the pilot sample, there is evidence of a decrease in quote competition. The number of quotes outside the NBBO increased 0.78%. Volume at the NBBO decreased 3.66% and volume outside increased 1.78%. In conclusion, there are no statistical differences between the samples for the third time

slice.

Overall, the only major difference is evident in the first time slice and the strength of the results is more evident in the 5-day pairings than the 3-day pairings.

(INSERT TABLES 2.11 – 2.12 HERE)

Tables 2.13 and 2.14 describes the NASDAQ pilot and matching samples for the 1-day pairings (+1 to -1). For the pilot sample, first time slice, several statistics indicate a decrease in quote competition: the number of quotes alone at the NBBO decreased 4.78% (Wilcoxon), volume at the NBBO decreased 5.78%, and volume outside increased 1.95%. For the matching sample, none of the Wilcoxon results are significant. There is one sign test: the number of quotes alone at the NBBO decreased 1.01%. Overall, the pilot sample indicates a decrease in quote competition, not evident in the matching sample.

For the second time slice, pilot sample, the number of quotes at the NBBO decreased 3.74% and volume outside the NBBO increased 1.19% indicating a decrease in quote competition. Matching sample results also indicate a decrease in quote competition: a decrease of 2.64% in the number of the quotes at the NBBO, an increase of 1.47% in the number of quotes outside the NBBO, and a decrease of 6.67% in the number of quotes alone at the NBBO. Therefore, there is no evidence of a significant difference between the pilot and matching sample for the second time slice.

For the third time slice, most of the pilot phase results are not significant (with the exception of an increased in the number of quotes at the ask of 2.72%). (There is, however, a decrease in the number of quotes at the NBBO and an increase of 1.08% in

quotes outside the NBBO, but neither result in significant.) For the matching sample, third time slice, results indicate a decrease in quote competition. The volume at the NBBO decreased 7.26% and volume outside increased 2.72%.

In conclusion, there are significant differences in the start and end of day time slices between the pilot and matching sample for the 1-day pairing, however, there are no significant differences in the second time slice.

(INSERT TABLES 2.13 – 2.14 HERE)

Tables 2.15 and 2.16 describe the NASDAQ pilot and matching sample of the 1-day pairings using the event day as the post date rather than the day following the event date (+0 to -1). For the pilot phase sample, most of the results are not significant. There are a few, however, that lend slight support for a decrease in quote competition.

For the first time slice, pilot sample, the number of quotes alone at the NBBO decreased 1.338%, the number alone at the bid decreased 0.402%, the volume alone at the NBBO decreased 2.342%, and the volume alone at the ask increased 0.081%. The matching sample also shows some support for a decrease in quote competition. For the first time slice there is a decrease of 1.693% in the number of quotes at the bid and volume at the bid (-0.866%).

For the second time slice, pilot phase sample, there is a decrease of 0.268% in the number of quotes at the bid, a decrease of 0.701% in the number alone at the NBBO, and a decrease of 0.466% in the volume at the bid. For the matching sample, second time slice, there is a decrease of 0.964% in the number of quotes at the NBBO, (and volume of 0.939%) and a decrease of 0.221% in the number of quotes at the bid. In addition, there is an increase of 1.577% in the number of quotes at the ask, an increase of 0.369% in the

number of quotes outside the NBBO (as well as an increase in volume outside of +1.014%). Other significant results indicate a decrease of 3.517% in the number of quotes alone at the NBBO (as well as a decrease in volume alone at the NBBO of -0.802%), and a decrease of 0.078% in the number of quotes alone at the bid. Overall, both samples support declining quote competition, but the matching sample is stronger.

For the third time slice, pilot phase sample, there is a decrease of 1.534% in the number of quotes alone at the NBBO, and a decrease of 4.865% in the volume alone at the NBBO. For the matching sample, third time slice results indicate an increase in the volume at the NBBO of 2.652%.

The event date, 1-day pairing, results are inconclusive. The results do not suggest that there is a significant difference between the pilot and matching samples.

(INSERT TABLES 2.15 – 2.16 HERE)

Overall, the pilot samples indicate a decrease in quote competition during the first and second time slice. The matching sample is stronger at end of day, during the third time slice. In some respects, they are opposite each other which may reflect the differences between the two platforms. The electronic markets are limit order markets whereas the specialist market is an auction based market. If the specialist is no longer in control, the quotes posted for the pilot are more likely to be limit orders posted by electronic traders. It makes sense that the quotes posted for the pilot would be less competitive earlier in the day and more competitive at the end of the day when volume is strongest. Limit order traders play a different role than the specialist who has had the responsibility to step in when order flow is thin. The specialist is responsible for making a market for the stocks whenever necessary. Limit order traders have no such

responsibility.

7.3 Examination of Trade Aggressiveness and Trading Costs

NYSE Stocks (Pilot and Matching Sample)

Tables 3.1 and 3.2 describe the NYSE pilot phase sample and matching sample median trade statistics for the 5-day pairings. For the first time slice, the NYSE pilot sample indicates a significant increase of \$0.69 in the average median trade price (Wilcoxon only). In addition, there is a significant increase of 1.36% in sell trades (and a corresponding decrease of 1.36% in buy trades). Other significant trends include an increase of 1.22% in the number of trades outside the NBBO and a decrease of 2.12% in the number of buy trades at the ask. The quoted half-spread is wider (sign test only), but the % quoted half-spread is narrower (10% level). In these situations, the % quoted half-spread is more relevant for interpretation purposes. Neither effective half-spread is significant. Finally, there is a significant decrease (although small, 0.77) in the total volume available at the spread. Results for the matching sample, first time slice, are very similar.

For the second time slice, the pilot phase sample has many of the same significant changes as the first time slice. In addition, the second time slice indicates an increase of 2.01% for trades inside the quoted spread; however, the quoted spreads are wider (although not significant). Wider spreads would naturally cause the number of trades inside the spread to increase. Therefore, the increase in trades inside the spread does not necessarily indicate an increase in trade aggressiveness in this case. There is a decrease of 1.04 in volume at the quoted spread. Finally, the effective half-spread increased

\$0.000087 and the % effective half-spread increased 0.000104% indicating an increase in trading costs for the second time slice pilot phase sample. Matching sample statistics are very similar. In addition, the matching sample, second time slice, indicates a significant increase in the quoted half-spreads.

For the third time slice, pilot phase sample, there is a decrease of 8400 shares, an increase of 1.18% in the number of trades inside the spread. In addition, there is a decrease of 4.61% in the number of buy trades at the ask and an increase of 4.10% in the number of sell trades at the bid. For the third time slice, there is no evidence of a change in trading costs. Total volume, however, decreased 2.14 for the third time slice pilot sample results. Matching sample results are very similar to the pilot for the third time slice.

Overall, there is no evidence of a change in trade aggressiveness or in trading costs as a result of the new rules for the NYSE stocks 5-day pairings.

(INSERT TABLES 3.1 – 3.2 HERE)

Tables 3.3 and 3.4 describe NYSE pilot and matching phase samples for the 3-day pairings. For the pilot sample, first time slice there is a significant increase of 2800 in trade volume, an increase in the average trade size (up 8.5 shares), and an increase in the average trade price (up \$.060). In addition, there is an increase of 1.35% in the number of trades outside the NBBO and a decrease of 1.9% in the number of buy trades at the ask. There is a decrease of 0.33 in the total volume at the spread, and total trading costs measured by the quoted half-spreads (\$ and %) and effective half-spreads (\$ and %) are insignificant. Matching sample results for the first time slice are similar, however, there is a significant change at the 10% level in the quoted half-spreads (\$ and %) and at the

effective half-spreads (\$ and %) not evident in the pilot.

For the second time slice, the pilot sample results indicate an increase in volume and a slight decrease in the average trade price. There is a significant shift from buy trades to sell trades. The number of trades inside the NBBO increased 2.04%, the number of trades outside the NBBO increased 1.24%, and the number of buy trades at the ask decreased 2.86%. Total volume at the quoted spread decreased 1.64 and the effective half spreads (\$ and %) increased reflecting higher trading costs. Matching sample results for the second time slice are similar to the pilot. Both the quoted half-spreads (\$ and %) and the effective half-spreads (\$ and %) increased.

The third time slice for the pilot sample indicates a decrease in trade volume and a decrease in the average trade price. There is a shift from buy trades to sell trades. The number of trades outside the NBBO increased 1.05%, the number of buy trades at the ask decreased 4.75% and the number of sell trades at the bid increased 3.32%. Total volume at the quoted spread decreased and the effective half spreads (\$ and %) both increased, reflecting increased trading costs. Matching sample results for the third time slice are similar.

Overall results are similar to the 5-day pairings in that there is little evidence that the new rules have had an effect on the trading statistics for NYSE stocks surrounding the pilot phase implementation period for these stocks.

(INSERT TABLES 3.3 – 3.4 HERE)

Tables 3.5 and 3.6 describe the NYSE pilot and matching phase stocks for the 1-day pairings (+1 to -1). For the pilot sample, first time slice, there are no significant

results (other than some descriptive changes). For the matching sample, first time slice, there are some important differences. The number of trades outside the NBBO increased 1.08% and there is a corresponding increase in the effective half-spreads (\$ and %) indicating an increase in trading costs.

For the second time slice, pilot phase sample, there is a significant increase of 0.92% in the number of trades outside the NBBO, a decrease of 2.91% in the number of buy trades at the ask, and an increase of 1.64% in the number of sell trades at the bid. Total volume at the quoted spreads decreased 1.49, and the effective half-spreads (\$ and %) increased, reflecting increased trading costs. The matching sample, second time slice is similar. Trading costs, as measured by the effective half-spreads (\$ and %) increased.

For the third time slice, results for both the pilot and matching sample are similar.

Overall, the first time slice does indicate some differences, but the second and third time slices are similar. In summary, the differences from the pre to the post period do not appear to be the result of the new rules.

(INSERT TABLES 3.5 – 3.6 HERE)

Finally, tables 3.7 and 3.8 describes the NYSE pilot and matching samples for the 1-day pairings (+0 to -1), using the event day. For the first time slice, pilot sample, most changes are not significant. Matching sample results, however, are stronger. There is a significant increase in the trade volume, trade size and trade price. There is an increase in the number of buy trades and a decrease in the number of sell trades. In addition, there is an increase of 2.95% in the number of buy trades at the ask and a decrease of 2.97% in the number of sell trades at the bid. Total volume at the quoted spread increased 0.15;

however, changes in trading costs (spreads) were not significant.

For the second time slice, pilot sample, most results are not significant. Matching sample results are also uneventful.

For the third time slice, pilot sample, there is an increase in the average trade price and an increase of 0.74% in the number of trades outside the NBBO. Spreads are not significant. The matching sample results are similar.

Again, other than the first time slice, the results are not significantly different from pilot sample to the matching sample stocks.

(INSERT TABLES 3.7 – 3.8 HERE)

NASDAQ Stocks (Pilot and Matching Sample)

Tables 3.9 and 3.10 describe NASDAQ pilot and matching sample stock results related to trades for the 5-days pairings. For the first time slice, pilot sample, there is a decrease of 1.93% in the number of buy trades at the ask and an increase of 2.41% in the number of sell trades at the bid. There is also an increase in the bid volume at the quoted spread of 2.26% and a corresponding decrease in the ask volume at the quoted spread. Trading costs as measured by the spreads are not significant. Results for the matching sample, first time slice, are similar.

For the second time slice there is an increase of 2.94% in the number of trades inside the spread and a decrease of 0.80% in the number of trades outside the spread. Quoted half-spreads and effective half-spreads react. There is a decrease in both the \$ quoted and % quoted half-spreads as well as a decrease in both the \$ effective and % effective half-spreads. Matching sample results, for the second time slice, indicate an

increase of 1.62% in the number of trades inside the NBBO and a decrease of 0.11% in the number of trades outside the NBBO, but the trading costs are not significant. This is important. Evidence exists to support the hypothesis that the new rule (in particular, the implementation of the trade-through rule to NASDAQ stocks) appears to make a difference in trading costs. For the pilot phase sample, trading costs decline. Quoted half-spreads and effective half-spreads have narrowed.

The third time slice for the pilot sample is also important. There is an increase of 1.13% in the number of trades inside the spread and a decrease of 1.63% of trades outside the spread. There is also a decrease of 2.67% in the number of buy trades at the ask and an increase of 1.05% in the number of sell trades at the bid. The % effective half spreads decreases, reflecting lower trading costs. For the matching sample, third time slice, results indicate an increase of 1.93% in the number of trades inside the spread and a decrease of 1.54% in the number of trades outside the spread, but the spreads are not significant.

Evidence exists to support the hypothesis that the new rules have reduced trading costs for the pilot phase sample over the 5-day period of analysis.

(INSERT TABLES 3.9 – 3.10 HERE)

Tables 3.11 and 3.12 describe NASDAQ pilot and matching sample stocks for the 3-day pairings. Results for the first time slice, pilot sample, are almost entirely insignificant. The same applies to the matching sample, first time slice.

For the second time slice, pilot sample, there is an increase of 3.99% in the number of trades inside the spread, a decrease of 2.93% in the number of buy trades at the ask, a decrease of 0.81% in the number of sell trades at the bid and a decrease in the

total volume at the quoted half-spread. There is also a decrease in the effective half-spreads (\$ at 10%, % at 5%, Wilcoxon only). For the matching sample, second time slice, there is an increase of 1.67% in the number of trades inside the NBBO, an increase of 0.26% in the number of trades outside the NBBO, and a decrease of 1.77% in the number of buy trades at the ask. However, the spreads increased (significant sign test only). There is evidence that the trade aggressiveness and resulting trade costs are stronger (and cheaper) for the pilot phase stocks now subject to the trade-through rule.

For the third time slice, pilot sample, results are not significant. For the matching sample, third time slice, results are evident. There is a decrease of 3.60% in the number of buy trades at the ask and an increase of 2.25% in the number of sell trades at the bid. Most importantly, there is a significant increase in the quoted and effective half-spreads (both \$ and %) for the matching sample. Matching sample stocks are not subject to the new trade-through rule, and trading costs increased for these stocks. This also adds support for the hypothesis that the extension of the trade-through rule would help reduce trading costs.

(INSERT TABLES 3.11 – 3.12 HERE)

Tables 3.13 and 3.14 describe the NASDAQ pilot and matching sample for the 1-day pairings (+1 to -1). Results for the first time slice, pilot phase sample, are mostly insignificant. Results for the matching sample, however, indicate that trading is more expensive and less aggressive. The number of trades outside the NBBO increased 2.51% and the effective half-spreads indicate an increase in trading costs (significant at the 10% level only).

The second time slice, for the pilot sample, indicates an increase of 4.33% in the

number of trades inside the NBBO and a decrease of 0.70% of trades outside the NBBO. Both indicate an increase in trade competition for pilot phase stocks. Spreads, however are relatively insignificant. For the matching sample, second time slice, there is an increase of 1.93% in the number inside the NBBO, an increase of 0.53% in the number of trades outside the NBBO, and a decrease of 3.03% in the number of buy trade at the ask. Most importantly, spreads increased (at the 10% level) indicating an increase in trading costs.

For the third time slice, pilot phase sample, results are relatively insignificant. The matching sample, third time slice is much stronger. There is an increase of 3.45% of the number of trades inside the NBBO, an increase of 0.18% of the trades outside the NBBO, and an decrease of 5.02% in the number of buy trades at the ask. The quoted half-spreads increased, but the effective half-spreads are not significant.

Overall, the results indicate that trading costs have increased for the matching sample, but not for the pilot phase stocks.

(INSERT TABLES 3.13 – 3.14 HERE)

Finally, tables 3.15 and 3.16 describe the NASDAQ pilot and matching samples for the 1-day pairings using the event day (+0 to -1). For the first time slice, pilot phase sample, there is a significant decrease of 0.78% in the number of trades outside the NBBO. Spreads are not significant. For the matching sample, first time slice, most results are also not significant.

For the second time slice, pilot phase sample, there is a decrease of 1.10% in trades outside the NBBO, but the spreads are not significant. For the matching sample, there is a decrease of 3.29% in the number of buy trades at the ask, and the spreads are

not significant for the matching sample either.

For the third time slice, pilot phase sample, there is a decrease of 1.22% in the number of trades inside the NBBO. Effective half-spreads, which measure actual trading costs, decrease (% effective half-spread at the 10% level Wilcoxon). Matching sample results for the third time slice are insignificant.

Overall, the third time slice for the pilot sample is significantly different from the matching sample in terms of trading costs. Evidence suggests that it is cheaper to trade under the new rules.

(INSERT TABLES 3.15 – 3.16 HERE)

7.4 Regressions

A series of event studies were conducted to assess the effect of the new rules on the stocks participating in the pilot phase implementation period. Returns for the regressions were obtained from the CRSP database over the period January 22, 2007 through July 30, 2007. The estimation window covers a 100-day period prior to the event window, and the event window covers the period 15 days before and 15 days after the start of the pilot phase trade-through implementation period starting on July 9, 2007 (event date).

The results for the NASDAQ pilot phase sample ($n = 94$ firms as 6 firms were omitted due to missing CRSP data) are in Table 4.1, Nasdaq Pilot Phase Stocks: Event Study Regressions. The Mid-Cap firms (between \$1 billion and \$8 billion; $n=29$) and the Small-Cap firms (less than \$1 billion; $n=62$) are also reported in Table 4.1. Since the NASDAQ pilot phase sample has only three (3) large cap firms, regression results are not calculated for this sub-sample.

For the full sample, mid-cap sample and the small-cap sample, positive abnormal returns were obtained on the event day. However, the results are not statistically significant. Also consistent across the various NASDAQ samples are the CARs values which are negative for all other time frames. However, only the CARs on the full sample and the small-cap sample for timeframe up1 – up15 are statistically significant.

The results for the NYSE pilot phase sample (n = 87 as 12 firms were omitted due to missing CRSP data and one firm was dropped by NYSE and not replaced) are reported in Table 4.2, NYSE Pilot Phase Stocks: Event Study Regressions. The Large-Caps (\$8 billion or greater; n=55), Mid-Caps (\$1 to \$8 billion; n=27), and the Small-Caps (less than \$1 billion; n=5) are also reported in Table 4.2.

For the full sample, and all sub-samples, negative abnormal returns are observed on the event day as well as all other time frames following the event day. The CARs following the event day are negative for all samples and time frames, and the full sample and the Large-Cap sample are statistically significant starting at up1 – up5 and continuing to up1 – up15. The Mid-Cap sample is statistically significant at up1-up15, whereas the Small-Cap sample is statistically significant at up1- up10 and up1 – up15.

Rule 611 allows electronic markets to ignore the specialist for trading NYSE stocks. The negative returns observed on the event day, and thereafter, may reflect the effect of this rule and the inability of the specialist to participate inside the spread.

7.5 Descriptive Changes in Matched Share Volume

Although the main intent of this thesis is to examine change in quote competitiveness and trading costs surrounding the pilot phase implementation period, there is an extended

period of time that is also of broader interest primarily for future research. The new regulations are implemented over a longer period of time and include the four (4) separate phases as discussed previously. This section reviews the changes in matched share volume over the period February 9, 2007 through July 7, 2011 all US equity securities.

The trade volume information is available on-line from www.batstrading.com and originates from the Consolidated Tape for reporting trades across the market on a daily and weekly basis. The stock exchange operations reported include the NYSE, the AMEX, the NASDAQ, ARCA, the National Stock Exchange (NSX), the International Stock Exchange (ISE), the Chicago Stock Exchange (CHX), the Chicago Board of Options Exchange (CBOE), the Boston Stock Exchange (BOX) and the Philadelphia Stock Exchange. Although BATS is reported, it was not officially an exchange operation until October 2008.³⁵ Direct Edge was not officially an exchange operation until March of 2010 (Although Direct Edge purchased the ISE in December of 2008).

Data from the BATS web site allows for the reporting of trade volume occurring on BATS prior to October of 2008. BATS is the second ECN (ARCA is first) to have obtained exchange status. Up until October of 2008, shares traded on BATS (as well as all other ECNs) reported to the consolidated tape through two mechanisms. If one of the exchange operations was involved in the trade, the exchange operation reported the trade. If both sides of the trade occurred on BATS, the trade was reported through the off-exchange reporting mechanism (discussed in the following paragraph). The table below summarizes the changes in volume from February 9, 2007 (prior to the implementation of the new rules) to July 7, 2011.

³⁵ BATS is approved by the SEC for exchange status effective October, 2008.

Total Consolidated Volume						
5-Day Averages						
	9-Feb-07	% of Total	7-Jul-11	% of Total	Difference	% Dif
Exchange	3,231,414,019	64%	4,518,812,876	69%	1,287,398,857	40%
Off-Exchange	1,845,987,973	36%	2,062,435,806	31%	216,447,833	12%
Total	5,077,401,992		6,581,248,682		1,503,846,690	30%

As shown, the amount of trade volume has grown over the four + year period (30% in total); however, the percentage of trades between the exchange and off-exchange markets decreased 5%. Most of this is due to the change in the status of the two ECNs (BATS and EDGE) from off-exchange to official exchange operations.

Additional information regarding the total changes in volume is provided in the next table and is detailed by exchange and off-exchange operation. The most interesting change is the dramatic loss of volume on the NYSE market (-15%) and an almost corresponding increase in volume at the two electronic exchange operations, BATS and EDGE. BATS increased 11% and Direct Edge (which purchased ISE) increased 8% during this period. The Boston exchange operation also increased 4% during this period of time.

Total Consolidated Volume						
Facility	9-Feb-07	% of Total	7-Jul-11	% of Total	Difference	Change in % of Total
Exchanges						
NYSE	1,481,198,376	29%	900,435,464	14%	-580,762,912	-15%
ARCA (ECN)	746,217,242	15%	824,915,282	13%	78,698,040	-2%
NASDAQ	913,566,204	18%	1,263,303,133	19%	349,736,929	1%
BATS (ECN)	0	0%	692,963,189	11%	692,963,189	11%
BEX (Boston)	4,199,740	0%	145,461,182	2%	141,261,442	2%
ISE/EDGE	419,920	0%	542,054,164	8%	541,634,244	8%
NSX	14,802,401	0%	42,974,270	1%	28,171,869	0%
CHX	25,307,571	0%	10,463,561	0%	-14,844,010	0%
AMEX	40,953,437	1%	18,734,736	0%	-22,218,701	-1%
CBOE	75,380	0%	8,263,580	0%	8,188,200	0%
PHLX	4,673,748	0%	69,244,316	1%	64,570,568	1%
Total	3,231,414,019	64%	4,518,812,877	69%	1,287,398,858	5%
Off-Exchange						
NASDAQ	690,732,902	14%	1,899,802,130	29%	3,113,563,739	15%
NYSE	-		162,633,676	2%	232,397,625	2%
Other	1,155,255,071	23%	-		1,155,255,071	-23%
Total	1,845,987,973	36%	2,062,435,806	31%	2,190,706,293	-5%
Grand Total	5,077,401,992	100%	6,581,248,683	100%	6,805,485,011	0%

Clearly, the new rules have dramatically altered the NYSE market's ability to attract and compete for order flow. Given the changes that are documented in the table above, the NYSE floor based operations have lost over half of their prior volume. The new rules have certainly allowed for greater competition and the electronic exchange operations seem best positioned to compete for market share.

Further detail is provided for NYSE and NASDAQ listings in the tables below.

The first table describes changes in volume for NYSE listings.

NYSE Consolidated Volume						
Based on 5-Day Average						
Facility	9-Feb-07	% of Total	7-Jul-11	% of Total	Difference	Change in % of Total
Exchanges						
NYSE	1,477,279,876	55%	900,435,464	25%	-576,844,412	-30%
ARCA (ECN)	268,382,320	10%	354,494,438	13%	86,112,118	3%
NASDAQ	0	0%	530,898,795	19%	530,898,795	19%
BATS (ECN)	5,743,626	0%	313,433,790	11%	307,690,164	10%
BEX (Boston)	2,432,480	0%	80,260,826	2%	77,828,346	2%
ISE/EDGE	258,440	0%	274,559,107	8%	274,300,667	8%
NSX	9,586,940	0%	23,479,618	1%	13,892,678	0%
CHX	17,274,843	1%	3,725,576	0%	-13,549,267	0%
AMEX	1,346,220	0%	0	0%	-1,346,220	0%
CBOE	0	0%	1,362,780	0%	1,362,780	0%
PHLX	3,325,740	0%	24,594,991	1%	21,269,251	1%
Total	1,785,630,485	67%	2,507,245,385	69%	721,614,900	2%
Off-Exchange						
NASDAQ	0	0%	1,009,986,480	29%	1,009,986,480	29%
NYSE	0	0%	94,746,509	2%	94,746,509	2%
Other	892,270,244	33%	0	0%	-892,270,244	-33%
Total	892,270,244	33%	1,104,732,989	31%	212,462,745	-2%
Grand Total	2,677,900,729	100%	3,611,978,374	100%	934,077,645	0%

The changes in order flow are dramatic since the implementation of the new rules.

The NYSE listings are significantly more fragmented and the order flow, which was primarily tied up on the floor is spread more evenly across 5 major markets. Although the NYSE floor still controls the bulk of the order flow (25%), the electronic markets are now able to fully compete. Off-exchange order flow as a percentage of total order flow decreased 2%. Again, this is most likely due to the formalization of the ECNs to an

exchange operation with direct reporting of trade volume through the tape.

The last table describes the changes in NASDAQ listings.

Nasdaq Consolidated Volume						
Based on 5-Day Average						
Facility	9-Feb-07	% of Total	7-Jul-11	% of Total	Difference	Change in % of Total
Exchanges						
NYSE	0	0%	0	0%	0	0%
ARCA (ECN)	386,430,082	18%	204,538,084	12%	-181,891,998	-7%
NASDAQ	913,566,204	44%	492,017,722	28%	-421,548,482	-15%
BATS (ECN)	195,950,375	9%	198,106,752	11%	2,156,377	2%
BEX (Boston)	1,714,420	0%	37,768,233	2%	36,053,813	2%
ISE/EDGE	152,820	0%	159,787,187	9%	159,634,367	9%
NSX	1,622,901	0%	14,133,908	1%	12,511,007	1%
CHX	6,085,188	0%	1,913,296	0%	-4,171,892	0%
AMEX	31,320	0%	4,703,415	0%	4,672,095	0%
CBOE	0	0%	1,456,202	0%	1,456,202	0%
PHLX	826,588	0%	19,414,632	1%	18,588,044	1%
Total	1,506,379,898	72%	1,133,839,431	66%	-372,540,467	-6%
Off-Exchange						
NASDAQ	494,782,527	24%	549,221,534	32%	54,439,007	8%
NYSE	0	0%	43,445,567	3%	43,445,567	3%
Other	95,404,906	5%	0	0%	-95,404,906	-5%
Total	590,187,433	28%	592,667,101	34%	2,479,668	6%
Grand Total	2,096,567,331	100%	1,726,506,532	100%	-370,060,799	0%

Several changes are important to note. First, the ECNs are competing and the order flow for NASDAQ securities is also more fragmented among markets. Also, there is a dramatic decrease of 6% from exchange to off-exchange trading. The totals, however, are in-line with the split seen in the NYSE listings. Both NASDAQ and NYSE listings appear to have a 60s/30s split between on-exchange and off-exchange volume.

8. Concluding Remarks

The null hypothesis states that there will be no change in quote competition resulting in no change in trading aggressiveness, trading costs, or returns following the pilot phase implementation date. Alternative hypothesis A1 proposes that trade competition will decrease resulting in increased costs, and alternative hypothesis A2 proposes that trade competition will increase resulting in decreased trading costs.

NYSE Conclusions

The slow quote/total quote test results (Tables 1.1 – 1.3) do not reveal any significant changes in the pattern of quotes posted by the specialist during the pilot phase implementation period of the new rules. There are, however, significant changes in the quoting behavior as described in Tables 2.1 through 2.8. Results indicate a shift in quoting behavior between the pilot and matching sample. Overall, results indicate that quote competition for pilot phase stocks has declined: there is a decrease in the number of quotes at the best quotes and an increase in the number of quotes outside the best quotes for many of the pairings and time slices. Volume of shares at the best quotes also declined while volume outside increased. Although the trade data is less conclusive and the median spreads appear unchanged, negative abnormal returns are observed on the event day as well as all other time frames (significant at up1 – up5 and higher). In addition, long-term trends in volume reveal dramatic shifts away from the floor to the electronic markets following the change in the rules, reducing the role of the specialist in trading NYSE securities and the competitive power of the floor.

Overall, the results indicate that the rules have had a significant effect on the trading environment for NYSE stocks. Surrounding the pilot phase period, quote

competition declined, spreads remained constant, and negative abnormal returns are evident. Long-term trends in NYSE securities reveal increased competition among markets. Since price protection exists only at the NBBO, decreases in volume at the best prices pose a potential risk to most investors.

The results are promising for future research endeavors. Additional work is necessary to determine the affect over a longer period of time. Although the new rules appear to have increased volume in the electronic markets, it is unclear whether the changes have improved the efficiency or the effectiveness of the market for NYSE securities. Volume is clearly more fragmented than it was prior to the new rules, but decreasing returns and the failure to affect the cost to trade (in spreads) during the pilot phase implementation is a concern. Future research is necessary to assess long-term trading costs relating to the new rules.

NASDAQ Conclusions

For the NASDAQ samples, results do not indicate a radical change in quoting behavior between samples. Unlike the NYSE market, there isn't a specialist, and as a result, the new rules did not change the nature of the quoting action for NASDAQ listings. Trading costs, however, indicate a significant change and it appears as though the implementation of the trade-through provision improved trading costs for stocks in the pilot sample. In addition, positive abnormal returns were obtained on the event day (although only the CARs on the full sample and the small-cap sample for time frame up 1 – up 15 are significant). For NASDAQ securities, these results indicate that the new regulations improved the market for NASDAQ securities by reducing trading costs

around the pilot phase implementation date. In terms of volume, competition among markets for NASDAQ listings has also improved and the order flow is more distributed among markets. These short-term results, surrounding the pilot phase would suggest that the concerns expressed by SEC Commissioners' Glassman and Atkins were unfounded. In fact, for NASDAQ listings the opposite occurred and trading costs declined. The long-term effect of the new rules on trading costs, are necessary to draw further conclusions and address Glassman and Atkins' concerns.

Overall Conclusions

Future research is necessary to assess quoting behavior, trading costs, as well as volatility in the new marketplace now that electronic markets control the bulk of the order flow. The increased volatility in today's market can most likely be attributed to the transition to more automated markets. The use of trade algorithms, electronic trading mechanisms, and the systemic shocks caused by the economic collapse have all played a role in causing the markets to exhibit more volatile patterns over the last several years. These issues are a concern to market participants and to SEC regulators attempting to manage the new electronic paradigm. An article published the Wall Street Journal (10/1/10) said:

Federal regulators investigating the causes of the May 6 [2010] "flash crash" concluded a large trader's use of a computer trading system to sell futures contracts led to a rapid and sudden selling that triggered additional sell-offs in an already unstable market.

According to a joint report from the Securities and Exchange Commission and Commodity Futures Trading Commission, the trader chose to use an algorithm to trade the E-mini futures contract, a contract that mimics trading in the S&P 500 stock index. The computer program executed the trade "extremely rapidly in just 20 minutes," according to the report.

The report found that the trades were initially absorbed by high-frequency traders and others in the market, but soon liquidity dried up for that contract and elsewhere.

[http://online.wsj.com/article/SB10001424052748703859204575525973854203534.html?
mod=djemalertNEWS](http://online.wsj.com/article/SB10001424052748703859204575525973854203534.html?mod=djemalertNEWS)

Liquidity can be defined as an asset's ability to be sold without causing a significant movement in its price and with minimum loss of value. This was the role of the specialist: to provide liquidity and maintain orderly markets. In today's market, order flow is dispersed among multiple markets and liquidity is thinner. Electronic markets are limit-order markets and these "standing" orders can be withdrawn quickly, as demonstrated in the flash crash in May 2010. To address the first question put forth in this thesis, "Did the SEC balance the competitive powers among market venues?" the answer would be yes. With regard to the second questions, "Did the SEC improve the price protection available to investors?" the answer is less clear. More research involving quoting behavior, trading costs and the corresponding welfare effects is necessary.

What the future holds for trading in electronic markets is unclear. There is also uncertainty as to whether or not the new electronic paradigm significantly benefits the overall market. Our understanding of the capital markets and the various players in the market has changed dramatically as a result of the electronic paradigm. Much of the academic literature regarding the role of the various markets, the differences among listings, and differences among traders (informed versus uninformed), is outdated and irrelevant in the context of the electronic paradigm. In addition, there is a growing body of research in the areas of off-exchange trading (dark markets/crossing markets and other ECNs not formally listed as exchange operations) and in international trading beyond the

reach of the SEC that has opened multiple areas of new research in today's economic environment. Textbooks on capital markets are in need of major revisions and much of the curriculum in this area of research is outdated. This research area is rapidly growing and will continue to challenge those with an interest in microstructure research and capital markets for years to come.

The role of the SEC will become more complicated as the complexity and volatility of the electronic paradigm grows. The regulatory environment may be more important than ever if volatility continues to increase at the expense of long-term traders. Determining an appropriate role for the SEC in an evolving market will prove challenging for years to come.

7 Future Research

Research opportunities exist with respect to the changing regulatory structure and the increase in electronic trading in the US equities market. In 2004, the NASDAQ market transitioned to an all anonymous format to compete more effectively with other ECNs. Boehmer's (2005) study examined NASDAQ stocks from November 2001 through December 2003 and found differences between order size and speed. These attributes were related to differences in dealing with informed trading across dealer versus specialist systems in the market (NYSE and NASDAQ). Studying how changes in transparency affect trading in the new electronic anonymous environment would further our understanding of limit-order markets.

An important research question is whether electronic trading is a substitute for order preferencing agreements. ECNs offer some of the same alternative features desired from such agreements (speed, low cost, and anonymity). ECNs also offer payment for posting

liquidity. Additionally, the regional exchange operations have changed dramatically and gaps in the literature exist with respect to the nature of preferencing agreements in the new market place.

Since floor based trading has declined rapidly as electronic access to exchange traded securities has improved over the last year, questions arise for researchers. Are specialist firms now concentrating on thinly traded stocks and IPOs? What role does the specialist, as well as the SEC play in designing regulatory provisions to ensure the orderly working of markets during crisis periods?

Another interesting research opportunity is an exploration of the changing role of the specialist during the end of the pilot phase period for the new SEC provisions. The mortgage meltdown crisis beginning in mid-August 2007 caused tremendous temporary volatility across the market. An examination of pilot phase stocks with only electronic accessibility versus non-pilot phase stocks eligible for trading in manual markets would increase our understanding of the role of the specialist in volatile markets. The same tests examined for this thesis could also be examined for the separate exchange operations.

A long-term study examining the changes in order flow and market quality from the period of NMS implementation to the present would further our understanding of the marketplace. Will liquidity and trading concentrate on a few major markets or continue to fragment over several markets? What changes can be observed in trading costs and market efficiency?

Finally, another issue explored under the new rules relates to price volatility in the more automated environment. Although the Commission has argued that the trade-through provision will ensure stability without adverse volatility, it is conceivable that

faster execution speeds and the increased use of electronic trading will give rise to increased volatility. If displayed liquidity is negatively affected by Rule 611, spreads may increase over time resulting in more price volatility. As mentioned, the perceived need for the trade-through provision was highly controversial (Glassman and Akins),³⁶ and even those in support of the provision conceded that favoring long-term traders would result in short-term traders paying more in the spread. Surprisingly, the Commission's view of investors neglects to appreciate the competitive interaction among long-term and short-term investors. If the provision harms short-term investors, then long-term investors will suffer too. Short-term investors provide significant liquidity to the market, and this is an important benefit to long-term investors (Glassman & Atkins, 2005). In all likelihood, the Commission has failed to appreciate the potential for increased volatility due to increased execution speeds and algorithmic trading. In fact, the SEC most likely created an environment that favors traders that profit from higher volatility. Excessively volatile markets can generate many opportunities for traders to earn short-term profits from rapid price swings. Short-term traders, including hedge funds, possess the systems capabilities and necessary expertise to enter and exit the market rapidly to exploit such price swings. In addition, if short-term traders continuously exploit the market, volatility may increase over time. The market frequently exhibits these types of problems and patterns. Certainly, these new rules have dramatically altered the behavior and perception of all market participants trading US equities.

The future role of the regulatory arm for enhancing liquidity, especially in the more global electronic marketplace, for facilitating trade practices and market efficiency, is an

³⁶ See dissenting opinions <http://sec.gov/rules/final/34-51808-dissent.pdf>

important research area. The SEC must carefully balance varied objectives of a wide range of market players before applying a monolithic approach to the competitive marketplace and to the niches that exist to serve diverse client needs. Clearly, the marketplace is changing dramatically, and these changes will present research opportunities for years to come.

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Table 1.1; NYSE 5-Day Pairings, Median Slow and Total Quotes

The table contains the median pair-wise results for both slow and total quotes for NYSE Pilot Phase Stocks. This pairing contains 5 days of data on both sides of the event date. The results are divided into three time slice elements to isolate beginning and end of day volatility. The sign test and Wilcoxon test results are the p-value results.

Time Slice	Quote Type	Pre	Post	Sign	Wilcoxon
1 (9:30 - 10:00)	Slow	1.00	1.00	0.096	0.186
1	Total	2588	2747	0.000	0.000
2 (10:00 - 3:30)	Slow	5.00	7.00	0.050	0.004
2	Total	21443	22972	0.000	0.000
3 (3:30 - 4:00)	Slow	0.00	1.00	0.000	0.000
3	Total	2549	2928	0.003	0.000

**5-Days Pairings
Slow Quotes and Total Quotes
Median Results, NYSE Matching Phase Sample**

The table contains the median pair-wise results for both slow and total quotes for NYSE Matching Sample Stocks. This pairing contains 5 days of data on both sides of the event date. The results are divided into three time slice elements to isolate beginning and end of day volatility. The sign test and Wilcoxon test results are the p-value results.

Time Slice	Quote Type	Pre	Post	Sign	Wilcoxon
1 (9:30 - 10:00)	Slow	1.00	1.00	0.321	0.189
1	Total	2322	2371	0.000	0.000
2 (10:00 - 3:30)	Slow	5.00	6.00	0.004	0.001
2	Total	19240	20959	0.000	0.000
3 (3:30 - 4:00)	Slow	0.00	1.00	0.017	0.003
3	Total	2311	2589	0.030	0.000

Table 1.2: NYSE 3-Day Pairings, Median Slow and Total Quotes

The table contains the median pair-wise results for both slow and total quotes for NYSE Pilot Phase Stocks. This pairing contains 3 days of data on both sides of the event date. The results are divided into three time slice elements to isolate beginning and end of day volatility. The sign test and Wilcoxon test results are the p-value results.

Time Slice	Quote Type	Pre	Post	Sign	Wilcoxon
1 (9:30 - 10:00)	Slow	1.00	2.00	0.099	0.070
1	Total	2516	2917	0.000	0.000
2 (10:00 - 3:30)	Slow	5.00	8.00	0.001	0.000
2	Total	18337	23900	0.000	0.000
3 (3:30 - 4:00)	Slow	0.00	1.00	0.000	0.000
3	Total	2076	3090	0.000	0.000

**3-Days Pairings
Slow Quotes and Total Quotes
Median Results, NYSE Matching Phase Sample**

The table contains the median pair-wise results for both slow and total quotes for NYSE Matching Sample Stocks. This pairing contains 3 days of data on both sides of the event date. The results are divided into three time slice elements to isolate beginning and end of day volatility. The sign test and Wilcoxon test results are the p-value results.

Time Slice	Quote Type	Pre	Post	Sign	Wilcoxon
1 (9:30 - 10:00)	Slow	1.00	1.00	0.007	0.003
1	Total	2242	2451	0.000	0.000
2 (10:00 - 3:30)	Slow	5.00	6.00	0.002	0.000
2	Total	15796	22165	0.000	0.000
3 (3:30 - 4:00)	Slow	0.00	1.00	0.000	0.000
3	Total	1612	2778	0.000	0.000

Table 1.3: NYSE 1-Day Pairings, Median Slow and Total Quotes

The table contains the median pair-wise results for both slow and total quotes for NYSE Pilot Phase Stocks. This pairing contains 1 day of data on both sides of the event date. The results are divided into three time slice elements to isolate beginning and end of day volatility. The sign test and Wilcoxon test results are the p-value results.

Time Slice	Quote Type	Pre	Post	Sign	Wilcoxon
1 (9:30 - 10:00)	Slow	1.00	1.00	1.000	0.633
1	Total	2653	30884	0.003	0.000
2 (10:00 - 3:30)	Slow	7.00	8.00	0.649	0.474
2	Total	22062	28805	0.000	0.000
3 (3:30 - 4:00)	Slow	1.00	1.00	0.047	0.024
3	Total	2790	3474	0.000	0.000

**1-Day Pairing
Slow Quotes and Total Quotes
Median Results, NYSE Matching Phase Sample**

The table contains the median pair-wise results for both slow and total quotes for NYSE Matching Sample Stocks. This pairing contains 1 day of data on both sides of the event date. The results are divided into three time slice elements to isolate beginning and end of day volatility. The sign test and Wilcoxon test results are the p-value results.

Time Slice	Quote Type	Pre	Post	Sign	Wilcoxon
1 (9:30 - 10:00)	Slow	1.00	2.00	0.193	0.007
1	Total	2322	2691	0.004	0.000
2 (10:00 - 3:30)	Slow	8.00	6.00	0.068	0.143
2	Total	19361	25688	0.000	0.000
3 (3:30 - 4:00)	Slow	0.00	2.00	0.185	0.267
3	Total	2438	3172	0.000	0.000

Table 2.1 Quotes: NYSE Pilot Phase Sample, Medians 5-Day Pairings

This table contains the median pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE pilot phase stocks.

The pairings contain 5 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average # of Quotes</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	36.35%	30.70%	-5.65%	0.000	0.000	36.84%	35.56%	-1.28%	0.148	0.296	41.30%	42.00%	0.70%	0.838	0.783
At Bid	13.13%	13.08%	-0.05%	0.526	0.965	9.50%	8.97%	-0.53%	0.936	0.828	8.46%	9.15%	0.69%	0.652	0.178
At Ask	13.49%	12.50%	-0.99%	0.031	0.185	9.76%	9.67%	-0.09%	0.356	0.919	8.94%	8.98%	0.04%	0.461	0.585
Inside NBBO	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Outside NBBO	18.29%	19.84%	1.55%	0.074	0.006	11.78%	12.50%	0.72%	1.000	0.138	7.36%	8.75%	1.39%	0.024	0.032
Alone NBBO	15.48%	12.46%	-3.02%	0.000	0.000	14.65%	12.90%	-1.75%	0.000	0.002	9.76%	9.58%	-0.18%	0.043	0.133
Alone Bid	3.70%	3.49%	-0.21%	0.007	0.001	2.82%	3.01%	0.19%	0.686	0.698	2.04%	2.52%	0.48%	0.000	0.001
Alone Ask	1.34%	1.30%	-0.04%	0.289	0.200	1.58%	1.61%	0.03%	0.758	0.708	1.19%	1.42%	0.23%	0.007	0.024
<i>Average Volume in Shares</i>															
Vol at NBBO	39.56%	39.33%	-0.23%	0.004	0.037	44.69%	39.83%	-4.86%	0.066	0.040	48.35%	48.14%	-0.21%	0.414	0.821
Vol at Bid	6.67%	6.65%	-0.02%	0.767	0.497	4.89%	5.77%	0.88%	0.005	0.013	4.11%	5.19%	1.08%	0.296	0.673
Vol at Ask	7.02%	6.53%	-0.49%	0.220	0.147	5.40%	5.73%	0.33%	0.748	0.742	4.16%	5.72%	1.56%	0.015	0.006
Vol Inside	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Vol Outside	22.74%	24.33%	1.59%	0.167	0.054	13.55%	14.34%	0.79%	0.225	0.347	10.28%	10.16%	-0.12%	0.305	0.772
Vol Alone NBBO	20.83%	17.35%	-3.48%	0.000	0.000	16.90%	16.42%	-0.48%	0.060	0.178	11.53%	10.16%	-1.37%	0.041	0.095
Vol Alone Bid	1.84%	1.92%	0.08%	0.830	0.638	1.71%	1.75%	0.04%	1.000	0.423	0.88%	1.31%	0.43%	0.000	0.000
Vol Alone Ask	0.67%	0.62%	-0.05%	0.808	0.873	0.96%	0.98%	0.02%	0.697	0.602	0.59%	0.65%	0.06%	0.184	0.752

Table 2.2: Quotes NYSE Matching Sample, Medians 5-Day Pairings

This table contains the median pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE matching sample stocks.

The pairings contain 5 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average # of Quotes</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	32.24%	32.00%	-0.24%	0.434	0.640	37.82%	36.16%	-1.66%	0.984	0.937	41.84%	40.11%	-1.73%	0.004	0.021
At Bid	13.69%	14.12%	0.43%	0.813	0.872	10.31%	10.35%	0.04%	0.984	0.999	9.57%	9.94%	0.37%	0.496	0.551
At Ask	13.67%	13.30%	-0.37%	0.605	0.988	10.67%	10.41%	-0.26%	0.104	0.146	9.75%	10.59%	0.84%	0.000	0.004
Inside NBBO	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Outside NBBO	18.73%	20.10%	1.37%	0.935	0.697	11.64%	12.05%	0.41%	0.904	0.773	7.31%	9.47%	2.16%	0.000	0.006
Alone NBBO	15.91%	13.64%	-2.27%	0.000	0.000	14.19%	13.45%	-0.74%	0.032	0.071	11.35%	10.53%	-0.82%	0.054	0.115
Alone Bid	3.82%	3.85%	0.03%	0.231	0.128	2.53%	2.95%	0.42%	0.787	0.786	2.08%	2.41%	0.33%	0.623	0.937
Alone Ask	1.39%	1.35%	-0.04%	0.574	0.037	1.58%	1.66%	0.08%	0.231	0.359	1.16%	1.34%	0.18%	0.004	0.152
<i>Average Volume in Shares</i>															
Vol at NBBO	40.87%	39.16%	-1.71%	0.010	0.060	44.73%	44.79%	0.06%	0.173	0.165	49.01%	47.53%	-1.48%	0.001	0.002
Vol at Bid	6.59%	6.90%	0.31%	0.637	0.242	5.58%	5.59%	0.01%	0.695	0.636	4.46%	5.29%	0.83%	0.190	0.417
Vol at Ask	6.69%	7.08%	0.39%	0.006	0.019	5.92%	5.29%	-0.63%	0.128	0.221	4.52%	5.57%	1.05%	0.009	0.032
Vol Inside	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Vol Outside	24.04%	23.73%	-0.31%	0.790	0.723	15.56%	15.79%	0.23%	0.253	0.016	9.95%	12.90%	2.95%	0.000	0.000
Vol Alone NBBO	21.42%	19.41%	-2.01%	0.002	0.049	17.45%	17.20%	-0.25%	0.149	0.605	12.82%	13.00%	0.18%	0.391	0.444
Vol Alone Bid	1.94%	2.12%	0.18%	0.500	0.517	1.67%	1.72%	0.05%	0.724	0.401	1.10%	1.35%	0.25%	0.016	0.121
Vol Alone Ask	0.70%	0.66%	-0.04%	0.092	0.000	0.91%	0.91%	0.00%	0.801	0.620	0.53%	0.69%	0.16%	0.123	0.190

Table 2.3: Quotes NYSE Pilot Phase Sample, Medians 3-Day Pairings

This table contains the median pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE Pilot Phase stocks.
The pairings contain 3 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility.
The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average # of Quotes</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	33.74%	30.63%	-3.11%	0.000	0.000	39.37%	34.20%	-5.17%	0.000	0.001	46.75%	41.33%	-5.42%	0.000	0.000
At Bid	12.63%	14.29%	1.66%	0.263	0.064	9.16%	9.70%	0.54%	0.015	0.055	7.63%	10.82%	3.19%	0.000	0.000
At Ask	13.46%	12.53%	-0.93%	0.131	0.494	9.50%	9.84%	0.34%	0.265	0.886	7.20%	9.18%	1.98%	0.057	0.158
Inside NBBO	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Outside NBBO	18.18%	19.40%	1.22%	0.022	0.001	11.90%	12.45%	0.55%	0.012	0.006	5.22%	8.71%	3.49%	0.000	0.000
Alone NBBO	14.86%	11.40%	-3.46%	0.000	0.000	16.04%	12.79%	-3.25%	0.000	0.000	10.71%	10.29%	-0.42%	0.070	0.160
Alone Bid	3.63%	3.49%	-0.14%	0.136	0.081	2.66%	3.20%	0.54%	0.039	0.088	1.62%	3.09%	1.47%	0.000	0.000
Alone Ask	1.36%	1.28%	-0.08%	1.000	0.946	1.48%	1.63%	0.15%	0.009	0.033	0.93%	1.70%	0.77%	0.000	0.000
<i>Average Volume in Shares</i>															
Vol at NBBO	39.82%	38.47%	-1.35%	0.000	0.007	45.32%	39.18%	-6.14%	0.001	0.002	52.16%	48.56%	-3.60%	0.000	0.000
Vol at Bid	6.48%	6.57%	0.09%	0.531	0.661	4.88%	5.91%	1.03%	0.009	0.012	3.11%	5.32%	2.21%	0.000	0.005
Vol at Ask	6.95%	6.28%	-0.67%	0.310	0.282	4.89%	5.66%	0.77%	0.452	0.593	3.05%	5.73%	2.68%	0.002	0.000
Vol Inside	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Vol Outside	23.47%	23.83%	0.36%	0.024	0.050	13.43%	14.24%	0.81%	0.010	0.033	9.75%	10.02%	0.27%	0.000	0.000
Vol Alone NBBO	20.83%	16.67%	-4.16%	0.000	0.000	17.93%	15.61%	-2.32%	0.000	0.001	13.38%	12.67%	-0.71%	0.185	0.159
Vol Alone Bid	1.88%	1.98%	0.10%	1.000	0.580	1.68%	1.81%	0.13%	0.250	0.755	0.62%	1.52%	0.90%	0.000	0.000
Vol Alone Ask	0.66%	0.67%	0.01%	0.317	0.278	0.89%	0.99%	0.10%	0.458	0.940	0.36%	0.74%	0.38%	0.000	0.000

Table 2.4: Quotes, NYSE Matching Sample, Medians 3-Day Pairings

This table contains the median pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE Matching sample stocks. The pairings contain 3 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
Average # of Quotes	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	32.26%	32.65%	0.39%	0.749	0.417	38.46%	35.95%	-2.51%	0.102	0.165	48.40%	41.88%	-6.52%	0.000	0.000
At Bid	12.92%	14.42%	1.50%	0.114	0.102	10.07%	10.25%	0.18%	0.128	0.342	7.87%	10.58%	2.71%	0.002	0.002
At Ask	12.97%	13.20%	0.23%	0.435	0.780	10.30%	9.80%	-0.50%	0.441	0.569	7.82%	11.07%	3.25%	0.000	0.000
Inside NBBO	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Outside NBBO	19.78%	19.94%	0.16%	0.474	0.420	11.85%	12.05%	0.20%	0.086	0.268	5.00%	8.33%	3.33%	0.000	0.000
Alone NBBO	16.67%	13.80%	-2.87%	0.000	0.000	15.45%	12.82%	-2.63%	0.000	0.000	13.33%	11.23%	-2.10%	0.002	0.000
Alone Bid	3.85%	3.94%	0.09%	0.519	0.804	2.50%	3.21%	0.71%	0.026	0.094	1.61%	2.59%	0.98%	0.000	0.000
Alone Ask	1.37%	1.34%	-0.03%	0.816	0.455	1.53%	1.73%	0.20%	0.013	0.206	0.84%	1.43%	0.59%	0.000	0.000
Average Volume in Shares															
Vol at NBBO	42.03%	38.82%	-3.21%	0.017	0.016	47.08%	43.41%	-3.67%	0.003	0.007	56.81%	49.00%	-7.81%	0.000	0.000
Vol at Bid	6.32%	7.36%	1.04%	0.038	0.013	6.18%	5.92%	-0.26%	0.351	0.680	3.51%	5.46%	1.95%	0.000	0.000
Vol at Ask	6.35%	7.29%	0.94%	0.000	0.002	6.08%	5.66%	-0.42%	0.410	0.469	3.38%	5.50%	2.12%	0.000	0.000
Vol Inside	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Vol Outside	24.03%	23.53%	-0.50%	0.671	0.736	15.20%	15.79%	0.59%	0.003	0.001	6.87%	12.27%	5.40%	0.000	0.000
Vol Alone NBBO	22.49%	18.48%	-4.01%	0.002	0.022	20.09%	16.09%	-4.00%	0.002	0.020	15.52%	13.16%	-2.36%	0.001	0.001
Vol Alone Bid	1.94%	2.33%	0.39%	0.207	0.087	1.62%	1.80%	0.18%	0.707	0.723	0.83%	1.51%	0.68%	0.000	0.000
Vol Alone Ask	0.68%	0.69%	0.01%	0.684	0.269	0.96%	0.92%	-0.04%	0.091	0.810	0.39%	0.77%	0.38%	0.000	0.000

Table 2.5: Quotes, NYSE Pilot Phase Sample, Medians 1-Day Pairings (+1 to -1)

This table contains the median pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE Pilot Phase stocks. The pairings contain 1 day of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average # of Quotes</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	36.36%	29.51%	-6.85%	0.000	0.000	39.46%	35.42%	-4.04%	0.004	0.043	41.67%	39.47%	-2.20%	0.027	0.030
At Bid	11.55%	15.42%	3.87%	0.027	0.001	9.74%	11.25%	1.51%	0.088	0.136	8.04%	12.50%	4.46%	0.002	0.002
At Ask	12.48%	11.82%	-0.66%	0.209	0.723	9.28%	7.46%	-1.82%	0.557	0.074	10.12%	9.96%	-0.16%	0.962	0.459
Inside NBBO	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Outside NBBO	17.65%	19.39%	1.74%	0.135	0.009	11.26%	11.81%	0.55%	0.020	0.007	7.66%	10.18%	2.52%	0.000	0.010
Alone NBBO	13.74%	9.68%	-4.06%	0.002	0.004	15.76%	10.51%	-5.25%	0.000	0.000	9.78%	9.09%	-0.69%	0.015	0.037
Alone Bid	3.60%	3.67%	0.07%	1.000	0.928	2.36%	3.08%	0.72%	0.005	0.010	1.92%	2.92%	1.00%	0.001	0.004
Alone Ask	1.35%	1.35%	0.00%	0.079	0.302	1.45%	1.46%	0.01%	0.963	0.537	1.14%	1.61%	0.47%	0.066	0.272
<i>Average Volume in Shares</i>															
Vol at NBBO	39.82%	37.92%	-1.90%	0.002	0.026	45.25%	35.92%	-9.33%	0.044	0.047	46.39%	42.88%	-3.51%	0.162	0.181
Vol at Bid	6.74%	8.28%	1.54%	0.638	0.654	4.52%	6.37%	1.85%	0.088	0.010	3.97%	5.26%	1.29%	0.155	0.587
Vol at Ask	6.78%	6.08%	-0.70%	0.629	0.894	4.63%	5.38%	0.75%	0.964	0.949	3.40%	6.16%	2.76%	0.015	0.003
Vol Inside	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Vol Outside	24.14%	23.36%	-0.78%	0.057	0.034	13.74%	13.98%	0.24%	0.054	0.246	11.16%	10.24%	-0.92%	0.087	0.331
Vol Alone NBBO	20.00%	15.69%	-4.31%	0.000	0.005	16.52%	11.20%	-5.32%	0.001	0.004	13.40%	11.81%	-1.59%	0.047	0.060
Vol Alone Bid	2.14%	2.16%	0.02%	0.341	0.664	1.44%	1.92%	0.48%	0.009	0.008	0.81%	1.53%	0.72%	0.001	0.012
Vol Alone Ask	0.77%	0.67%	-0.10%	0.688	0.512	0.67%	0.74%	0.07%	0.748	0.526	0.47%	0.67%	0.20%	0.082	0.967

Table 2.6: Quotes, NYSE Matching Sample, Medians 1-Day Pairings (+1 to -1)

This table contains the median pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE Matching Sample stocks. The pairings contain 1 day of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average # of Quotes</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	34.06%	31.75%	-2.31%	0.381	0.113	42.19%	34.39%	-7.80%	0.002	0.001	41.84%	40.02%	-1.82%	0.001	0.020
At Bid	11.95%	13.33%	1.38%	0.504	0.490	9.37%	11.80%	2.43%	0.000	0.003	10.27%	11.78%	1.51%	0.772	0.471
At Ask	12.77%	13.90%	1.13%	0.733	0.868	9.12%	9.31%	0.19%	0.108	0.229	10.27%	12.30%	2.03%	0.000	0.010
Inside NBBO	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Outside NBBO	19.48%	20.95%	1.47%	0.034	0.022	11.64%	11.83%	0.19%	0.000	0.030	7.77%	9.45%	1.68%	0.004	0.118
Alone NBBO	16.47%	14.36%	-2.11%	0.038	0.008	14.42%	10.91%	-3.51%	0.007	0.004	10.91%	9.47%	-1.44%	0.005	0.023
Alone Bid	3.58%	4.05%	0.47%	0.266	0.237	2.49%	3.49%	1.00%	0.000	0.000	2.09%	2.76%	0.67%	0.024	0.015
Alone Ask	1.38%	1.40%	0.02%	0.577	0.902	1.38%	1.65%	0.27%	0.074	0.900	1.08%	1.38%	0.30%	0.008	0.159
<i>Average Volume in Shares</i>															
Vol at NBBO	43.58%	39.39%	-4.19%	0.011	0.015	48.37%	39.16%	-9.21%	0.000	0.000	51.28%	42.64%	-8.64%	0.000	0.000
Vol at Bid	7.25%	7.94%	0.69%	0.739	0.561	5.59%	5.94%	0.35%	0.118	0.298	4.27%	6.77%	2.50%	0.004	0.002
Vol at Ask	5.10%	8.09%	2.99%	0.001	0.002	5.57%	4.38%	-1.19%	0.890	0.698	4.42%	6.45%	2.03%	0.017	0.018
Vol Inside	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Vol Outside	23.33%	23.29%	-0.04%	0.269	0.197	14.64%	17.64%	3.00%	0.000	0.000	10.11%	15.16%	5.05%	0.001	0.001
Vol Alone NBBO	20.80%	18.34%	-2.46%	0.549	0.816	18.72%	14.06%	-4.66%	0.003	0.033	14.70%	10.14%	-4.56%	0.001	0.001
Vol Alone Bid	1.97%	2.42%	0.45%	0.440	0.112	1.70%	1.65%	-0.05%	0.711	0.741	1.04%	1.51%	0.47%	0.011	0.018
Vol Alone Ask	0.65%	0.74%	0.09%	0.446	0.651	0.87%	0.83%	-0.04%	0.259	0.964	0.49%	0.77%	0.28%	0.581	0.635

Table 2.7: Quotes, NYSE Pilot Phase Sample, Medians Event Day Matching (+0 to -1)

This table contains the median pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE Pilot Phase stocks.

The pairings contain 1 day of data before the event to the event date. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average # of Quotes</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO															
At Bid	3.082%	3.252%	0.170%	0.422	0.543	0.917%	0.998%	0.081%	1.000	0.281	3.520%	3.610%	0.090%	0.353	0.134
At Ask	14.421%	14.857%	0.436%	0.040	0.058	5.750%	5.562%	-0.188%	0.893	0.436	10.200%	8.745%	-1.455%	0.559	0.158
Inside NBBO	0.000%	0.000%	0.000%			0.000%	0.000%	0.000%			0.000%	0.000%	0.000%		
Outside NBBO	23.077%	23.848%	0.771%	0.429	0.923	18.498%	17.124%	-1.374%	1.000	0.886	9.270%	7.895%	-1.375%	0.748	0.978
Alone NBBO	15.601%	15.814%	0.213%	0.291	0.712	7.217%	7.102%	-0.115%	0.896	0.514	12.813%	12.026%	-0.786%	0.648	0.912
Alone Bid	0.400%	0.384%	-0.016%	0.667	0.571	0.068%	0.070%	0.002%	0.026	0.006	0.299%	0.312%	0.013%	0.210	0.938
Alone Ask	1.381%	1.173%	-0.208%	0.089	0.041	1.539%	1.457%	-0.082%	0.290	0.033	1.125%	1.051%	-0.074%	0.096	0.008
<i>Average Volume in Shares</i>															
Vol at NBBO	45.918%	44.048%	-1.870%	0.569	0.943	50.203%	51.911%	1.708%	0.695	0.726	54.795%	57.591%	2.796%	0.524	0.235
Vol at Bid	7.476%	6.755%	-0.721%	0.004	0.027	7.244%	7.849%	0.605%	0.500	0.766	5.408%	5.750%	0.342%	0.845	0.609
Vol at Ask	6.965%	7.094%	0.129%	0.294	0.563	7.307%	7.254%	-0.053%	0.096	0.639	6.323%	5.118%	-1.205%	0.330	0.459
Vol Inside	0.000%	0.000%	0.000%			0.000%	0.000%	0.000%			0.000%	0.000%	0.000%		
Vol Outside	25.903%	26.825%	0.922%	0.792	0.602	17.479%	19.119%	1.640%	0.542	0.905	11.823%	9.332%	-2.491%	0.463	0.115
Vol Alone NBBO	19.348%	19.995%	0.647%	1.000	0.336	22.966%	22.106%	-0.860%	0.459	0.290	15.222%	15.022%	-0.199%	0.387	0.519
Vol Alone Bid	1.643%	1.527%	-0.116%	0.000	0.004	0.943%	0.959%	0.016%	0.341	0.080	0.862%	0.776%	-0.086%	0.689	0.972
Vol Alone Ask	0.626%	0.488%	0.00	0.072	0.180	1.296%	1.006%	-0.290%	0.214	0.091	0.532%	0.477%	-0.055%	0.174	0.025

Table 2.8: Quotes, NYSE Matching Sample, Medians Event Day Matching (+0 to -1)

This table contains the median pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE Matching sample stocks.

The pairings contain 1 day of data before the event to the event date. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average # of Quotes</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	40.809%	37.500%	-3.309%	0.015	0.006	58.080%	58.798%	0.717%	0.041	0.113	52.827%	52.135%	-0.692%	0.963	0.443
At Bid	3.458%	4.468%	1.011%	0.001	0.003	1.344%	1.248%	-0.096%	0.747	0.745	4.414%	4.585%	0.171%	0.768	0.673
At Ask	14.982%	15.520%	0.538%	0.500	0.535	7.116%	6.443%	-0.673%	0.154	0.645	10.631%	9.639%	-0.993%	0.842	0.513
Inside NBBO	0.000%	0.000%	0.000%			0.000%	0.000%	0.000%			0.000%	0.000%	0.000%		
Outside NBBO	23.670%	24.348%	0.678%	0.652	0.579	18.160%	18.110%	-0.050%	0.013	0.058	9.091%	9.605%	0.514%	0.423	0.724
Alone NBBO	17.507%	17.360%	-0.147%	0.964	0.633	7.939%	7.254%	-0.686%	0.091	0.003	14.000%	14.257%	0.257%	0.207	0.209
Alone Bid	0.436%	0.454%	0.019%	0.228	0.060	0.080%	0.070%	-0.010%	0.711	0.687	0.345%	0.391%	0.046%	0.320	0.927
Alone Ask	1.318%	1.208%	-0.110%	0.263	0.155	1.524%	1.449%	-0.075%	0.319	0.073	1.038%	1.079%	0.041%	0.386	0.130
<i>Average Volume in Shares</i>															
Vol at NBBO	46.867%	44.605%	-2.262%	0.261	0.309	52.178%	52.850%	0.672%	0.350	0.255	57.647%	58.582%	0.936%	0.576	0.632
Vol at Bid	7.636%	6.878%	-0.758%	0.086	0.119	8.778%	8.863%	0.085%	0.963	0.803	6.408%	5.791%	-0.617%	0.768	0.297
Vol at Ask	7.155%	7.074%	-0.081%	0.248	0.245	9.131%	7.944%	-1.188%	0.818	0.747	6.520%	6.348%	-0.172%	1.000	0.813
Vol Inside	0.000%	0.000%	0.000%			0.000%	0.000%	0.000%			0.000%	0.000%	0.000%		
Vol Outside	25.627%	27.801%	2.174%	0.500	0.246	16.862%	16.653%	-0.210%	0.423	0.144	10.465%	11.705%	1.241%	0.814	0.882
Vol Alone NBBO	22.506%	23.161%	0.655%	0.822	0.157	23.522%	21.872%	-1.650%	0.894	0.865	17.339%	18.134%	0.795%	0.963	0.316
Vol Alone Bid	1.692%	1.593%	-0.099%	0.736	0.651	1.149%	0.966%	-0.183%	0.405	0.646	0.974%	0.836%	-0.138%	0.728	0.912
Vol Alone Ask	0.518%	0.530%	0.012%	0.684	0.803	1.144%	0.995%	-0.149%	0.041	0.003	0.517%	0.528%	0.010%	0.284	0.027

Table 2.9: Quotes, Nasdaq Pilot Sample, Medians 5-Day Pairings

This table contains the median pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ Pilot Phase stocks.

The pairings contain 5 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average # of Quotes</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	54.70%	54.23%	-0.47%	0.478	0.395	60.05%	61.30%	1.25%	0.541	0.369	63.51%	61.87%	-1.64%	0.153	0.129
At Bid	12.15%	12.50%	0.35%	0.816	0.718	10.57%	10.10%	-0.47%	0.178	0.452	8.81%	8.46%	-0.35%	0.550	0.402
At Ask	11.54%	12.68%	1.14%	0.575	0.233	10.46%	11.33%	0.87%	0.339	0.453	7.42%	9.82%	2.40%	0.000	0.000
Inside NBBO	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Outside NBBO	10.00%	10.08%	0.08%	0.254	0.327	6.13%	6.09%	-0.04%	0.476	0.172	3.70%	4.07%	0.37%	0.250	0.636
Alone NBBO	41.42%	41.04%	-0.38%	0.855	0.735	42.77%	43.15%	0.38%	0.197	0.363	38.30%	40.78%	2.48%	0.346	0.127
Alone Bid	3.45%	3.75%	0.30%	0.218	0.099	2.82%	2.78%	-0.04%	0.567	0.855	2.08%	2.05%	-0.03%	0.690	0.591
Alone Ask	0.83%	0.92%	0.09%	0.816	0.215	1.35%	1.19%	-0.16%	0.520	0.136	0.79%	0.61%	-0.18%	1.000	0.693
<i>Average Volume in Shares</i>															
Vol at NBBO	64.38%	63.99%	-0.39%	0.120	0.244	71.44%	71.15%	-0.29%	0.634	0.917	73.35%	73.81%	0.46%	0.541	0.980
Vol at Bid	5.19%	5.63%	0.44%	0.056	0.019	4.60%	5.21%	0.61%	0.698	0.526	4.00%	3.81%	-0.19%	0.658	0.329
Vol at Ask	5.30%	5.32%	0.02%	0.744	0.442	4.67%	4.98%	0.31%	0.891	0.604	3.37%	3.83%	0.46%	0.012	0.034
Vol Inside	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Vol Outside	12.25%	13.06%	0.81%	0.073	0.140	7.25%	7.39%	0.14%	0.084	0.201	3.78%	5.09%	1.31%	0.891	0.677
Vol Alone NBBO	51.43%	52.15%	0.72%	0.437	0.934	52.41%	54.64%	2.23%	0.390	0.395	45.74%	50.67%	4.93%	0.029	0.022
Vol Alone Bid	1.92%	2.21%	0.29%	0.202	0.028	1.94%	2.10%	0.16%	0.731	0.596	1.19%	1.20%	0.01%	0.490	0.810
Vol Alone Ask	0.31%	0.36%	0.05%	0.471	0.551	0.74%	0.74%	0.00%	0.366	0.072	0.25%	0.20%	-0.05%	0.058	0.149

Table 2.10: Quotes, Nasdaq Matching Sample, Medians 5-Day Pairings

This table contains the median pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ Matching Sample stocks.

The pairings contain 5 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average # of Quotes</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	52.51%	52.35%	-0.16%	0.006	0.104	50.01%	59.33%	9.32%	0.483	0.578	61.51%	63.43%	1.92%	0.357	0.502
At Bid	12.50%	12.50%	0.00%	0.621	0.828	10.40%	10.89%	0.49%	0.467	0.903	9.42%	8.33%	-1.09%	0.303	0.141
At Ask	11.33%	12.07%	0.74%	0.029	0.083	10.74%	11.17%	0.43%	0.328	0.529	8.39%	8.84%	0.45%	0.092	0.107
Inside NBBO	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Outside NBBO	10.00%	10.03%	0.03%	0.045	0.049	6.45%	6.56%	0.11%	0.337	0.644	4.21%	4.08%	-0.13%	0.723	0.483
Alone NBBO	40.77%	41.17%	0.40%	0.011	0.040	42.31%	43.77%	1.46%	0.003	0.002	38.92%	40.18%	1.26%	0.384	0.564
Alone Bid	3.66%	3.75%	0.09%	0.353	0.391	2.93%	3.00%	0.07%	0.398	0.233	2.33%	2.17%	-0.16%	0.570	0.534
Alone Ask	0.62%	0.75%	0.13%	0.066	0.143	1.12%	1.00%	-0.12%	0.080	0.176	0.64%	0.52%	-0.12%	0.200	0.465
<i>Average Volume in Shares</i>															
Vol at NBBO	64.06%	62.11%	-1.95%	0.026	0.026	70.15%	69.39%	-0.76%	0.635	0.965	71.43%	70.40%	-1.03%	0.024	0.078
Vol at Bid	5.09%	5.72%	0.63%	0.095	0.198	4.84%	4.81%	-0.03%	0.524	0.834	3.54%	3.83%	0.29%	0.398	0.490
Vol at Ask	5.26%	5.20%	-0.06%	0.174	0.164	4.20%	4.02%	-0.18%	0.139	0.112	3.58%	4.47%	0.89%	0.003	0.008
Vol Inside	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Vol Outside	12.69%	12.89%	0.20%	0.003	0.006	8.15%	8.60%	0.45%	0.583	0.878	5.28%	5.97%	0.69%	0.114	0.353
Vol Alone NBBO	50.00%	51.82%	1.82%	0.435	0.998	51.93%	55.65%	3.72%	0.114	0.034	49.19%	47.16%	-2.03%	0.443	0.561
Vol Alone Bid	1.94%	2.27%	0.33%	0.004	0.037	1.89%	2.09%	0.20%	0.263	0.215	1.10%	1.10%	0.00%	1.000	0.658
Vol Alone Ask	0.21%	0.27%	0.06%	0.043	0.056	0.62%	0.56%	-0.06%	0.867	0.725	0.23%	0.18%	-0.05%	0.658	0.260

Table 2.11: Quotes, Nasdaq Pilot Sample, Medians 3-Day Pairings

This table contains the median pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ Pilot Phase stocks.

The pairings contain 3 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average # of Quotes</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	54.62%	54.05%	-0.57%	0.249	0.559	60.90%	60.30%	-0.60%	0.861	0.800	68.70%	63.72%	-4.98%	0.000	0.000
At Bid	12.40%	12.50%	0.10%	0.673	0.952	10.06%	10.56%	0.50%	0.953	0.436	7.04%	8.03%	0.99%	0.084	0.042
At Ask	11.18%	12.69%	1.51%	0.366	0.194	10.44%	11.17%	0.73%	0.332	0.502	6.02%	8.82%	2.80%	0.000	0.000
Inside NBBO	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Outside NBBO	9.65%	10.23%	0.58%	0.976	0.830	6.32%	6.16%	-0.16%	1.000	0.232	2.63%	3.66%	1.03%	0.007	0.094
Alone NBBO	42.61%	41.18%	-1.43%	0.392	0.228	43.00%	44.14%	1.14%	0.129	0.252	42.42%	45.07%	2.65%	0.615	0.684
Alone Bid	3.47%	3.70%	0.23%	0.360	0.276	2.81%	2.79%	-0.02%	0.745	0.975	1.69%	1.96%	0.27%	0.000	0.002
Alone Ask	0.81%	0.89%	0.08%	0.444	0.187	1.37%	1.14%	-0.23%	0.148	0.046	0.46%	0.36%	-0.10%	0.705	0.295
<i>Average Volume in Shares</i>															
Vol at NBBO	63.79%	64.33%	0.54%	0.768	0.936	71.40%	70.88%	-0.52%	0.682	0.931	76.58%	75.19%	-1.39%	0.006	0.028
Vol at Bid	5.40%	5.77%	0.37%	0.741	0.213	4.84%	5.15%	0.31%	0.289	0.935	2.96%	3.40%	0.44%	0.071	0.129
Vol at Ask	5.08%	5.31%	0.23%	0.718	0.637	4.64%	5.01%	0.37%	0.304	0.672	2.54%	3.23%	0.69%	0.000	0.021
Vol Inside	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Vol Outside	12.56%	13.56%	1.00%	0.696	0.953	7.72%	7.38%	-0.34%	0.130	0.568	2.89%	4.84%	1.95%	0.046	0.121
Vol Alone NBBO	52.43%	53.06%	0.63%	0.093	0.721	52.39%	55.02%	2.63%	0.170	0.269	49.93%	55.16%	5.23%	0.067	0.048
Vol Alone Bid	1.92%	2.26%	0.34%	0.394	0.080	1.98%	2.12%	0.14%	0.976	0.729	0.79%	1.20%	0.41%	0.001	0.038
Vol Alone Ask	0.27%	0.33%	0.06%	0.947	0.789	0.77%	0.68%	-0.09%	0.242	0.037	0.15%	0.11%	-0.04%	0.043	0.024

Table 2.12: Quotes, Nasdaq Matching Sample, Medians 3-Day Pairings

This table contains the median pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ Matching Sample stocks.

The pairings contain 3 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average # of Quotes</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	52.57%	53.43%	0.86%	0.026	0.525	59.26%	58.90%	-0.36%	1.000	0.846	66.67%	65.85%	-0.82%	0.537	0.405
At Bid	12.15%	12.08%	-0.07%	0.738	0.367	10.89%	10.74%	-0.15%	0.113	0.486	7.21%	7.77%	0.56%	0.764	0.808
At Ask	11.62%	11.95%	0.33%	0.204	0.509	10.37%	11.39%	1.02%	0.428	0.381	6.93%	8.14%	1.21%	0.027	0.181
Inside NBBO	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Outside NBBO	9.77%	9.73%	-0.04%	0.038	0.049	5.99%	6.69%	0.70%	0.059	0.348	2.94%	3.72%	0.78%	0.008	0.107
Alone NBBO	40.30%	41.81%	1.51%	0.390	0.938	43.57%	43.43%	-0.14%	0.521	0.549	42.93%	43.88%	0.95%	0.260	0.184
Alone Bid	3.53%	3.63%	0.10%	0.805	0.693	3.03%	2.90%	-0.13%	0.976	0.666	1.69%	2.13%	0.44%	0.009	0.040
Alone Ask	0.57%	0.68%	0.11%	0.448	0.473	1.01%	0.87%	-0.14%	0.037	0.116	0.33%	0.27%	-0.06%	0.573	0.730
<i>Average Volume in Shares</i>															
Vol at NBBO	64.52%	61.69%	-2.83%	0.005	0.009	70.91%	70.48%	-0.43%	0.381	0.392	75.06%	71.40%	-3.66%	0.000	0.001
Vol at Bid	4.98%	5.54%	0.56%	0.504	0.249	4.56%	4.62%	0.06%	0.860	0.870	2.94%	3.76%	0.82%	0.001	0.006
Vol at Ask	5.35%	5.18%	-0.17%	0.334	0.664	3.73%	4.96%	1.23%	0.064	0.146	2.74%	4.12%	1.38%	0.000	0.018
Vol Inside	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Vol Outside	12.96%	12.33%	-0.63%	0.004	0.005	8.09%	8.63%	0.54%	0.175	0.496	3.62%	5.40%	1.78%	0.001	0.005
Vol Alone NBBO	49.74%	52.64%	2.90%	0.496	0.643	51.54%	55.84%	4.30%	0.815	0.212	53.21%	48.46%	-4.75%	0.050	0.136
Vol Alone Bid	1.88%	2.16%	0.28%	0.060	0.213	1.80%	1.94%	0.14%	0.302	0.558	0.74%	1.19%	0.45%	0.005	0.041
Vol Alone Ask	0.18%	0.25%	0.07%	0.129	0.258	0.54%	0.49%	-0.05%	0.926	0.652	0.08%	0.07%	-0.01%	0.665	0.327

Table 2.13: Quotes, Nasdaq Pilot Sample, Medians 1-Day Pairing (+1 to -1)

This table contains the median pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ Pilot Phase stocks.

The pairings contain 1 day of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
Average # of Quotes	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	35.83%	54.49%	18.66%	0.124	0.407	62.07%	58.33%	-3.74%	0.020	0.026	61.90%	60.55%	-1.35%	0.053	0.191
At Bid	11.95%	12.81%	0.86%	0.715	0.425	11.11%	12.60%	1.49%	0.242	0.046	9.68%	8.80%	-0.88%	0.531	0.743
At Ask	11.71%	12.71%	1.00%	0.210	0.268	10.73%	12.00%	1.27%	0.104	0.147	8.20%	10.92%	2.72%	0.005	0.010
Inside NBBO	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Outside NBBO	11.11%	10.86%	-0.25%	1.000	0.773	5.42%	6.20%	0.78%	0.197	0.618	3.86%	4.94%	1.08%	0.160	0.522
Alone NBBO	44.59%	39.81%	-4.78%	0.138	0.037	44.38%	43.57%	-0.81%	0.687	0.703	37.45%	40.00%	2.55%	0.760	0.462
Alone Bid	3.43%	3.91%	0.48%	0.400	0.199	2.71%	3.00%	0.29%	0.261	0.076	2.17%	2.37%	0.20%	0.262	0.079
Alone Ask	0.76%	0.92%	0.16%	0.085	0.077	1.61%	1.32%	-0.29%	0.958	0.433	0.90%	1.10%	0.20%	0.133	0.887
Average Volume n Shares															
Vol at NBBO	66.71%	60.93%	-5.78%	0.028	0.002	72.13%	68.51%	-3.62%	0.106	0.150	71.53%	72.59%	1.06%	0.838	0.814
Vol at Bid	5.04%	6.32%	1.28%	0.231	0.011	5.56%	5.57%	0.01%	0.879	0.380	4.42%	3.64%	-0.78%	0.095	0.287
Vol at Ask	5.20%	4.89%	-0.31%	0.754	0.736	4.77%	5.67%	0.90%	0.263	0.313	4.03%	3.77%	-0.26%	0.093	0.313
Vol Inside	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Vol Outside	12.68%	14.63%	1.95%	0.043	0.016	6.82%	8.01%	1.19%	0.005	0.030	5.53%	6.98%	1.45%	0.160	0.278
Vol Alone NBBO	52.86%	52.47%	-0.39%	0.284	0.543	51.61%	52.29%	0.68%	0.290	0.472	49.87%	49.40%	-0.47%	0.879	0.388
Vol Alone Bid	1.95%	2.89%	0.94%	0.007	0.002	1.63%	2.53%	0.90%	0.153	0.015	1.42%	1.81%	0.39%	0.098	0.181
Vol Alone Ask	0.24%	0.38%	0.14%	0.168	0.116	0.84%	0.87%	0.03%	0.874	0.342	49.00%	0.43%	-48.57%	0.525	0.092

Table 2.14: Quotes, Nasdaq Matching Sample, Medians 1-Day Pairing (+1 to -1)

This table contains the median pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ Matching Sample stocks.

The pairings contain 1 day of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average # of Quotes</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	32.63%	52.61%	19.98%	0.610	0.958	60.28%	57.64%	-2.64%	0.005	0.003	50.09%	61.33%	11.24%	0.168	0.124
At Bid	12.02%	11.85%	-0.17%	1.000	0.946	10.44%	11.01%	0.57%	0.612	0.929	9.88%	8.60%	-1.28%	0.209	0.083
At Ask	11.31%	11.06%	-0.25%	0.918	0.994	9.09%	10.74%	1.65%	0.010	0.007	9.64%	10.31%	0.67%	0.753	0.539
Inside NBBO	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Outside NBBO	10.96%	10.37%	-0.59%	0.469	0.595	6.22%	7.69%	1.47%	0.000	0.001	4.51%	5.81%	1.30%	0.041	0.253
Alone NBBO	40.34%	39.33%	-1.01%	0.011	0.080	45.85%	39.18%	-6.67%	0.003	0.041	37.90%	36.67%	-1.23%	0.332	0.123
Alone Bid	3.68%	3.54%	-0.14%	0.915	0.683	2.70%	3.00%	0.30%	0.185	0.140	2.38%	4.37%	1.99%	0.259	0.696
Alone Ask	0.70%	0.67%	-0.03%	0.767	0.490	0.86%	1.30%	0.44%	0.311	0.147	0.74%	5.70%	4.96%	0.682	0.848
<i>Average Volume in Shares</i>															
Vol at NBBO	63.35%	58.39%	-4.96%	0.103	0.171	67.64%	68.24%	0.60%	0.615	0.480	72.33%	65.07%	-7.26%	0.025	0.021
Vol at Bid	4.97%	6.26%	1.29%	0.497	0.094	4.97%	5.16%	0.19%	0.361	0.541	3.77%	4.37%	0.60%	0.295	0.144
Vol at Ask	5.72%	4.94%	-0.78%	0.438	0.214	4.59%	4.83%	0.24%	0.722	0.939	5.42%	5.70%	0.28%	0.462	0.366
Vol Inside	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%			0.00%	0.00%	0.00%		
Vol Outside	14.45%	13.82%	-0.63%	0.326	0.124	8.11%	9.68%	1.57%	0.060	0.121	5.28%	8.00%	2.72%	0.001	0.008
Vol Alone NBBO	50.53%	48.62%	-1.91%	0.334	0.263	50.32%	51.54%	1.22%	0.227	0.366	49.28%	42.86%	-6.42%	0.262	0.211
Vol Alone Bid	2.17%	2.54%	0.37%	0.089	0.142	1.86%	1.88%	0.02%	0.154	0.402	1.22%	1.96%	0.74%	0.361	0.355
Vol Alone Ask	0.29%	0.23%	-0.06%	0.678	0.445	0.49%	0.62%	0.13%	0.122	0.460	0.25%	40.00%	39.75%	0.413	0.898

Table 2.15: Quotes, Nasdaq Pilot Sample, Medians Event Day Matching (+0 to -1)

This table contains the median pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ Pilot Phase stocks.

The pairings contain 1 day before the event day to the event day. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average # of Quotes</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	58.571%	58.549%	-0.022%	0.878	0.478	70.715%	71.008%	0.293%	1.000	0.997	66.418%	68.443%	2.025%	0.682	0.236
At Bid	11.513%	11.220%	-0.292%	1.000	0.844	2.168%	1.900%	-0.268%	0.000	0.000	9.827%	8.696%	-1.131%	0.712	0.796
At Ask	11.749%	12.397%	0.648%	0.601	0.895	12.542%	11.668%	-0.874%	0.387	0.461	8.743%	8.108%	-0.635%	0.288	0.134
Inside NBBO	0.000%	0.000%				0.000%	0.000%				0.000%	0.000%			
Outside NBBO	10.795%	9.376%	-1.419%	0.498	0.717	8.059%	6.153%	-1.906%	0.638	0.782	3.404%	3.220%	-0.185%	0.444	0.251
Alone NBBO	43.875%	42.537%	-1.338%	0.003	0.000	37.446%	36.745%	-0.701%	0.000	0.005	38.776%	37.241%	-1.534%	0.004	0.002
Alone Bid	1.087%	0.685%	-0.402%	0.000	0.000	0.256%	0.272%	0.015%	0.919	0.729	0.959%	0.870%	-0.090%	0.357	0.188
Alone Ask	0.684%	0.829%	0.145%	0.385	0.110	1.523%	1.457%	-0.067%	0.016	0.093	0.877%	0.885%	0.008%	0.326	0.400
<i>Average Volume in Shares</i>															
Vol at NBBO	67.435%	67.396%	-0.040%	0.759	0.614	73.122%	74.719%	1.597%	1.000	0.790	76.129%	77.215%	1.086%	0.574	0.587
Vol at Bid	5.045%	4.952%	-0.093%	0.875	0.419	4.947%	4.481%	-0.466%	0.025	0.015	4.301%	4.204%	-0.097%	0.493	0.922
Vol at Ask	5.167%	5.150%	-0.016%	0.402	0.585	4.616%	4.345%	-0.271%	0.647	0.405	4.007%	39.908%	35.901%	0.671	0.557
Vol Inside	0.000%	0.000%				0.000%	0.000%				0.000%	0.000%			
Vol Outside	13.866%	13.594%	-0.273%	0.434	0.634	8.630%	7.465%	-1.164%	0.714	0.503	5.534%	4.435%	-1.099%	0.913	0.510
Vol Alone NBBO	53.186%	50.844%	-2.342%	0.016	0.002	52.049%	51.337%	-0.712%	0.038	0.134	48.754%	43.890%	-4.865%	0.000	0.000
Vol Alone Bid	1.796%	1.825%	0.029%	0.242	0.295	1.716%	1.701%	-0.015%	1.000	0.943	1.301%	1.082%	-0.218%	0.665	0.683
Vol Alone Ask	0.245%	0.325%	0.081%	0.118	0.017	0.907%	0.801%	-0.106%	0.310	0.706	0.484%	0.304%	-0.180%	0.119	0.130

Table 2.16: Quotes, Nasdaq Matching Sample, Medians Event Day Matching (+0 to -1)

This table contains the median pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ Matching sample stocks.

The pairings contain 1 day before the event day to the event day. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average # of Quotes</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
At NBBO	58.824%	57.613%	-1.210%	0.509	0.395	68.915%	67.952%	-0.964%	0.175	0.044	63.536%	64.103%	0.567%	0.442	0.174
At Bid	11.594%	9.901%	-1.693%	0.005	0.010	2.232%	2.011%	-0.221%	0.001	0.000	9.091%	7.782%	-1.309%	0.873	0.999
At Ask	11.638%	11.419%	-0.219%	0.715	0.786	11.158%	12.734%	1.577%	0.033	0.041	10.096%	8.889%	-1.207%	0.223	0.219
Inside NBBO	0.000%	0.000%				0.000%	0.000%				0.000%	0.000%			
Outside NBBO	9.698%	8.696%	-1.003%	0.681	0.988	7.385%	7.754%	0.369%	0.168	0.007	3.947%	3.804%	-0.143%	0.110	0.240
Alone NBBO	42.857%	41.250%	-1.607%	0.446	0.262	38.713%	35.196%	-3.517%	0.002	0.000	37.063%	35.071%	-1.992%	0.757	0.727
Alone Bid	1.083%	0.926%	-0.157%	0.203	0.155	0.311%	0.232%	-0.078%	0.000	0.000	0.909%	0.881%	-0.028%	1.000	0.189
Alone Ask	0.615%	0.797%	0.181%	0.722	0.731	1.063%	1.054%	-0.010%	0.259	0.510	0.730%	0.708%	-0.022%	0.953	0.436
<i>Average Volume n Shares</i>															
Vol at NBBO	68.209%	68.592%	0.383%	0.960	0.512	71.829%	70.890%	-0.939%	0.010	0.002	72.634%	75.286%	2.652%	0.035	0.050
Vol at Bid	5.419%	4.553%	-0.866%	0.041	0.026	4.803%	4.640%	-0.164%	0.839	0.202	4.231%	4.255%	0.024%	0.313	0.434
Vol at Ask	5.263%	5.039%	-0.225%	0.715	0.415	4.323%	4.596%	0.273%	0.186	0.391	5.416%	3.401%	-2.014%	0.243	0.115
Vol Inside	0.000%	0.000%				0.000%	0.000%				0.000%	0.000%			
Vol Outside	12.755%	13.131%	0.376%	0.878	0.998	8.193%	9.206%	1.014%	0.028	0.001	5.625%	4.819%	-0.806%	0.545	0.511
Vol Alone NBBO	52.269%	52.319%	0.050%	0.611	0.381	53.431%	52.629%	-0.802%	0.039	0.049	47.565%	44.783%	-2.782%	0.680	0.610
Vol Alone Bid	2.135%	1.665%	-0.470%	0.056	0.288	1.704%	1.596%	-0.108%	0.474	0.151	1.240%	1.022%	-0.218%	0.049	0.324
Vol Alone Ask	0.192%	0.308%	0.116%	0.261	0.197	0.637%	0.622%	-0.016%	0.707	0.181	0.248%	0.244%	-0.004%	0.679	0.672

Table 3.1: Trades, NYSE Pilot Phase Sample, Medians 5-Day Pairings

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price.

Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid.

Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads.

The pairings contain 5 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average Descriptives</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	32500.00	30200.00	-2300.00	0.748	0.236	139900	131950	-7950.00	0.658	0.169	40100.00	31700.00	-8400.00	0.000	0.000
Ave. Trade Size	210.00	210.00	0.00	0.853	0.895	197	200	3.00	0.256	0.017	220.00	215.00	-5.00	0.296	0.065
Ave. Trade Price	43.50	44.19	0.69	0.412	0.000	44.08	44.95	0.87	0.826	0.000	41.85	42.97	1.12	0.000	0.195
<i>Trades</i>															
% # of buy trades	50.621%	49.260%	-1.36%	0.002	0.000	50.608%	49.979%	-0.63%	0.000	0.000	52.066%	48.198%	-3.87%	0.000	0.000
% # of sell trades	49.379%	50.740%	1.36%	0.002	0.000	49.392%	50.022%	0.63%	0.000	0.000	47.934%	51.802%	3.87%	0.000	0.000
% # of trades inside NBBO	27.29%	27.66%	0.37%	0.676	0.759	22.59%	24.59%	2.01%	0.000	0.000	14.29%	15.47%	1.18%	0.006	0.001
% # of trades outside NBBO	6.81%	8.03%	1.22%	0.000	0.000	3.18%	3.83%	0.65%	0.000	0.000	2.65%	2.80%	0.15%	0.806	0.209
% # of buy trades at ask	31.53%	29.41%	-2.12%	0.000	0.000	34.95%	32.65%	-2.30%	0.000	0.000	40.36%	35.75%	-4.61%	0.000	0.000
% # of sell trades at bid	30.47%	30.33%	-0.14%	0.073	0.135	33.03%	33.65%	0.62%	0.164	0.175	35.90%	40.00%	4.10%	0.000	0.000
Quoted half spread	0.013690	0.013925	0.000235	0.021	0.126	0.007500	0.007736	0.000236	0.947	0.171	0.006250	0.006421	0.000171	0.955	0.307
% quoted half spread	0.034249%	0.033887%	-0.000362%	0.018	0.076	0.020563%	0.020288%	-0.000275%	0.260	0.302	0.016781%	0.017211%	0.000430%	0.422	0.300
Bid vol at quoted spread	4.66	4.51	-0.15	0.000	0.002	5.90	0.72	-5.18	0.000	0.000	8.79	7.79	-1.00	0.000	0.001
% bid vol at quoted spread	49.420%	49.977%	0.56%	0.054	0.015	49.398%	50.228%	0.83%	0.000	0.000	49.927%	50.000%	0.07%	0.153	0.018
Ask vol at quoted spread	5.00	4.52	-0.48	0.000	0.000	6.08	5.51	-0.57	0.000	0.000	8.77	7.80	-0.97	0.000	0.000
% Ask vol at quoted spread	50.581%	50.623%	0.04%	0.054	0.015	50.602%	49.772%	-0.83%	0.000	0.000	50.073%	50.000%	-0.07%	0.153	0.018
Total Vol at QS	10.22	9.45	-0.77	0.000	0.000	12.49	11.45	-1.04	0.000	0.000	18.01	15.87	-2.14	0.000	0.000
Effective half spread	0.005594	0.005797	0.000203	0.401	0.866	0.003163	0.003250	0.000087	0.000	0.000	0.002823	0.002835	0.000012	0.595	0.601
% effective half spread	0.013992%	0.014492%	0.000500%	0.588	0.916	0.008748%	0.008852%	0.000104%	0.001	0.002	0.007478%	0.007377%	-0.000101%	0.956	0.677

Table 3.2: Trades, NYSE Matching Sample, Medians 5-Day Pairings

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 5 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average Descriptives</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	21300.00	21300.00	0.00	0.336	0.739	112600.00	109300.00	-3300.00	0.518	0.112	28800.00	21900.00	-6900.00	0.000	0.000
Ave. Trade Size	197.00	195.00	-2.00	0.030	0.005	190.00	189.00	-1.00	0.296	0.506	202.00	200.00	-2.00	0.042	0.065
Ave. Trade Price	47.24	47.44	0.21	0.025	0.829	47.15	47.22	0.07	0.005	0.969	46.66	46.49	-0.17	0.115	0.890
% # of buy trades	51.579%	49.153%	-2.43%	0.000	0.000	50.557%	50.000%	-0.56%	0.022	0.010	51.566%	49.129%	-2.44%	0.000	0.000
% # of sell trades	48.421%	50.848%	2.43%	0.000	0.000	49.443%	50.000%	0.56%	0.022	0.010	48.434%	50.871%	2.44%	0.000	0.000
% # of trades inside NBBO	29.31%	29.90%	0.60%	0.739	0.542	25.53%	27.57%	2.04%	0.000	0.000	16.70%	18.92%	2.22%	0.000	0.000
% # of trades outside NBBO	6.39%	7.08%	0.69%	0.001	0.001	3.30%	3.75%	0.44%	0.000	0.000	2.68%	2.74%	0.06%	0.618	0.755
% # of buy trades at ask	31.30%	28.57%	-2.73%	0.000	0.000	34.26%	32.50%	-1.75%	0.000	0.000	38.71%	34.54%	-4.17%	0.000	0.000
% # of sell trades at bid	28.70%	29.41%	0.71%	0.006	0.000	32.22%	31.62%	-0.60%	0.238	0.101	35.79%	36.50%	0.71%	0.000	0.001
Quoted half spread	0.015277	0.015301 0.034424	0.000024	0.046	0.503	0.007997	0.008402	0.000405	0.000	0.000	0.006686	0.007034	0.000348	0.010	0.035
% quoted half spread	0.035030%	%	-0.000606%	0.047	0.445	0.020081%	0.020806%	0.000725%	0.000	0.001	1.760900%	0.017774%	-1.743126%	0.074	0.118
Bid vol at quoted spread	4.17	4.00	-0.17	0.000	0.004	4.81	4.62	-0.18	0.000	0.000	6.27	5.96	-0.30	0.012	0.007
% bid vol at quoted spread	50.000%	50.169%	0.17%	0.144	0.016	49.275%	50.263%	0.99%	0.000	0.000	48.763%	50.000%	1.24%	0.001	0.000
Ask vol at quoted spread	4.36	3.93	-0.43	0.000	0.000	5.11	4.65	-0.46	0.000	0.000	6.85	5.99	-0.86	0.000	0.000
% Ask vol at quoted spread	50.000%	49.832%	-0.17%	0.144	0.016	50.725%	49.737%	-0.99%	0.000	0.000	51.237%	50.000%	-1.24%	0.001	0.000
Total Vol at QS	8.93	8.43	-0.50	0.000	0.000	10.39	9.45	-0.94	0.000	0.000	13.59	11.92	-1.67	0.000	0.000
Effective half spread	0.005988	0.006137 0.014009	0.000149	0.312	0.537	0.003250	0.003529	0.000279	0.000	0.000	0.002891	0.002914	0.000023	0.843	0.635
% effective half spread	0.013829%	%	0.000180%	0.074	0.332	0.008251%	0.008889%	0.000638%	0.000	0.000	0.007615%	0.007590%	-0.000025%	0.615	0.438

Table 3.3: Trades, NYSE Pilot Phase Sample, Medians 3-Day Pairings

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 3 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average Descriptives</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	29950.00	32750.00	2800.00	0.000	0.000	129950	142150	12200.00	0.000	0.000	36800.00	34300.00	-2500.00	0.094	0.025
Ave. Trade Size	206.00	214.50	8.50	0.005	0.002	199.5	200	0.50	0.162	0.582	220.00	210.00	-10.00	0.366	0.222
Ave. Trade Price	43.23	43.83	0.60	0.000	0.000	45.12	44.95	-0.17	0.000	0.000	42.95	42.40	-0.55	0.000	0.000
% # of buy trades	50.000%	49.476%	-0.52%	0.285	0.075	50.420%	49.755%	-0.66%	0.000	0.001	50.000%	47.095%	-2.91%	0.000	0.000
% # of sell trades	50.000%	50.524%	0.52%	0.285	0.075	49.581%	50.245%	0.66%	0.000	0.001	50.000%	52.905%	2.91%	0.000	0.000
% # of trades inside NBBO	27.36%	27.27%	-0.09%	0.589	0.566	22.54%	24.58%	2.04%	0.003	0.001	14.38%	15.69%	1.30%	0.463	0.366
% # of trades outside NBBO	6.48%	7.83%	1.35%	0.000	0.000	3.02%	4.26%	1.24%	0.000	0.000	2.08%	3.13%	1.05%	0.000	0.000
% # of buy trades at ask	31.31%	29.41%	-1.90%	0.002	0.000	35.06%	32.20%	-2.86%	0.000	0.000	39.54%	34.78%	-4.75%	0.000	0.000
% # of sell trades at bid	31.27%	30.39%	-0.88%	0.857	0.924	33.03%	33.92%	0.89%	0.212	0.234	37.50%	40.82%	3.32%	0.000	0.000
Quoted half spread	0.013333	0.013924	0.000591	0.275	0.401	0.007561	0.007802	0.000241	0.222	0.854	0.006188	0.006279	0.000091	0.248	0.866
% quoted half spread	0.033138%	0.033517%	0.000379%	0.307	0.543	0.020752%	0.020649%	-0.000103%	0.528	0.803	0.016610%	0.017511%	0.000901%	0.109	0.083
Bid vol at quoted spread	4.69	4.62	-0.07	0.082	0.056	6.01	5.54	-0.48	0.000	0.000	9.00	7.69	-1.31	0.021	0.009
% bid vol at quoted spread	49.974%	50.000%	0.03%	0.000	0.000	49.488%	50.544%	1.06%	0.002	0.000	49.743%	50.628%	0.88%	0.010	0.005
Ask vol at quoted spread	4.84	4.61	-0.23	0.006	0.000	6.17	5.40	-0.77	0.000	0.000	9.17	7.61	-1.56	0.000	0.000
% Ask vol at quoted spread	50.026%	50.000%	-0.03%	0.150	0.098	50.513%	49.456%	-1.06%	0.002	0.000	50.257%	49.372%	-0.88%	0.010	0.005
Total Vol at QS	10.00	9.67	-0.33	0.013	0.000	12.96	11.33	-1.64	0.000	0.000	18.75	15.60	-3.14	0.000	0.000
Effective half spread	0.005518	0.005789	0.000271	0.084	0.152	0.003136	0.003279	0.000143	0.000	0.000	0.002716	0.002868	0.000152	0.004	0.000
% effective half spread	0.013558%	0.014652%	0.001094%	0.064	0.275	0.008668%	0.009248%	0.000580%	0.000	0.000	0.007164%	0.007703%	0.000539%	0.000	0.000

Table 3.4: Trades, NYSE Matching Sample, Medians 3-Day Pairings

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 3 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average Descriptives</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	20200.00	23500.00	3300.00	0.000	0.000	103500	123800	20300.00	0.000	0.000	27100.00	24200.00	-2900.00	0.201	0.018
Ave. Trade Size	194.00	198.50	4.50	0.220	0.262	194	191	-3.00	0.911	0.218	201.00	200.00	-1.00	0.712	0.726
Ave. Trade Price	47.61	46.53	-1.08	0.000	0.000	47.48	46.908	-0.57	0.000	0.000	47.10	4625.00	4577.90	0.000	0.000
% # of buy trades	51.454%	49.105%	-2.35%	0.000	0.000	50.283%	49.921%	-0.36%	0.017	0.006	50.000%	48.649%	-1.35%	0.000	0.001
% # of sell trades	48.546%	50.895%	2.35%	0.000	0.000	49.717%	50.079%	0.36%	0.017	0.006	50.000%	51.351%	1.35%	0.000	0.001
% # of trades inside NBBO	29.30%	28.91%	-0.38%	0.667	0.518	25.69%	27.71%	2.01%	0.000	0.000	17.65%	19.41%	1.76%	0.001	0.005
% # of trades outside NBBO	6.04%	7.14%	1.10%	0.000	0.000	3.13%	4.10%	0.97%	0.000	0.000	2.08%	3.26%	1.18%	0.000	0.000
% # of buy trades at ask	30.77%	28.35%	-2.42%	0.000	0.000	33.88%	31.44%	-2.44%	0.000	0.000	37.70%	33.33%	-4.37%	0.000	0.000
% # of sell trades at bid	29.37%	30.00%	0.63%	0.092	0.006	32.15%	32.46%	0.32%	0.889	0.827	38.16%	36.83%	-1.33%	0.044	0.198
Quoted half spread	0.014900	0.015045	0.000145	0.870	0.090	0.008218	0.008456	0.000238	0.031	0.018	0.006751	0.007156	0.000405	0.243	0.205
% quoted half spread	0.033515%	0.033507%	-0.000008%	0.673	0.059	0.020394%	0.021088%	0.000694%	0.002	0.005	0.017908%	0.017895%	-0.000013%	0.001	0.031
Bid vol at quoted spread	4.22	4.22	0.00	0.117	0.256	4.86	4.73	-0.14	0.002	0.000	6.25	6.15	-0.10	0.811	0.398
% bid vol at quoted spread	50.000%	50.540%	0.54%	0.241	0.115	49.376%	50.460%	1.08%	0.000	0.000	49.029%	50.633%	1.60%	0.002	0.000
Ask vol at quoted spread	4.27	4.05	-0.22	0.126	0.022	5.26	4.57	-0.68	0.000	0.000	6.84	5.89	-0.95	0.000	0.000
% Ask vol at quoted spread	50.000%	49.489%	-0.51%	0.241	0.115	50.624%	49.540%	-1.08%	0.000	0.000	50.971%	49.367%	-1.60%	0.002	0.000
Total Vol at QS	8.86	8.70	-0.16	0.021	0.033	10.62	9.40	-1.23	0.000	0.000	13.35	12.11	-1.23	0.021	0.001
Effective half spread	0.005665	0.006091	0.000426	0.020	0.004	0.003228	0.003705	0.000477	0.000	0.000	0.002845	0.003020	0.000175	0.002	0.000
% effective half spread	0.013147%	0.013768%	0.000621%	0.000	0.001	0.008094%	0.009211%	0.001117%	0.000	0.000	0.007362%	0.008133%	0.000771%	0.000	0.000

Table 3.5: Trades, NYSE Pilot Phase Sample, Medians 1-Day Pairings (+1 to -1)

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 1 day of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average Descriptives</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	32500.00	33600.00	1100.00	0.082	0.006	137350	142950	5600.00	0.012	0.000	34200.00	35000.00	800.00	0.000	0.000
Ave. Trade Size	200.00	214.00	14.00	0.034	0.029	196	196.5	0.50	0.748	0.755	212.00	201.00	-11.00	0.244	0.466
Ave. Trade Price	43.65	43.72	0.07	0.002	0.376	45.15	44.95	-0.20	0.000	0.000	43.45	43.34	-0.11	0.000	0.000
<i>Trades</i>															
% # of buy trades	48.240%	48.190%	-0.05%	0.682	0.417	50.000%	47.970%	-2.03%	0.001	0.022	48.550%	44.500%	-4.05%	0.000	0.000
% # of sell trades	51.760%	51.810%	0.05%	0.682	0.417	50.000%	52.030%	2.03%	0.001	0.022	51.450%	55.500%	4.05%	0.000	0.000
% # of trades inside NBBO	27.42%	26.67%	-0.75%	0.437	0.255	23.23%	24.43%	1.20%	0.926	0.614	14.09%	14.61%	0.52%	0.030	0.067
% # of trades outside NBBO	7.58%	7.14%	-0.44%	1.000	0.406	3.06%	3.98%	0.92%	0.000	0.000	2.24%	3.32%	1.08%	0.000	0.000
% # of buy trades at ask	28.85%	28.25%	-0.60%	0.836	0.727	33.33%	30.42%	-2.91%	0.001	0.002	37.74%	31.44%	-6.30%	0.000	0.000
% # of sell trades at bid	33.33%	32.49%	-0.84%	0.959	0.922	34.79%	36.43%	1.64%	0.001	0.002	40.34%	44.81%	4.47%	0.000	0.000
Quoted half spread	0.012970	0.013974	0.001004	0.740	0.823	0.007455	0.007686	0.000231	0.183	0.541	0.005973	0.019500	0.013527	0.015	0.065
% quoted half spread	0.034336%	0.032803%	-0.001533%	0.742	0.644	0.020937%	0.020826%	-0.000111%	0.922	0.914	0.016531%	0.016626%	0.000095%	0.957	0.969
Bid vol at quoted spread	4.68	5.00	0.32	0.243	0.224	5.33	5.12	-0.21	0.000	0.002	8.47	8.06	-0.41	1.000	0.764
% bid vol at quoted spread	50.581%	50.805%	0.22%	1.000	0.642	49.893%	50.467%	0.57%	0.143	0.036	50.000%	50.368%	0.37%	0.389	0.320
Ask vol at quoted spread	4.49	4.57	0.08	0.376	0.550	5.61	4.85	-0.75	0.000	0.000	8.52	7.25	-1.27	0.084	0.286
% Ask vol at quoted spread	49.419%	49.196%	-0.22%	1.000	0.642	50.107%	49.533%	-0.57%	0.143	0.036	50.000%	49.632%	-0.37%	0.389	0.320
Total Vol at QS	9.67	9.92	0.26	0.062	0.208	11.60	10.11	-1.49	0.000	0.000	17.64	15.52	-2.11	0.872	0.691
Effective half spread	0.005783	0.005529	-0.000254	0.783	0.414	0.003083	0.003199	0.000116	0.002	0.015	0.002673	0.002848	0.000175	0.137	0.039
% effective half spread	0.014093%	0.014084%	-0.000009%	0.660	0.599	0.008753%	0.008847%	0.000094%	0.000	0.003	0.007203%	0.007858%	0.000655%	0.000	0.002

Table 3.6: Trades, NYSE Matching Sample, Medians 1-Day Pairings (+1 to -1)

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 1 day of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average Descriptives</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	20400.00	23500.00	3100.00	0.015	0.002	103950.00	122650.00	18700.00	0.001	0.000	23400.00	24700.00	1300.00	0.013	0.000
Ave. Trade Size	191.00	200.00	9.00	0.753	0.827	189.00	187.00	-2.00	0.667	0.632	197.00	203.00	6.00	0.683	0.741
Ave. Trade Price	47.62	47.42	-0.20	0.000	0.000	47.27	46.91	-0.36	0.000	0.000	47.30	46.86	-0.44	0.000	0.000
% # of buy trades	47.921%	46.961%	-0.96%	0.296	0.402	49.571%	49.404%	-0.17%	0.306	0.739	48.770%	44.828%	-3.94%	0.000	0.001
% # of sell trades	52.079%	53.039%	0.96%	0.296	0.403	50.429%	50.596%	0.17%	0.306	0.741	51.423%	55.172%	3.75%	0.000	0.001
% # of trades inside NBBO	29.63%	28.89%	-0.74%	0.527	0.876	26.89%	27.91%	1.02%	0.597	0.655	18.03%	19.17%	1.14%	0.875	0.955
% # of trades outside NBBO	6.06%	7.14%	1.08%	0.002	0.004	2.86%	4.21%	1.35%	0.000	0.000	2.20%	4.00%	1.80%	0.000	0.000
% # of buy trades at ask	27.07%	27.07%	0.00%	0.636	0.673	33.21%	30.77%	-2.44%	0.025	0.085	34.88%	30.97%	-3.90%	0.000	0.000
% # of sell trades at bid	31.71%	31.58%	-0.13%	0.833	0.368	33.14%	33.36%	0.22%	0.115	0.253	38.89%	39.36%	0.47%	0.002	0.020
Quoted half spread	0.015792	0.015752	-0.000040	0.536	0.103	0.008303	0.004340	-0.003963	0.001	0.003	0.006800	0.007095	0.000295	0.911	0.448
% quoted half spread	0.033723%	0.034175 %	0.000452%	0.502	0.163	0.001004%	0.000861%	-0.000143%	0.000	0.001	0.012484%	0.001877%	-0.010607%	0.093	0.893
Bid vol at quoted spread	4.29	4.26	-0.03	0.573	0.892	4.45	4.80	0.35	0.112	0.058	5.76	6.52	0.76	0.080	0.006
% bid vol at quoted spread	50.373%	50.663%	0.29%	0.537	0.419	49.890%	50.726%	0.84%	0.011	0.000	49.543%	51.230%	1.69%	0.007	0.004
Ask vol at quoted spread	3.86	4.00	0.14	0.129	0.129	4.86	4.27	-0.59	0.000	0.000	5.91	5.70	-0.21	1.000	0.301
% Ask vol at quoted spread	49.627%	49.337%	-0.29%	0.537	0.419	50.110%	49.274%	-0.84%	0.011	0.000	50.457%	48.771%	-1.69%	0.007	0.004
Total Vol at QS	8.50	8.84	0.34	0.314	0.382	9.83	9.11	-0.72	0.003	0.000	12.03	12.82	0.79	0.300	0.249
Effective half spread	0.005626	0.006111	0.000485	0.010	0.007	0.001399	0.003763	0.002364	0.000	0.000	0.002942	0.003046	0.000104	0.204	0.121
% effective half spread	0.012487%	0.014019 %	0.001532%	0.010	0.007	0.008000%	0.009197%	0.001197%	0.000	0.000	0.007541%	0.007817%	0.000276%	0.022	0.011

Table 3.7: Trades, NYSE Pilot Phase Sample, Medians Event Day Matching (+0 to -1)

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 1 day of data before the event date to the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
Average Descriptives	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	32600.00	31450.00	-1150.00	0.383	0.126	131200.00	146100.00	14900.00	0.790	0.177	34100.00	32400.00	-1700.00	0.691	0.210
Ave. Trade Size	202.50	228.00	25.50	0.003	0.000	195.00	200.00	5.00	1.000	0.343	212.00	202.00	-10.00	0.473	0.748
Ave. Trade Price	43.66	44.09	0.43	0.000	0.000	45.18	45.33	0.15	0.000	0.000	43.86	44.10	0.24	0.054	0.043
Trades															
% # of buy trades	48.258%	49.180%	0.92%	0.181	0.209	50.000%	50.000%	0.00%	0.716	0.615	48.472%	48.356%	-0.12%	0.724	0.443
% # of sell trades	51.742%	50.820%	-0.92%	0.181	0.209	50.000%	50.000%	0.00%	0.716	0.615	51.528%	51.644%	0.12%	0.724	0.443
% # of trades inside NBBO	27.47%	27.20%	-0.27%	0.680	0.845	23.70%	24.66%	0.96%	0.249	0.224	14.29%	13.87%	-0.42%	0.117	0.376
% # of trades outside NBBO	7.69%	7.37%	-0.32%	0.487	0.489	2.90%	2.97%	0.07%	0.492	0.714	2.22%	2.96%	0.74%	0.007	0.008
% # of buy trades at ask	28.57%	29.75%	1.18%	0.117	0.022	33.33%	32.92%	-0.41%	0.781	0.905	37.84%	36.51%	-1.32%	0.648	0.692
% # of sell trades at bid	33.33%	29.81%	-3.52%	0.002	0.005	34.36%	33.33%	-1.03%	0.485	0.609	40.34%	36.38%	-3.96%	0.723	0.156
Quoted half spread	0.011089	0.010362	-0.000727	0.603	0.917	0.006775	0.006930	0.000155	0.234	0.455	0.005831	0.005860	0.000029	0.587	0.655
% quoted half spread	0.027672%	0.027247%	-0.000425%	1.000	0.638	0.018078%	0.018537%	0.000459%	0.060	0.152	0.014825%	0.014850%	0.000025%	0.712	0.587
Bid vol at quoted spread	3.81	3.91	0.10	0.689	0.998	5.00	5.00	0.00	0.580	0.811	6.54	6.57	0.03	0.539	0.462
% bid vol at quoted spread	50.000%	50.000%	0.00%	0.960	0.520	50.000%	50.000%	0.00%	0.580	0.917	50.000%	49.848%	-0.15%	0.798	0.779
Ask vol at quoted spread	3.69	3.73	0.04	0.146	0.120	5.05	5.00	-0.05	0.580	0.578	6.92	7.03	0.11	0.261	0.880
% Ask vol at quoted spread	50.000%	50.000%	0.00%	0.960	0.520	50.000%	50.000%	0.00%	0.580	0.917	50.000%	50.152%	0.15%	0.798	0.779
Total Vol at QS	8.07	7.84	-0.23	0.766	0.485	10.31	10.31	0.00	0.270	0.229	13.95	14.17	0.22	0.919	0.333
Effective half spread	0.004428	0.004642	0.000214	0.793	0.776	0.002810	0.002845	0.000035	0.296	0.438	0.002559	0.002644	0.000085	0.419	0.342
% effective half spread	0.011597%	0.011106%	-0.000491%	0.754	0.916	0.007800%	0.007547%	-0.000252%	0.187	0.299	0.006414%	0.006552%	0.000138%	0.493	0.260

Table 3.8: Trades, NYSE Matching Sample, Medians Event Day Matching (+0 to -1)

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 1 day of data before the event date to the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average Descriptives</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	20300.00	27950.00	7650.00	0.037	0.010	103500.00	141000.00	37500.00	0.050	0.014	24900.00	28100.00	3200.00	1.000	0.659
Ave. Trade Size	190.50	197.00	6.50	0.044	0.003	186.00	189.00	3.00	0.069	0.056	195.00	192.00	-3.00	0.794	0.435
Ave. Trade Price	47.61	47.64	0.03	0.000	0.000	47.29	47.51	0.22	0.010	0.005	47.08	47.08	0.00	0.021	0.207
% # of buy trades	47.727%	50.669%	2.94%	0.009	0.001	49.604%	50.000%	0.40%	0.452	0.237	48.373%	49.575%	1.20%	0.412	0.101
% # of sell trades	52.273%	49.331%	-2.94%	0.009	0.001	50.396%	50.000%	-0.40%	0.452	0.237	51.627%	50.425%	-1.20%	0.412	0.101
% # of trades inside NBBO	29.79%	29.33%	-0.47%	0.104	0.193	27.02%	27.31%	0.30%	0.068	0.187	18.49%	18.76%	0.27%	0.493	0.595
% # of trades outside NBBO	6.15%	6.47%	0.32%	0.127	0.082	2.86%	2.85%	-0.01%	0.801	0.553	2.21%	2.73%	0.52%	0.022	0.014
% # of buy trades at ask	26.87%	29.82%	2.95%	0.012	0.001	32.83%	33.03%	0.20%	0.362	0.440	34.62%	35.85%	1.23%	1.000	0.423
% # of sell trades at bid	31.73%	28.76%	-2.97%	0.000	0.000	33.33%	32.06%	-1.27%	0.274	0.111	38.83%	36.09%	-2.74%	0.959	0.267
Quoted half spread	0.012598	0.011664	-0.000934	0.748	0.577	0.007592	0.007851	0.000259	0.528	0.878	0.006177	0.006341	0.000164	0.913	0.973
% quoted half spread	0.027894%	0.029581%	0.001687%	0.524	0.385	0.019530%	0.019480%	-0.000050%	0.924	0.934	0.016587%	0.015936%	-0.000651%	1.000	0.810
Bid vol at quoted spread	3.22	3.23	0.01	0.013	0.016	3.96	3.98	0.02	0.478	0.785	4.99	5.34	0.35	0.044	0.003
% bid vol at quoted spread	50.000%	49.857%	-0.14%	0.002	0.007	50.000%	50.000%	0.00%	1.000	0.229	49.869%	50.000%	0.13%	0.642	0.849
Ask vol at quoted spread	3.13	3.26	0.13	0.509	0.181	4.18	4.00	-0.18	0.318	0.287	5.08	5.23	0.15	0.195	0.092
% Ask vol at quoted spread	50.000%	50.143%	0.14%	0.002	0.007	50.000%	50.000%	0.00%	1.000	0.229	50.131%	50.000%	-0.13%	0.642	0.849
Total Vol at QS	6.68	6.83	0.15	0.130	0.522	8.27	8.33	0.06	0.814	0.888	10.49	11.26	0.77	0.012	0.001
Effective half spread	0.004600	0.005000	0.000400	0.021	0.118	0.002905	0.002938	0.000033	0.807	0.546	0.002696	0.002701	0.000005	0.702	0.388
% effective half spread	0.011043%	0.011787%	0.000744%	0.136	0.133	0.007392%	0.007450%	0.000058%	0.597	0.680	0.006735%	0.006711%	-0.000023%	0.559	0.574

Table 3.9: Trades, Nasdaq Pilot Phase Sample, Medians 5- Day Pairings

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 5 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average Descriptives</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	6900.00	6177.00	-723.00	0.393	0.134	41951.00	40720.00	-1231.00	0.023	0.362	10505.00	8752.00	-1753.00	0.000	0.000
Ave. Trade Size	180.00	175.00	-5.00	0.638	0.381	160.00	158.00	-2.00	0.040	0.331	161.00	164.00	3.00	0.507	0.265
Ave. Trade Price	21.47	22.02	0.55	0.000	0.000	21.72	22.06	0.34	0.000	0.000	21.79	22.19	0.40	0.000	0.000
% # of buy trades	50.00%	50.00%	0.00%	0.122	0.117	49.41%	50.00%	0.59%	0.399	0.124	50.00%	50.00%	0.00%	0.141	0.089
% # of sell trades	50.00%	50.00%	0.00%	0.122	0.117	50.59%	50.00%	-0.59%	0.399	0.124	50.00%	50.00%	0.00%	0.141	0.089
% # of trades inside NBBO	34.23%	35.32%	1.09%	0.317	0.415	25.41%	28.35%	2.94%	0.000	0.000	18.87%	20.00%	1.13%	0.013	0.003
% # of trades outside NBBO	4.88%	4.27%	-0.61%	0.345	0.108	4.14%	3.34%	-0.80%	0.000	0.000	3.11%	1.48%	-1.63%	0.000	0.000
% # of buy trades at ask	27.27%	25.34%	-1.93%	0.034	0.024	31.88%	30.03%	-1.85%	0.008	0.010	36.49%	33.82%	-2.67%	0.000	0.000
% # of sell trades at bid	25.00%	27.41%	2.41%	0.032	0.041	33.33%	31.58%	-1.75%	0.002	0.000	34.95%	36.00%	1.05%	0.040	0.058
Quoted half spread	0.027852	0.028516	0.000664	0.802	0.523	0.018372	0.018333	-0.000039	0.135	0.018	0.011200	0.011326	0.000126	0.665	0.822
% quoted half spread	0.148281%	0.152667%	0.004386%	0.100	0.659	0.113241%	0.104506%	-0.008735%	0.155	0.002	0.071457%	0.070545%	-0.000912%	0.618	0.456
Bid vol at quoted spread	2.25	2.43	0.18	0.030	0.033	2.66	2.68	0.02	0.905	0.861	3.16	3.06	-0.10	0.004	0.011
% bid vol at quoted spread	47.740%	50.000%	2.26%	0.004	0.001	48.400%	50.260%	1.86%	0.000	0.000	49.420%	50.000%	0.58%	0.544	0.768
Ask vol at quoted spread	2.67	2.46	-0.21	0.065	0.104	2.95	2.68	-0.27	0.000	0.000	3.38	3.19	-0.19	0.091	0.025
% Ask vol at quoted spread	52.260%	50.000%	-2.26%	0.004	0.001	51.600%	49.740%	-1.86%	0.000	0.000	50.580%	50.000%	-0.58%	0.544	0.768
Total Vol at QS	5.40	5.50	0.10	0.829	0.930	6.12	5.91	-0.21	0.001	0.000	7.07	6.89	-0.18	0.009	0.008
Effective half spread	0.009839	0.010076	0.000237	0.775	0.873	0.007078	0.006643	-0.000435	0.001	0.000	0.004611	0.004444	-0.000167	0.313	0.058
% effective half spread	0.055220%	0.055741%	0.000521%	0.521	0.607	0.044973%	0.038658%	-0.006315%	0.000	0.000	0.028887%	0.028192%	-0.000695%	0.101	0.031

Table 3.10: Trades, Nasdaq Matching Sample, Medians 5-Day Pairings

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 5 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average Descriptives</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	6061.00	6187.00	126.00	0.825	0.108	36200.00	36568.50	368.50	0.354	0.070	9445.00	7961.00	-1484.00	0.000	0.000
Ave. Trade Size	168.00	173.00	5.00	0.046	0.198	157.50	163.00	5.50	0.586	0.020	157.00	161.00	4.00	0.563	0.128
Ave. Trade Price	19.24	19.41	0.17	0.408	0.001	19.02	19.11	0.09	0.501	0.039	19.33	19.55	0.22	0.769	0.380
% # of buy trades	50.260%	49.060%	-1.20%	0.000	0.000	49.660%	49.300%	-0.36%	0.087	0.421	50.000%	50.000%	0.00%	0.083	0.368
% # of sell trades	49.740%	50.940%	1.20%	0.000	0.000	50.340%	50.700%	0.36%	0.087	0.421	50.000%	50.000%	0.00%	0.083	0.368
% # of trades inside NBBO	34.95%	34.29%	-0.66%	0.889	0.936	26.65%	28.27%	1.62%	0.000	0.002	18.41%	20.34%	1.93%	0.006	0.000
% # of trades outside NBBO	3.92%	4.35%	0.43%	0.878	0.807	3.93%	3.82%	-0.11%	0.306	0.692	2.86%	1.32%	-1.54%	0.000	0.000
% # of buy trades at ask	26.67%	24.55%	-2.12%	0.005	0.013	31.38%	30.52%	-0.86%	0.009	0.009	35.06%	33.33%	-1.73%	0.002	0.005
% # of sell trades at bid	25.35%	26.92%	1.57%	0.091	0.042	32.58%	31.87%	-0.71%	0.417	0.139	35.00%	34.78%	-0.22%	0.549	0.661
Quoted half spread	0.028498	0.027241	-0.001257	0.461	0.486	0.018485	0.017374	-0.001111	0.691	0.264	0.010000	0.010661	0.000661	0.369	0.294
% quoted half spread	0.144047%	0.139526%	-0.004521%	0.825	0.485	0.101892%	0.097158%	-0.004734%	0.927	0.185	0.059757%	0.061602%	0.001845%	0.337	0.194
Bid vol at quoted spread	2.27	2.35	0.08	0.940	0.689	2.71	2.69	-0.02	0.093	0.524	3.00	2.87	-0.13	0.013	0.032
% bid vol at quoted spread	50.000%	50.000%	0.00%	0.796	0.548	49.910%	49.730%	-0.18%	0.692	0.606	49.890%	48.780%	-1.11%	0.554	0.771
Ask vol at quoted spread	2.38	2.40	0.02	0.680	0.171	2.87	2.67	-0.20	0.299	0.311	3.24	3.11	-0.13	0.249	0.326
% Ask vol at quoted spread	50.000%	50.000%	0.00%	0.796	0.548	50.090%	50.270%	0.18%	0.692	0.606	50.110%	51.220%	1.11%	0.554	0.771
Total Vol at QS	5.12	5.21	0.09	0.319	0.194	6.03	5.67	-0.36	0.063	0.402	7.06	6.42	-0.64	0.012	0.072
Effective half spread	0.009781	0.009840	0.000059	0.460	0.837	0.006787	0.006558	-0.000229	0.759	0.944	0.004245	0.004178	-0.000067	0.910	0.618
% effective half spread	0.047671%	0.049504%	0.001833%	0.507	0.944	0.039617%	0.038849%	-0.000768%	0.784	0.549	0.025469%	0.023798%	-0.001671%	0.768	0.704

Table 3.11: Trades, Nasdaq Pilot Phase Sample, Medians 3-Day Pairings

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 3 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
Average Descriptives	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	6202.00	7800.00	1598.00	0.000	0.000	38608.00	52115.00	13507.00	0.000	0.000	8315.00	11088.00	2773.00	0.001	0.000
Ave. Trade Size	179.00	179.00	0.00	0.030	0.295	163.00	161.00	-2.00	0.362	0.887	158.00	169.00	11.00	0.231	0.192
Ave. Trade Price	20.69	21.87	1.18	0.033	0.000	21.82	21.91	0.09	0.069	0.001	22.12	21.85	-0.27	0.000	0.000
% # of buy trades	50.000%	50.000%	0.00%	0.596	0.730	50.000%	49.580%	-0.42%	0.458	0.698	50.000%	50.00%	0.00%	0.313	0.180
% # of sell trades	50.000%	50.000%	0.00%	0.596	0.730	50.000%	50.420%	0.42%	0.458	0.698	50.000%	50.00%	0.00%	0.313	0.180
% # of trades inside NBBO	33.82%	35.09%	1.27%	0.320	0.584	24.58%	28.57%	3.99%	0.000	0.000	18.92%	20.00%	1.08%	0.192	0.144
% # of trades outside NBBO	4.58%	4.41%	-0.17%	0.969	0.470	4.23%	3.80%	-0.43%	0.508	0.333	2.38%	2.22%	-0.16%	1.000	0.818
% # of buy trades at ask	26.28%	26.67%	0.39%	0.225	0.520	32.56%	29.63%	-2.93%	0.000	0.000	36.36%	34.29%	-2.07%	0.035	0.006
% # of sell trades at bid	25.38%	27.07%	1.69%	0.214	0.260	33.33%	32.52%	-0.81%	0.024	0.013	34.78%	35.29%	0.51%	0.531	0.267
Quoted half spread	0.027917	0.028049	0.000132	0.495	0.983	0.018352	0.018998	0.000646	0.506	0.667	0.011272	0.011631	0.000359	0.535	0.661
% quoted half spread	0.147285%	0.154512%	0.007227%	0.365	0.523	0.113124%	0.109551%	-0.003573%	0.394	0.629	0.070271%	0.073627%	0.003356%	0.759	0.891
Bid vol at quoted spread	2.31	2.53	0.22	0.048	0.092	2.76	2.84	0.08	0.088	0.234	3.10	3.39	0.29	0.795	0.935
% bid vol at quoted spread	48.000%	49.510%	1.51%	0.100	0.130	48.050%	50.250%	2.20%	0.000	0.000	48.840%	50.000%	1.16%	0.090	0.170
Ask vol at quoted spread	2.61	2.61	0.00	0.679	0.851	3.03	2.76	-0.27	0.002	0.001	3.38	3.31	-0.07	0.501	0.177
% Ask vol at quoted spread	52.000%	50.490%	-1.51%	0.100	0.130	51.960%	49.750%	-2.21%	0.000	0.000	51.160%	50.000%	-1.16%	0.090	0.170
Total Vol at QS	5.45	5.63	0.18	0.715	0.698	6.22	6.11	-0.11	0.188	0.017	7.07	7.55	0.48	0.383	0.368
Effective half spread	0.009902	0.010076	0.000174	0.928	0.836	0.007132	0.006829	-0.000303	0.311	0.087	0.004654	0.004572	-0.000082	0.680	0.580
% effective half spread	0.054719%	0.056102%	0.001383%	0.415	0.495	0.044152%	0.039705%	-0.004447%	0.215	0.034	0.029203%	0.029602%	0.000399%	0.683	0.883

Table 3.12: Trades, Nasdaq Matching Sample, Medians 3-Day Pairings

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 3 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average Descriptives</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	5631.00	7700.00	2069.00	0.000	0.000	32864.00	52192.00	19328.00	0.000	0.000	7862.00	10097.00	2235.00	0.000	0.000
Ave. Trade Size	167.00	176.00	9.00	0.012	0.059	165.00	166.00	1.00	0.522	0.041	161.00	165.00	4.00	0.696	0.731
Ave. Trade Price	19.10	19.12	0.02	0.018	0.203	19.01	18.94	-0.07	0.000	0.000	19.14	19.20	0.06	0.000	0.000
% # of buy trades	50.000%	49.740%	-0.26%	0.044	0.254	50.000%	48.890%	-1.11%	0.049	0.141	50.580%	48.450%	-2.13%	0.002	0.010
% # of sell trades	50.000%	50.260%	0.26%	0.044	0.254	50.000%	51.110%	1.11%	0.049	0.141	49.420%	51.550%	2.13%	0.002	0.010
% # of trades inside NBBO	35.56%	34.48%	-1.08%	0.667	0.684	26.53%	28.20%	1.67%	0.001	0.010	18.57%	20.41%	1.84%	0.546	0.124
% # of trades outside NBBO	3.19%	4.46%	1.27%	0.141	0.058	3.64%	3.90%	0.26%	0.037	0.377	2.44%	2.38%	-0.06%	0.883	0.616
% # of buy trades at ask	25.64%	25.00%	-0.64%	0.688	0.951	32.11%	30.34%	-1.77%	0.012	0.003	35.68%	32.08%	-3.60%	0.000	0.000
% # of sell trades at bid	26.47%	26.24%	-0.23%	0.885	0.952	32.42%	32.26%	-0.16%	0.410	0.808	33.33%	35.58%	2.25%	0.044	0.005
Quoted half spread	0.027655	0.026659	-0.000996	0.344	0.667	0.018799	0.018697	-0.000102	0.201	0.864	0.009876	0.010999	0.001123	0.026	0.029
% quoted half spread	0.138295%	0.143139%	0.004844%	0.603	0.748	0.102410%	0.103216%	0.000806%	0.177	0.977	0.059003%	0.064477%	0.005474%	0.016	0.027
Bid vol at quoted spread	2.31	2.44	0.13	0.597	0.574	2.82	2.74	-0.08	0.023	0.066	3.00	2.96	-0.04	0.550	0.313
% bid vol at quoted spread	50.000%	50.350%	0.35%	0.812	0.872	50.020%	49.710%	-0.31%	0.812	0.754	49.530%	47.850%	-1.68%	0.258	0.511
Ask vol at quoted spread	2.38	2.46	0.08	0.847	0.493	3.08	2.73	-0.35	0.141	0.092	3.44	3.37	-0.07	0.516	0.353
% Ask vol at quoted spread	50.000%	49.650%	-0.35%	0.812	0.872	49.980%	50.290%	0.31%	0.812	0.754	50.470%	52.150%	1.68%	0.258	0.511
Total Vol at QS	5.14	5.53	0.39	0.478	0.276	6.31	5.79	-0.52	0.081	0.067	7.32	6.56	-0.76	0.132	0.165
Effective half spread	0.009311	0.009557	0.000246	0.394	0.207	0.006643	0.006817	0.000174	0.066	0.286	0.004123	0.004418	0.000295	0.064	0.092
% effective half spread	0.045688%	0.049445%	0.003757%	0.277	0.236	0.039527%	0.040714%	0.001187%	0.026	0.632	0.024548%	0.025345%	0.000797%	0.021	0.068

Table 3.13: Trades, Nasdaq Pilot Phase Sample, Medians 1-Day Pairing (+1 to -1)

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 1 day of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average Descriptives</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	4720.00	9708.00	4988.00	0.000	0.000	37652.00	55735.50	18083.50	0.000	0.000	8024.50	101855.50	93831.00	0.000	0.000
Ave. Trade Size	179.00	186.00	7.00	0.001	0.059	153.00	156.00	3.00	0.556	0.116	158.00	165.50	7.50	0.367	0.598
Ave. Trade Price	22.08	21.88	-0.20	0.466	0.528	22.26	22.46	0.20	0.038	0.010	22.28	22.47	0.19	0.000	0.000
<i>Trades</i>															
% # of buy trades	48.15%	48.72%	0.57%	0.580	0.664	48.33%	48.88%	0.55%	0.659	0.270	48.96%	48.16%	-0.80%	0.770	0.551
% # of sell trades	51.85%	51.28%	-0.57%	0.580	0.664	51.66%	51.12%	-0.54%	0.659	0.270	51.04%	51.84%	0.80%	0.770	0.551
% # of trades inside NBBO	35.71%	35.03%	-0.68%	0.461	0.294	25.03%	29.36%	4.33%	0.001	0.000	19.20%	20.67%	1.47%	0.413	0.133
% # of trades outside NBBO	3.92%	4.62%	0.70%	0.733	0.729	4.25%	3.55%	-0.70%	0.090	0.085	2.20%	2.79%	0.59%	0.546	0.683
% # of buy trades at ask	23.47%	26.42%	2.95%	0.120	0.051	31.41%	29.28%	-2.13%	0.285	0.551	33.80%	33.33%	-0.47%	0.089	0.051
% # of sell trades at bid	27.63%	28.29%	0.66%	0.805	0.859	33.89%	33.42%	-0.47%	0.243	0.019	35.86%	34.78%	-1.08%	0.954	0.985
Quoted half spread	0.029393	0.029643	0.000250	0.585	0.950	0.018514	0.019504	0.000990	0.099	0.375	0.011754	0.011603	-0.000151	0.779	0.600
% quoted half spread	0.145549%	0.170231%	0.024682%	0.482	0.983	0.105541%	0.107566%	0.002025%	0.043	0.454	0.066923%	0.073802%	0.006879%	0.677	0.236
Bid vol at quoted spread	2.33	2.65	0.32	0.048	0.039	2.59	2.76	0.17	0.102	0.390	2.96	3.39	0.43	0.833	0.502
% bid vol at quoted spread	48.330%	49.930%	1.60%	0.182	0.186	49.190%	50.380%	1.19%	0.102	0.155	49.530%	50.850%	1.32%	0.294	0.428
Ask vol at quoted spread	2.50	2.65	0.15	0.135	0.316	2.72	2.47	-0.25	0.327	0.216	3.06	3.26	0.20	0.573	0.991
% Ask vol at quoted spread	51.670%	50.070%	-1.60%	0.182	0.186	50.810%	49.620%	-1.19%	0.102	0.155	50.470%	49.150%	-1.32%	0.294	0.428
Total Vol at QS	5.38	5.66	0.28	0.085	0.102	5.82	5.67	-0.15	1.000	0.343	6.34	7.75	1.41	0.726	0.794
Effective half spread	0.010632	0.011250	0.000618	0.696	0.516	0.007137	0.007153	0.000016	0.599	0.984	0.004821	0.004569	-0.000252	0.726	0.804
% effective half spread	0.054420%	0.059203%	0.004783%	0.815	0.395	0.041494%	0.039428%	-0.002066%	0.327	0.735	0.027490%	0.030602%	0.003112%	1.000	0.704

Table 3.14: Trades: Nasdaq Matching Sample, Medians 1-Day Pairing (+1 to -1)

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 1 day of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
<i>Average Descriptives</i>	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	4700.00	8083.00	3383.00	0.000	0.000	34030.00	52192.00	18162.00	0.000	0.000	6926.00	10098.50	3172.50	0.000	0.000
Ave. Trade Size	164.00	171.00	7.00	0.006	0.021	156.00	162.00	6.00	0.130	0.075	156.50	159.50	3.00	1.000	0.966
Ave. Trade Price	19.10	19.15	0.05	0.042	0.023	19.14	19.30	0.16	0.000	0.000	19.35	19.20	-0.15	0.000	0.000
% # of buy trades	48.150%	47.370%	-0.78%	0.288	0.779	49.660%	47.580%	-2.08%	0.001	0.010	47.260%	45.990%	-1.27%	0.442	0.666
% # of sell trades	51.850%	52.630%	0.78%	0.288	0.779	50.350%	52.420%	2.07%	0.001	0.010	52.750%	54.010%	1.26%	0.442	0.666
% # of trades inside NBBO	35.00%	34.15%	-0.85%	0.118	0.622	26.67%	28.60%	1.93%	0.021	0.046	18.18%	21.63%	3.45%	0.036	0.004
% # of trades outside NBBO	3.13%	5.64%	2.51%	0.023	0.004	3.41%	3.94%	0.53%	0.046	0.072	2.44%	2.62%	0.18%	0.629	0.315
% # of buy trades at ask	23.53%	23.08%	-0.45%	0.899	0.850	32.11%	29.08%	-3.03%	0.001	0.002	34.47%	29.45%	-5.02%	0.001	0.000
% # of sell trades at bid	30.00%	28.21%	-1.79%	0.851	0.654	32.12%	33.33%	1.21%	0.029	0.245	36.34%	36.24%	-0.10%	0.442	0.468
Quoted half spread	0.026795	0.026834	0.000039	0.681	0.445	0.016667	0.017724	0.001057	0.080	0.092	0.009457	0.010824	0.001367	0.033	0.022
% quoted half spread	0.145422%	0.176185%	0.030763%	0.805	0.235	0.093283%	.096057%	.002774%	0.074	0.153	0.057237%	0.060238%	0.003001%	0.016	0.018
Bid vol at quoted spread	2.21	2.52	0.31	0.453	0.240	2.62	2.69	0.07	0.549	0.901	3.01	2.93	-0.08	0.208	0.170
% bid vol at quoted spread	50.000%	51.330%	1.33%	0.366	0.468	50.180%	50.000%	-0.18%	0.843	0.336	50.000%	47.940%	-2.06%	0.079	0.162
Ask vol at quoted spread	2.26	2.24	-0.02	0.869	0.730	2.89	2.50	-0.39	0.258	0.184	3.35	3.31	-0.04	0.883	0.821
% Ask vol at quoted spread	50.000%	48.670%	-1.33%	0.366	0.468	49.820%	50.010%	0.19%	0.843	0.336	50.000%	52.060%	2.06%	0.079	0.162
Total Vol at QS	4.77	5.32	0.55	0.565	0.277	5.87	5.43	-0.44	0.843	0.696	7.16	6.77	-0.39	0.465	0.500
Effective half spread	0.008891	0.010597	0.001706	0.099	0.128	0.006108	0.006671	0.000563	0.159	0.054	0.004199	0.004481	0.000282	0.205	0.223
% effective half spread	0.048349%	0.057526%	0.009177%	0.118	0.095	0.036256%	0.039353%	0.003097%	0.055	0.095	0.023010%	0.024060%	0.001050%	0.093	0.341

Table 3.15: Trades, Nasdaq Pilot Phase Sample, Medians Event Day Matching (0 to -1)

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price.

Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid.

Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads.

The pairings contain 1 day of data before the event date to the event date. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
Average Descriptives	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	4558.50	7169.50	2611.00	0.000	0.000	37233.00	44480.00	7247.00	0.001	0.001	8004.00	9566.00	1562.00	0.011	0.002
Ave. Trade Size	180.00	184.50	4.50	0.327	0.957	152.00	159.00	7.00	0.026	0.051	157.00	160.00	3.00	0.809	0.496
Ave. Trade Price	21.23	21.39	0.16	0.000	0.000	22.25	22.11	-0.14	0.013	0.005	22.29	22.88	0.59	0.007	0.012
% # of buy trades	47.987%	47.913%	-0.07%	0.356	0.484	47.908%	49.733%	1.83%	0.868	0.528	48.413%	49.222%	0.81%	0.224	0.429
% # of sell trades	52.013%	52.087%	0.07%	0.356	0.484	52.092%	50.267%	-1.83%	0.868	0.528	51.587%	50.778%	-0.81%	0.224	0.429
% # of trades inside NBBO	36.36%	33.75%	-2.61%	0.503	0.298	25.10%	27.31%	2.21%	0.261	0.232	19.20%	17.99%	-1.22%	0.126	0.015
% # of trades outside NBBO	3.88%	3.10%	-0.78%	0.245	0.023	4.11%	3.01%	-1.10%	0.145	0.033	2.26%	1.64%	-0.61%	0.250	0.119
% # of buy trades at ask	23.13%	25.00%	1.87%	0.069	0.029	31.13%	30.82%	-0.31%	0.301	0.680	33.47%	34.41%	0.93%	0.953	0.401
% # of sell trades at bid	27.34%	28.69%	1.36%	0.458	0.392	33.95%	32.77%	-1.18%	0.312	0.365	36.21%	36.81%	0.60%	0.032	0.144
Quoted half spread	0.000000	0.000000	0.000000	0.333	0.986	0.007077	0.008177	0.001100	0.574	0.877	0.005714	0.005735	0.000021	0.061	0.037
% quoted half spread	0.000000%	0.000000%	0.000000%	0.333	0.373	0.053051%	0.057136%	0.004085%	0.756	0.843	0.031923%	0.028082%	-0.003841%	0.084	0.121
Bid vol at quoted spread	2.19	2.42	0.23	0.343	0.276	3.03	3.25	0.22	0.602	0.211	3.58	3.87	0.29	0.023	0.176
% bid vol at quoted spread	50.000%	49.281%	-0.72%	0.221	0.185	50.000%	50.000%	0.00%	0.19	0.312	50.000%	50.000%	0.00%	0.628	0.463
Ask vol at quoted spread	2.21	2.71	0.50	0.019	0.002	3.12	3.39	0.27	0.047	0.071	3.78	4.09	0.31	0.027	0.006
% Ask vol at quoted spread	50.000%	50.719%	0.72%	0.221	0.185	50.000%	50.000%	0.00%	0.19	0.312	50.000%	50.000%	0.00%	0.628	0.463
Total Vol at QS	4.73	5.50	0.77	0.005	0.002	6.31	7.10	0.79	0.433	0.169	7.64	8.35	0.71	0.069	0.014
Effective half spread	0.000000	0.000000	0.000000	0.708	0.459	0.003136	0.003333	0.000197	0.574	0.080	0.002583	0.002500	-0.000083	0.020	0.015
% effective half spread	0.000000%	0.000000%	0.000000%	0.881	0.889	0.021518%	0.019621%	-0.001897%	0.534	0.127	0.013609%	0.012272%	-0.001337%	0.025	0.096

Table 3.16: Trades, Nasdaq Matching Sample, Medians Event Day Matching (+0 to -1)

This table contains the median pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price.

Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid.

Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads.

The pairings contain 1 day of data before the event date to the event date. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

No F Trades	1st Time Slice 9:30 am - 10:00 am					2nd Time Slice 10:00 am - 3:30 pm					3rd Time Slice 3:30 pm - 4:00pm				
Average Descriptives	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon	Pre	Post	Dif	Sign	Wilcoxon
Trade Volume	4740.50	6905.00	2164.50	0.001	0.000	33912.00	37273.00	3361.00	0.004	0.009	6770.00	9110.00	2340.00	0.036	0.014
Ave. Trade Size	164.00	186.50	22.50	0.001	0.003	156.00	158.00	2.00	0.101	0.248	153.50	155.50	2.00	0.809	0.708
Ave. Trade Price	19.86	19.96	0.10	0.000	0.000	19.14	19.43	0.29	0.099	0.416	20.12	19.36	-0.76	0.279	0.217
% # of buy trades	47.564%	46.195%	-1.37%	0.800	0.856	49.655%	48.873%	-0.78%	0.050	0.113	46.667%	49.444%	2.78%	0.078	0.297
% # of sell trades	52.436%	53.805%	1.37%	0.800	0.856	50.345%	51.127%	0.78%	0.050	0.112	53.333%	50.556%	-2.78%	0.078	0.297
% # of trades inside NBBO	34.52%	35.29%	0.77%	0.707	0.553	27.31%	27.73%	0.42%	0.307	0.182	17.92%	15.95%	-1.97%	0.717	0.274
% # of trades outside NBBO	3.13%	4.76%	1.63%	0.158	0.152	3.39%	3.37%	-0.02%	0.395	0.240	1.84%	2.01%	0.17%	0.454	0.690
% # of buy trades at ask	23.45%	22.51%	-0.94%	0.653	0.735	32.11%	28.81%	-3.29%	0.030	0.018	34.34%	33.33%	-1.00%	1.000	0.722
% # of sell trades at bid	30.28%	29.41%	-0.87%	0.655	0.705	31.98%	33.33%	1.35%	0.396	0.509	36.54%	36.86%	0.32%	0.953	0.848
Quoted half spread	0.000000	0.000000	0.000000	0.455	0.726	0.008664	0.007849	-0.000815	0.341	0.554	0.005362	0.005630	0.000268	0.627	0.939
% quoted half spread	0.000000%	0.000000%	0.000000%	0.654	0.522	0.045163%	0.045123%	-0.000040%	0.375	0.295	0.020525%	0.026798%	0.006273%	0.788	0.728
Bid vol at quoted spread	2.09	2.34	0.25	0.014	0.006	2.83	2.92	0.09	0.874	0.895	3.31	3.67	0.36	0.167	0.125
% bid vol at quoted spread	50.000%	50.000%	0.00%	0.648	0.862	50.000%	50.433%	0.43%	0.525	0.412	50.000%	50.000%	0.00%	0.912	0.796
Ask vol at quoted spread	2.06	2.32	0.26	0.008	0.004	3.01	2.80	-0.21	0.460	0.524	3.64	3.67	0.03	0.204	0.168
% Ask vol at quoted spread	50.000%	50.000%	0.00%	0.648	0.862	50.000%	49.568%	-0.43%	0.525	0.412	50.000%	50.000%	0.00%	0.912	0.796
Total Vol at QS	4.34	5.26	0.92	0.003	0.000	6.10	6.26	0.16	0.139	0.247	7.61	8.00	0.39	0.154	0.070
Effective half spread	0.000000	0.000000	0.000000	0.407	0.642	0.003353	0.003136	-0.000217	0.848	0.927	0.002500	0.002500	0.000000	1.000	0.757
% effective half spread	0.000000%	0.000000%	0.000000%	0.600	0.592	0.017232%	0.018015%	0.000783%	1.000	0.889	0.009072%	0.011256%	0.002184%	0.840	0.896

Table 4.1: Nasdaq Pilot Phase Stocks: Event Study Regressions

Rule 611 Pilot Phase Implementation Event Date: July 9, 2007

Estimation Period: 100-days prior to Event Period

Event Period: 15 days on both sides of the Event Date

Returns from CRSP Database

Full Sample N=94			
Period	CARS	t-stat	P-value
dn1 - dn15	-0.006040	-0.838050	0.404154
dn1 - dn10	-0.004700	-0.582060	0.561935
dn1 - dn5	-0.012760	-1.436150	0.154316
Event	0.004921	0.454757	0.650343
up1 - up5	-0.002190	-0.185990	0.852860
up1 - up10	-0.014950	-1.193630	0.235658
up1 - up15	-0.040730	-2.964340	0.003853

Mid-Cap Sample N=29			
Period	CARS	t-stat	P-value
dn1 - dn15	-0.015420	-1.63070	0.114153
dn1 - dn10	-0.003090	-0.28639	0.776690
dn1 - dn5	-0.013830	-1.15807	0.256620
Event	0.000516	0.04022	0.968203
up1 - up5	-0.003030	-0.21616	0.830430
up1 - up10	-0.019490	-1.37706	0.179404
up1 - up15	-0.021790	-1.34978	0.187898

Small-Cap Sample N=62			
Period	CARS	t-stat	P-value
dn1 - dn15	-0.003520	-0.354440	0.724228
dn1 - dn10	-0.006820	-0.614070	0.541451
dn1 - dn5	-0.013300	-1.088880	0.280491
Event	0.007571	0.496161	0.621564
up1 - up5	-0.001070	-0.064520	0.948763
up1 - up10	-0.012760	-0.721360	0.473443
up1 - up15	-0.047790	-2.478400	0.015979

Nasdaq Large Cap firms N=3 (sample regression omitted)

Table 4.2: NYSE Pilot Phase Stocks: Event Study Regressions**Rule 611 Pilot Phase Implementation Event Date: July 9, 2007****Estimation Period: 100-days prior to Event Period****Event Period: 15 days on both sides of the Event Date****Returns from CRSP Database**

Full Sample N=87			
Period	CARS	t-stat	P-value
dn1 - dn15	-0.012003	-2.202440	0.030310
dn1 - dn10	-0.007014	-1.093700	0.277141
dn1 - dn5	0.004371	0.629676	0.530576
Event	-0.000728	-0.106494	0.915439
up1 - up5	-0.016579	-2.133343	0.035745
up1 - up10	-0.026273	-3.081189	0.002769
up1 - up15	-0.046837	-4.574548	0.000016
Large Cap Sample N=55			
Period	CARS	t-stat	P-value
dn1 - dn15	-0.006135	-1.526460	0.132732
dn1 - dn10	0.000756	0.164524	0.869933
dn1 - dn5	-0.000015	-0.002960	0.997649
Event	-0.000024	-0.005095	0.995954
up1 - up5	-0.012583	-2.212486	0.031182
up1 - up10	-0.015200	-2.118473	0.038752
up1 - up15	-0.023748	-2.726367	0.008617
Mid-Cap Sample N=27			
Period	CARS	t-stat	P-value
dn1 - dn15	-0.013301	-0.978396	0.336895
dn1 - dn10	-0.012801	-0.799914	0.431009
dn1 - dn5	0.009597	0.560763	0.579760
Event	-0.001511	-0.083971	0.933723
up1 - up5	-0.016994	-0.906734	0.372875
up1 - up10	-0.025856	-1.348841	0.189020
up1 - up15	-0.043413	-2.212406	0.035927
Small-Cap Sample N=5			
Period	CARS	t-stat	P-value
dn1 - dn15	-0.069550	-1.906990	0.129193
dn1 - dn10	-0.061230	-1.476170	0.213941
dn1 - dn5	0.024397	0.571318	0.598353
Event	-0.004230	-0.101620	0.923949
up1 - up5	-0.058300	-1.239350	0.282962
up1 - up10	-0.150330	-3.080610	0.036910
up1 - up15	-0.319310	-4.403240	0.011662

Appendix A – NASDQ Pilot Phase Sample

Information for the 94 NASDAQ Stocks included in the pilot phase sample

- **Original Sample included 100 NASDAQ Stocks. Six firms were dropped due to data omissions on CRSP.**

Nasdaq Pilot Phase Sample						
	Pilot Phase Stock Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded	Sector and Industry
1	ARKANSAS BEST CORPORATION	ABFS	775.077	30.790	1,154.911	Services Trucking
2	AMERICAN COMMERCIAL LINES INC	ACLI	1,015.938	20.260	766.030	Services Air Delivery & Freight Services
3	ADVANCED ENERGY INDUSTRIES INC	AEIS	489.412	10.810	627.267	Technology Diversified Electronics
4	ALEXION PHARMACEUTICALS INC	ALXN	2,455.509	65.320	924.076	Healthcare Drug Manufacturers
5	ARM HOLDINGS PLC	ARMH	3,018.117	7.080	600.019	Technology Diversified Electronics
6	ASSOCIATED BANC-CORP	ASBC	3,580.833	28.180	1,914.122	Financial Regional Midwest Banks
7	ASCENT SOLAR TECHNOLOGIES INC	ASTI	169.260	15.000	574.713	Technology Semiconductor
8	AVICI SYSTEMS INC	AVCI	100.938	6.840	121.658	
9	AVOCENT CORPORATION	AVCT	829.685	16.600	1,218.167	
10	AVID TECHNOLOGY INC	AVID	1,064.379	25.920	673.635	Technology Multimedia & Graphic Software
11	AVI BIOPHARMA INC	AVII	79.889	1.240	410.204	Healthcare Biotechnology
12	ASPEN TECHNOLOGY INC	AZPN.PK	1,237.622	14.050	733.804	Technology Business Software
13	BALLARD POWER SYSTEMS INC	BLDP	528.304	4.590	517.897	Industrial Goods Industrial Electrical Equipment
14	CHINA BAK BATTERY INC	CBAK	233.002	4.400	581.664	Industrial Goods Industrial Electrical Equipment
15	COGENT COMMUNICATIONS	CCOI	986.306	20.470	1,108.638	Technology Diversified

	GRP					Communication Services
	Nasdaq Pilot Phase Sample					
	Pilot Phase Stock Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded	
16	CHARLOTTE RUSSE HOLDING INC	CHIC	450.371	18.030	995.409	Services Apparel Stores
17	CASUAL MALE RETAIL GRP INC	CMRG	200.878	4.860	602.287	Services Apparel Stores
18	COSI INC	COSI	122.910	3.000	231.689	Services Restaurants
19	CEPHEID INC	CPHD	1,694.970	30.540	1,687.408	Technology Scientific & Technical Instruments
20	CERADYNE INC	CRDN	1,315.265	48.150	705.012	Aerospace & Defense
21	CSG SYSTEMS INTL INC	CSGS	431.020	12.760	694.519	Technology Business Software & Services
22	DIODES INC	DIOD	927.597	23.150	554.402	Technology Semiconductor – Integrated Circuits
23	EDDIE BAUER HOLDINGS INC	EBHI	196.921	6.420	401.773	Services Apparel Stores
24	EAGLE BULK SHIPPING INC	EGLE	1,155.091	24.720	992.026	Services Shipping
25	EMAGEON INC	EMAG	61.635	2.880	131.006	Healthcare Technology
26	FINISH LINE INC -CL A	FINL	95.547	2.240	1,295.210	Services Apparel Stores
27	FLAMEL TECHNOLOGIES SA-ADR	FLML	225.754	9.390	183.234	Healthcare Drug Delivery
28	FORMFACTOR INC	FORM	1,176.995	24.220	1,055.661	Technology Semiconductor – Broad Line
29	FIBERTOWER CORP	FTWR	261.687	1.790	526.663	Technology Wireless Communication
30	GENVEC INC	GNVC	116.847	1.550	678.039	Healthcare Biotechnology
31	INTERDIGITAL INC	IDCC	958.884	20.210	727.655	Technology Wireless Communication

	Nasdaq Pilot Phase Sample					
	Pilot Phase Stock Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded	
32	INNERWORKINGS INC	INWK	664.745	13.850	504.843	Services Business Services
33	KNOT INC	KNOT	461.936	14.640	375.563	Technology Internet Information Providers
34	LCA VISION INC	LCAV	314.714	16.510	654.766	Healthcare Medical Practioners
35	LIFECCELL CORP	LIFC	1,346.777	39.510	622.595	Healthcare Biotechnology
36	LA JOLLA PHARMACEUTICAL CO	LJPC	140.605	3.550	98.466	Healthcare Biotechnology
37	LINCARE HOLDINGS INC	LNCR	2,678.480	33.410	1,277.767	Healthcare Home Health Care
38	MEDIACOM COMMUNICATIONS CORP	MCCC	389.236	4.960	628.981	Technology Broadcasting & Cable TV
39	MILlicom Intl Cellular SA	MICC	11,445.970	105.940	1,045.978	Technology Wireless Telecommunications
40	MKS INSTRUMENTS INC	MKSI	1,054.322	18.600	504.074	Industrial Goods Diversified Machinery
41	MACROVISION CORP	MVSN	903.336	16.790	1,172.969	Technology Systems Software
42	NABI BIOPHARMACEUTICALS	NABI	215.891	3.530	524.013	Healthcare Biotechnology
43	NAPSTER INC	NAPS	83.622	1.810	270.607	Technology Home Entertainment Software
44	NEWPORT CORP	NEWP	389.414	10.500	441.952	Technology Scientific & Technical Instruments
45	NORTHFIELD LABORATORIES INC	NFLD	28.577	1.060	111.497	Healthcare Biotechnology
46	NUTRITION 21 INC	NXXI	35.010	0.560	162.227	Healthcare Biotechnology
47	OMNI ENERGY SERVICES CORP	OMNI	74.476	3.960	241.458	Oil & Gas Equipment Services
48	OMNITURE INC	OMTR	1,729.411	24.720	1,412.117	Technology Internet Service Providers
49	O'REILLY AUTOMOTIVE	ORLY	3,386.422	29.430	2,023.213	Services

	INC					Auto Parts
	Nasdaq Pilot Phase Sample					
	Pilot Phase Stock Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded	
50	PACER INTERNATIONAL INC	PACR	594.565	17.130	547.943	Services Air Delivery & Freight Services
51	PANACOS PHARMACEUTICALS INC	PANC	26.768	0.500	493.235	Healthcare Biotechnology
52	P F CHANGS CHINA BISTRO INC	PFCB	739.440	28.440	1,576.414	Services Restaurants
53	PROGRESSIVE GAMING INTL CORP	PGIC	152.505	2.460	241.875	Services Gaming
54	PARALLEL PETROLEUM CORP	PLLL	572.592	13.880	651.600	Oil & Gas Exploration & Production
55	PANERA BREAD CO	PNRA	1,166.344	37.780	831.319	Services Specialty Eateries
56	PSYCHIATRIC SOLUTIONS INC	PSYS	1,657.992	30.170	1,108.359	Healthcare Specialized Health Services
57	PAIN THERAPEUTICS INC	PTIE	381.941	8.660	259.214	Healthcare Drug Manufacturer
58	PIXELWORKS INC	PXLW	39.876	0.860	204.905	Technology Semiconductor – Integrated Circuits
59	QLT INC	QLTI	273.855	3.670	514.366	Healthcare Biotechnology
60	QUANTUM FUEL SYS TECH WORLDW	QTWW	44.205	0.570	1,063.050	Consumer Goods Auto Parts
61	REGENERON PHARMACEUT	REGN	1,296.561	20.280	633.309	Healthcare Biotechnology
62	RENOVIS INC	RNVS	77.997	2.620	60.646	Healthcare Biotechnology
63	RYANAIR HOLDINGS PLC -ADR	RYAAY	9,964.527	33.420	1,145.169	Services Airlines
64	SCIELE PHARMA INC	SCRX	852.724	23.920	1,230.508	Healthcare Pharmaceuticals
65	SEATTLE GENETICS INC	SGEN	710.120	9.160	750.353	Healthcare Biotechnology
66	SHIRE PLC -ADR	SHPGY	10,037.030	53.850	1,459.214	Healthcare Drug Manufacturer
67	SIFY TECHNOLOGIES LTD -ADR	SIFY	204.584	4.780	245.120	Technology Internet Service

						Providers
	Nasdaq Pilot Phase Sample					
	Pilot Phase Stock Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded	
68	SKYWEST INC	SKYW	1,584.280	26.020	581.467	Services Regional Airlines
69	SHANDA INTERACTIVE-ADR	SNDA	1,983.610	27.490	1,070.084	Technology Multimedia & Graphics Software
70	SOLARFUN POWER HOLDINGS -ADR	SOLF	910.429	16.190	5,042.447	Electrical Equipment and Components
71	SONIC CORP	SONC	1,348.699	22.180	1,624.574	Services Restaurants
72	S1 CORP	SONE	328.280	5.660	273.456	Technology Internet Services Provider
73	STEWART ENTERPRISES -CL A	STEI	674.057	7.120	780.170	Specialized Consumer Services
74	STATS CHIPPAK LTD -ADR	STTSY.PK	1,899.346	9.280	9.431	Technology Semiconductors
75	SUPERGEN INC	SUPG	188.528	3.280	529.536	Healthcare Drug Manufacturer
76	SAVVIS INC	SVVS	1,069.832	20.200	949.090	Technology Internet Software & Services
77	SMITH & WESSON HOLDING CORP	SWHC	191.819	4.750	1,535.582	Industrial Goods Aerospace Defense
78	SIERRA WIRELESS INC	SWIR	464.071	14.810	943.669	Technology Diversified Communication Services
79	SYNAPTICS INC	SYNA	694.486	26.500	2,390.051	Technology Computer Peripherals
80	TECH DATA CORP	TECD	1,906.680	34.380	723.450	Services Computer wholesale
81	TARGETED GENETICS CORP	TGEN	23.381	1.180	53.568	Healthcare Biotechnology
82	THRESHOLD PHARMACEUTICALS	THLD	15.324	0.410	110.037	Healthcare Biotechnology
83	THORATEC CORP	THOR	864.224	16.000	663.998	Healthcare Medical Instruments & Supplies
84	TESSERA TECHNOLOGIES INC	TSRA	1,874.441	39.170	565.844	Technology Semiconductor Equipment &

						Materials
	Nasdaq Pilot Phase Sample					
	Pilot Phase Stock Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded	
85	TEXAS ROADHOUSE INC	TXRH	839.263	12.070	1,228.728	Services Restaurant
86	ULTRA CLEAN HOLDINGS INC	UCTT	210.602	9.790	272.554	Technology Semiconductor – Specialized
87	UNITED NATURAL FOODS INC	UNFI	1,027.303	23.980	591.598	Services Food Wholesale
88	UNITED ONLINE INC	UNTD	755.919	11.170	813.318	Services Specialty Retail
89	UTI WORLDWIDE INC	UTIW	1,857.527	18.700	764.937	Services Air Delivery & Freight Services
90	VERENIUM CORP	VRNM	258.685	4.100	381.031	Basic Materials Specialty Chemicals
91	WINN-DIXIE STORES INC	WINN	955.126	17.720	361.236	Services Grocery Stores
92	WARREN RESOURCES INC	WRES	740.075	12.720	405.137	Basic Materials Oil & Gas Equipment & Services
93	ZEBRA TECHNOLOGIES CP -CL A	ZBRA	2,088.802	30.710	609.034	Technology Computer Peripherals
94	ZIONS BANCORPORATION	ZION	5,863.585	54.740	2,735.148	Financial Regional – Pacific Banks
	Average		1,177.783	17.141	792.422	
	Median		702.303	14.345	631.145	
	Standard Deviation		1,937.598	16.405	676.435	
	Maximum		11,445.970	105.940	5,042.447	
	Minimum		15.324	0.410	9.431	
	Small Cap Firms (< \$1 billion)		62.000			
	Mid-Cap Firms (\$1 B - \$8 B)		29.000			
	Large Cap Firms (> \$8 billion)		3.000			

Appendix B – NASDAQ Matching Sample

Information for the 94 NASDAQ Matching Stocks included in the pilot phase sample

	NASDAQ Matching Sample				
	Matching Sample Stock Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded
1	Energy Conversion Dev	ENER	922.669	23.080	1,304.066
2	Resources Connection Inc	RECN	944.859	20.850	689.772
3	Veeco Instruments Inc	VECO	449.821	14.160	517.685
4	Healthways Inc	HWAY	2,023.647	56.300	1,053.267
5	Ansys Inc	ANSS	2,732.825	34.910	773.709
6	Popular Inc	BPOP	3,785.992	13.520	3,528.027
7	People Support Inc	PSPT	283.839	12.510	274.759
8	China Grentech Corp - ADR	GRRF	177.998	7.120	131.087
9	Cybersource Corp	CYBS	1,149.435	16.750	1,189.326
10	Euronet Worldwide Inc	EEFT	1,287.919	26.440	662.186
11	Cell Therapeutics Inc	CTIC	96.016	1.660	372.597
12	Netgear Inc	NTGR	937.686	26.660	719.134
13	Global Sources LTD	GSOL	617.079	13.250	605.578
14	Power-One Inc	PWER	200.027	2.290	423.387
15	J2 Global Communications Inc	JCOM	1,080.864	21.910	574.821
16	Dress Barn	DBRN	733.338	12.190	1,293.732
17	Stein Mart Inc.	SMRT	266.188	6.390	867.704
18	Cost Plus Inc	CPWM	88.348	4.000	227.383
19	OSI Pharmaceuticals	OSIP	2,315.752	39.880	1,799.640
20	Old Dominion Freight	ODFL	1,086.858	29.150	734.096
21	Axion Corp	ADES	858.667	10.610	716.207
22	Monolithic Power Systems Inc	MPWR	514.473	15.640	507.640
23	Cache Inc	CACH	170.631	10.990	406.430
24	Tetra Tech Inc	TTEK	1,152.219	19.690	799.077
25	Captaris Inc	CAPA	89.797	3.370	138.293
26	Hot Topic Inc	HOTT	241.908	5.550	782.573
27	Dexcom Inc	DXCM	237.969	8.410	226.073
28	Cymer Inc	CYMI	825.588	27.010	1,253.032
29	USA Mobility Inc	USMO	327.993	12.010	272.731
30	Penwest Pharmaceuticals Co	PPCO	119.086	5.090	695.782

	NASDAQ Matching Sample				
	Matching Sample Stock Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded
31	Iconix Brand Group Inc	ICON	1,183.263	20.790	994.610
32	Fuelcell Energy Inc	FCEL	575.236	8.410	1,703.005
33	Divx Inc	DIVX	493.121	14.250	378.480
34	Sun Healthcare Group Inc	SUNH	742.906	17.230	584.472
35	Amedisys Inc	AMED	1,118.014	42.630	558.955
36	Alexza Pharmaceuticals Inc	ALXA	195.470	6.300	130.263
37	Perrigo Co.	PRGO	2,882.707	30.840	1,479.482
38	Dennys Corp	DENN	319.504	3.390	791.879
39	NII Holdings Inc	NIHD	7,389.480	42.660	3,844.050
40	Fei Co	FEIC	822.286	22.660	554.213
41	Tekelec	TKLC	825.044	11.990	489.837
42	Angiotech Pharmaceuticals	ANPI	267.132	3.140	574.935
43	Silverstar Holdings Ltd	SSTR	31.152	1.640	270.202
44	Universal Display Corp	PANL	570.267	16.170	484.089
45	Advanced Life Sciences Hldgs	ADLS	38.503	1.000	261.580
46	Acusphere inc	ACUS	25.451	0.550	271.959
47	Particle Drilling Tech Inc	PDRT	63.889	2.020	192.438
48	WebSense Inc	WBSN	930.228	20.500	963.078
49	Dollar Tree Stores Inc	DLTR	2,575.463	28.010	1,940.556
50	Fuel Tech Inc	FTEK	426.515	19.040	422.832
51	Insmid Inc	INSM	90.150	0.740	488.636
52	CBRL Group	CBRL	742.850	31.270	867.258
53	Century Casinos Inc	CNTY	110.951	4.690	104.294
54	Bronco Drilling Co	BRNC	419.829	15.660	642.708
55	Tractor Supply Co	TSCO	1,484.985	38.540	789.346
56	Lifepoint Hospitals Inc	LPNT	1,568.754	27.000	793.086
57	Tercica Inc	TRCA	341.615	6.640	170.162
58	Centillum Communications	CTLM	31.944	0.770	224.697
59	Idenix Pharmaceuticals	IDIX	291.621	5.190	426.441
60	LJ International Inc	JADE	67.955	3.170	925.408
61	Axcan Pharma Inc	AXCA	1,258.120	22.720	636.407
62	Biodelivery Sciences Intl	BDSI	54.378	2.850	56.888
63	C H Robinson Worldwide	CHRW	9,424.638	55.540	2,198.263
64	Allscripts Healthcare Soltns	MDRX	842.107	14.830	1,326.803
65	Akorn Inc	AKRX	665.977	7.500	536.018

	NASDAQ Matching Sample				
	Matching Sample Stock Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded
66	Intuitive Surgical Inc	ISRG	9,705.086	254.000	1,345.605
67	Travelzoo Inc	TZOO	225.720	15.840	240.089
68	Hub Group Inc	HUBG	1,110.494	29.130	503.594
69	Netease.com Inc. ADR	NTES	2,216.956	18.070	1,119.895
70	YRC Worldwide Inc	YRCW	1,036.932	18.310	4,080.849
71	Rent-A-Center Inc	RCII	1,143.734	17.100	1,191.120
72	Navisite Inc	NAVI	158.472	4.500	249.747
73	Exide Technologies	XIDE	622.475	8.270	445.535
74	Chartered Semiconductor	CHRT	1,371.425	5.400	39.430
75	Cadence Pharmaceuticals	CADX	165.630	5.690	544.964
76	Gigamedia LTD	GIGM	920.173	17.450	981.486
77	Wet Seal Inc - CLA	WTSLA	287.328	3.050	1,842.925
78	Hutchinson Technology Inc	HTCH	415.745	15.770	910.012
79	Electronics for Imaging Inc	EFII	837.896	14.760	1,619.825
80	Insight Enterprises	NSIT	836.472	17.270	458.128
81	Genaera Corp	GENR	30.035	1.720	47.084
82	Genta	GNTA.OB	15.004	0.490	121.956
83	Bruker Biosciences Corp	BRKR	1,083.117	10.250	537.649
84	Concur Technologies Inc	CNQR	1,544.253	35.060	996.872
85	Bebe Stores Inc	BEBE	1,020.787	11.520	1,107.233
86	Rudolph Technologies Inc	RTEC	298.931	10.250	245.720
87	Performance Food Group Co	PFGC	1,123.055	31.630	937.783
88	Entegris Inc	ENTG	889.542	7.700	970.341
89	UAP Holding Corp	UAPH	2,011.201	38.340	1,566.082
90	Superior Bancorp	SUPR	232.225	5.790	258.283
91	Caseys General Stores Inc.	CASY	1,317.706	26.000	639.923
92	Rosetta Resources Inc	ROSE	892.119	17.530	324.677
93	National Instruments Corp.	NATI	2,138.190	26.860	532.318
94	American Capital Strategies	ACAS	6,602.393	35.170	4,568.366
	Average		1,115.363	18.666	840.900
	Median		742.878	14.505	620.993
	Standard Deviation		1,702.336	27.537	819.651
	Maximum		9,705.086	254.000	4,568.366
	Minimum		15.004	0.490	39.430

NASDAQ Matching Sample				
Matching Sample Stock Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded
Small Cap Firms (< \$1 billion)		62.000		
Mid-Cap Firms (\$1 B - \$8 B)		30.000		
Large Cap Firms (> \$8 billion)		2.000		

Appendix C – NYSE Pilot Phase Sample

Information for the 87 NYSE Stocks included in the pilot phase sample

- Original Sample included 100 NYSE Stocks. Twelve firms were dropped due to data omissions on CRSP and one firm was eliminated by the NYSE since it was acquired by another firm just prior to the pilot phase period and not replaced.

NYSE Pilot Phase Sample					
	Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded
1	APPLERA CORP-APPLIED BIOSYS	ABI	5,291.069	31.460	2,195.528
2	ABBOTT LABORATORIES	ABT	86,813.435	56.180	8,792.668
3	ACE LTD	ACE	19,195.030	58.240	3,377.051
4	ARCH COAL INC	ACI	6,288.805	43.950	4,279.218
5	AMERN EAGLE OUTFITTERS INC	AEO	4,916.824	22.980	6,659.347
6	AETNA INC	AET	26,651.303	53.260	4,072.447
7	AGCO CORP	AG	5,515.249	60.220	2,450.622
8	AMERICAN INTERNATIONAL GROUP	AIG	139,417.008	54.970	19,961.286
9	ABERCROMBIE & FITCH -CL A	ANF	6,856.917	79.590	2,366.643
10	PEABODY ENERGY CORP	BTU	14,317.712	53.860	6,331.901
11	CITIGROUP INC	C	140,318.539	28.170	128,317.666
12	CONAGRA FOODS INC	CAG	10,473.347	21.480	3,592.668
13	CARDINAL HEALTH INC	CAH	20,970.653	58.000	3,520.658
14	CONTINENTAL AIRLS INC -CL B	CAL	2,677.096	27.280	5,612.868
15	CAMECO CORP	CCJ	11,644.130	33.810	3,073.255
16	CLEAR CHANNEL COMMUNICATIONS	CCU	15,286.145	30.700	12,410.324
17	CENTERPOINT ENERGY INC	CNP	5,136.851	15.990	2,808.292
18	CANADIAN NATURAL RESOURCES	CNQ	34,440.108	63.810	2,423.875
19	CAMPBELL SOUP CO	CPB	12,106.448	31.560	1,975.684
20	DOMINION RESOURCES INC	D	24,744.264	43.000	3,524.423
21	GENENTECH INC	DNA	73,884.864	70.160	4,057.455
22	DOW CHEMICAL	DOW	36,491.539	38.640	8,701.419
23	AMDOCS LTD	DOX	6,898.857	33.050	1,657.429
24	DORAL FINANCIAL CORP	DRL	1,064.900	19.790	95.091
25	CONSOLIDATED EDISON INC	ED	11,829.952	43.570	2,880.743
26	ISHARES MSCI EMERGING MKT FD	EEM	23,572.457	136.890	30,405.469
27	EDISON INTERNATIONAL	EIX	16,942.172	52.000	2,635.929
28	EL PASO CORP	EP	11,508.986	16.430	8,645.861
29	ISHARES MSCI TAIWAN FUND	EWT	2,447.772	13.690	12,148.269
30	FAIRCHILD SEMICONDUCTOR INTL	FCS	1,524.182	12.250	1,970.858
31	FREMONT GENERAL CORP	FMT	262.779	3.300	1,401.930
32	FOREST LABORATORIES -CL A	FRX	12,374.486	39.680	3,780.955
33	GANNETT CO	GCI	8,573.004	36.930	3,058.731
34	GENERAL DYNAMICS CORP	GD	34,148.430	84.530	2,362.048
35	GENERAL ELECTRIC CO	GE	357,355.590	35.360	52,439.859

	NYSE Pilot Phase Sample				
	Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded
36	GOLDMAN SACHS GROUP INC	GS	79,003.246	199.550	13,025.581
37	HESS CORP	HES	28,951.662	90.630	5,360.790
38	HARTFORD FINANCIAL SERVICES	HIG	25,264.523	80.500	3,311.377
39	PETROHAWK ENERGY CORP	HK	2,983.664	15.750	2,909.785
40	HONEYWELL INTERNATIONAL INC	HON	44,111.705	59.070	5,873.001
41	BLOCK H & R INC	HRB	6,253.654	19.240	3,228.995
42	ICICI BANK LTD -ADR	IBN	33,264.975	60.760	3,219.759
43	INTL GAME TECHNOLOGY	IGT	13,425.378	42.680	3,311.974
44	IMPAC MORTGAGE HOLDINGS INC	IMH	111.843	1.470	694.322
45	INTL PAPER CO	IP	13,786.044	32.200	4,405.003
46	JOHNSON & JOHNSON	JNJ	180,690.893	63.140	16,179.419
47	JPMORGAN CHASE & CO	JPM	159,614.761	47.400	42,575.658
48	KING PHARMACEUTICALS INC	KG	2,564.123	10.490	4,544.064
49	KOHL'S CORP	KSS	14,281.440	45.530	7,955.481
50	LEGG MASON INC	LM	9,514.596	71.950	2,819.308
51	LOWE'S COMPANIES INC	LOW	38,656.598	26.430	16,471.815
52	LOEWS CORP	LTR	24,631.694	46.510	2,957.868
53	MASCO CORP	MAS	8,456.584	22.930	6,399.379
54	MEDTRONIC INC	MDT	52,575.646	46.500	6,685.964
55	ALTRIA GROUP INC	MO	159,638.000	75.790	15,258.214
56	MERCK & CO	MRK	100,339.731	46.100	22,273.433
57	MARATHON OIL CORP	MRO	33,432.881	47.070	8,270.596
58	MORGAN STANLEY	MS	54,500.373	49.340	18,189.089
59	MGIC INVESTMENT CORP/WI	MTG	1,505.809	18.410	3,771.015
60	NEWMONT MINING CORP	NEM	23,581.065	54.250	12,075.320
61	NEWFIELD EXPLORATION CO	NFX	6,534.777	49.920	1,536.558
62	ANNALY CAPITAL MANAGMENT INC	NLY	8,925.141	19.710	10,332.969
63	NRG ENERGY INC	NRG	9,209.658	38.590	4,978.772
64	NATIONAL SEMICONDUCTOR CORP	NSM	4,689.939	18.400	6,902.039
65	NEWS CORP	NWS	19,128.642	19.390	3,579.912
66	NEW YORK TIMES CO -CLA	NYT	2,394.255	16.740	3,615.893
67	PROCTER & GAMBLE CO	PG	203,170.892	65.420	14,625.509
68	PROGRESSIVE CORP-OHIO	PGR	12,691.910	18.550	5,327.010
69	PULTE HOMES INC	PHM	4,186.074	16.350	10,924.623
70	PRUDENTIAL FINANCIAL INC	PRU	37,999.640	84.070	4,427.200
71	QWEST COMMUNICATION INTL INC	Q	10,816.472	5.890	24,191.998
72	ROWAN COS INC	RDC	3,788.142	34.040	3,152.687
73	RADIAN GROUP INC	RDN	734.025	9.130	3,305.536
74	RELIANT ENERGY INC	RRI	7,302.942	21.210	3,608.471
75	RYLAND GROUP INC	RYL	1,421.177	33.770	3,410.873
76	SAP AG -ADR	SAP	59,458.971	47.710	3,853.936
77	SK TELECOM LTD -ADR	SKM	18,153.546	24.840	2,172.839
78	SAKS INC	SKS	2,558.389	18.050	3,017.534

	NYSE Pilot Phase Sample				
	Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded
79	CONSTELLATION BRANDS -CL A	STZ	4,009.247	20.900	2,152.506
80	AT&T INC	T	232,633.570	38.490	36,813.040
81	TITANIUM METALS CORP	TIE	3,514.679	21.670	2,686.518
82	TEMPLE-INLAND INC	TIN	1,995.195	18.810	3,033.736
83	TOLL BROTHERS INC	TOL	3,684.037	23.280	6,473.306
84	GRUPO TELEVISIA SA -ADR	TV	11,015.909	22.250	3,933.032
85	VONAGE HOLDINGS CORP	VG	310.169	1.990	1,059.705
86	VIACOM INC	VIA	23,166.247	38.700	3,878.513
87	WCI COMMUNITIES INC	WCI	254.759	6.050	2,350.049
	Average		34,446.324	40.372	8,863.223
	Median		12,106.448	35.360	3,853.936
	Standard Deviation		59,256.664	29.249	15,764.985
	Maximum		357,355.590	199.550	128,317.666
	Minimum		111.843	1.470	95.091
	Small Cap Firms (< \$1 billion)		5.000		
	Mid-Cap Firms (\$1 B - \$8 B)		27.000		
	Large Cap Firms (> \$8 billion)		55.000		
	Total		87.000		

Appendix D – NYSE Matching Sample

Information for the 87 NYSE Stocks included in the matching sample

	NYSE Matching Sample				
	Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded
1	Health Net Inc.	HNT	5123.66	46.49	1732.38
2	Unitedhealth Group Inc	UNH	65693.52	50.84	9128.96
3	Chubb Corp	CB	19400.54	51.79	4159.62
4	Tesoro Corp	TSO	5328.6	38.9	5588.55
5	Limited Brands Inc	LTD	6734.46	19.07	6738.7
6	Medco Health Solutions Inc	MHS	26735.45	49.98	6164.1
7	Avery Dennison Corp	AVY	5092.2	51.75	1235.1
8	HSBC Holdings PLC -ADR	HBC	174006.43	75.31	2772.46
9	Polo Ralph Lauren CP -CL A	RL	3534.49	60.68	2748.88
10	Talisman Energy Inc	TLM	16124.25	15.83	6075.48
11	Bank of American Corp	BAC	195932.62	44.15	57067.6
12	Coca-Cola Enterprises Inc	CCE	11180.73	23.05	3018.55
13	Automatic Data Processign	ADP	21194.89	40.28	3375.48
14	Carlisle Cos Inc	CSL	2065.03	33.3	541.97
15	Southwestern Energy Co	SWN	9561.4	56.1	3045.46
16	Macy's Inc	M	11959.13	27.62	11129.75
17	CMS Energy Corp	CMS	3527.18	15.67	3229.83
18	EOG Resources	EOG	21482.39	87.33	2983.09
19	SYSCO Corp	SY	17636.64	29	5257.28
20	PPL Corp	PPL	18181.78	48.85	2772.43
21	Lilly (ELI) & Co	LLY	58292.34	51.39	8336.68
22	Du Pont (EI) DE Nemours	DD	40618.99	45.18	8678.78
23	AVNET Inc	AVT	5342.96	35.61	1839.92
24	Imperial Capital Bancorp Inc	IMP	109.83	20.26	99.83
25	Mirant Corp	MIR	9420.93	36.79	3773.86
26	Capital One Financial Group	COF	20356.87	54.62	11970.88
27	Entergy Corp	ETR	20889.56	108.18	2423.42
28	Spectra Energy Corp	SE	14441.69	22.84	3729.19
29	Ishares MSCI Germany Fund	EWG	1712.88	31.2	3382.65
30	Intl Rectifier Corp	ARF	2018.09	27.83	1008.39
31	Downey Financial Corp	DSL	959.01	34.43	1115.92

	NYSE Matching Sample				
	Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded
32	Elan Corp PLC -ADR	ELN	11924.15	25.36	3873.42
33	Gamestop Corp	GME	8299.36	51.56	4158.35
34	Deere & Co	DE	38142.36	87.56	6816.88
35	Siemens AG -ADR	SI	118892.1	130.05	1069.28
36	American Express Co	AXP	56892.54	49.13	16301.21
37	Petro-Canada	PCZ	22045.73	45.6	1200.44
38	AFLAC Inc	AFL	29722.12	61.09	3834.39
39	EXCO Resources Inc	XCO	1565.35	14.98	1084.73
40	Emerson Electric	EMR	40059.48	50.78	5118.96
41	Service Corp International	SCI	3344.06	12	1267.46
42	China Life Ins Co -ADR	LFC	27656.37	55.75	2734.16
43	Marriott Intl Inc	MAR	13224.76	35.96	3587.04
44	Alesco Financial Inc	AFN	212.44	3.59	681.49
45	Agrium Inc	AGU	10161.48	64.42	4143.55
46	Pfizer Inc	PFE	159544.25	23.36	51433.09
47	Wachovia Corp	WB	75401.2	38.47	32453.15
48	Health Management Assoc	HMA	1310.42	5.4	4224.14
49	Omnicom Group	OMC	14831.45	45.37	3188.18
50	Assurant Inc	AIZ	7638.15	64.78	1543.97
51	Carnival Corp/PLC (USA)	CCL	27688.77	44.4	5532.73
52	Allstate Corp	ALL	28090.64	49.22	5247.42
53	Ingersoll-Rand Co Ltd	IR	10762.57	39.49	5830.76
54	Astrazeneca PLC -ADR	AZN	61340.2	42.1	2068.15
55	Wal-mart Stores Inc	WMT	203204.02	50.74	28108.57
56	Novartis AG -ADR	NVS	115011.56	50.79	2662.48
57	Transocean Inc	RIG	38623.79	122.25	8399.42
58	U S Bancorp	USB	58620.18	33.95	17525.09
59	Astoria Financial Corp	AF	2610.26	27.18	1586.93
60	Goldcorp Inc	GG	26371.91	37.23	10305.72
61	Pioneer Natural Resources Co	PXD	5025.07	41.9	1757.01
62	Thornburg Mortgage Inc	TMA	1636.87	11.14	4517.35
63	AES Corp. (THE)	AES	12776.12	19.09	5476.24
64	Cypress Semiconductor Corp	CY	3381.22	21.24	10294.94
65	CBS Corp	CBS	15761.62	25.2	7186.24
66	R H Donnelley Corp	RHD	2143.15	30.07	1472.22

	NYSE Matching Sample				
	Name	Ticker	Market Value (in \$M)	Closing Price	Ave # of Shares Traded
67	Pepsico Inc	PEP	109540.23	68.05	8649.58
68	XL Capital Ltd	XL	8025.89	45	3627.2
69	D R Horton Inc	DHI	5436.14	17.26	12610.84
70	METLIFE Inc	MET	43606.29	58.88	6857.38
71	EMBARQ Corp	EQ	6925.3	45.32	1669.32
72	Pride International Inc	PDE	5292.75	31.71	3470.45
73	PMI Group Inc	PMI	770.64	9.5	4407.88
74	Progress Energy Inc	PGN	11708.15	45.17	1843
75	KB Home	KBH	2461.94	27.5	7188.86
76	Corning Inc	GLW	38072.15	24.16	16901.07
77	Crown Castle Intl Corp	CCI	10301.5	36.12	2818.75
78	Dillards Inc -CL A	DDS	1411.72	19.84	2189.4
79	Dean Foods Co	DF	3681.02	27.97	1754
80	Verizon Communications Inc	VZ	111713.92	38.83	19173.29
81	Ivanhoe Mines LTD	IVN	3623.21	9.66	1074.58
82	Sealed Air Corp	SEE	4223.83	26.15	2014.49
83	Standard Pacific Corp	SPF	273.65	3.76	6290.26
84	Harley-Davidson Inc	HOG	9692.64	40.64	3783.23
85	Citizens Communications Co	CZN	3759.58	11.47	4599.48
86	Las Vegas Sands Corp	LVS	31164.32	87.75	3650.51
87	Beazer Homes USA Inc	BZH	341.51	8.71	2602.59
	Average		28,512.650	40.563	6,540.075
	Median		11,708.154	38.830	3,773.856
	Standard Deviation		43,376.363	24.008	9,187.379
	Maximum		203,204.020	130.050	57,067.602
	Minimum		109.829	3.590	99.834
	Small Cap Firms (< \$1 billion)		6.000		
	Mid-Cap Firms (\$1 B - \$8 B)		28.000		
	Large Cap Firms (> \$8 billion)		53.000		

Appendix E – Preferencing Notification Example

Your Rights and Responsibilities as a Raymond James Client

(Retrieved June 6, 2007 http://www.raymondjames.com/billofrights/order_flow.htm)

Indirect Compensation for Order Flow

Some transactions, generally in equities and options, involve an indirect form of compensation to the firm. If transactions are directed to it, the firm receiving the directed order may reciprocate by giving other orders to the referring firm. This practice is somewhat common for listed orders directed to “third market” firms that execute trades at prices equivalent to or better than exchange quotes, as well as in the over-the-counter market. Similarly, firms may receive payment for order flow on some options transactions. The amounts vary substantially, but generally do not exceed \$0.75 per contract. All market makers do not pay for option order flow and such payment is not generally relevant in making the decision as to where to send the transaction.

Raymond James & Associates will send trades to a particular broker/dealer or market center in order to receive best execution quality. As a result, we may receive compensation. It may also be possible that this practice has resulted in markets that are less efficient. The source and specific amount of any such compensation are available upon request.

Additionally, Raymond James & Associates is a market maker in a number of over-the-counter securities. As a result of these directed orders, trading profits or losses may be generated by Raymond James in stocks purchased by clients.

The information in this section also appears in the brochure entitled: “Your rights and responsibilities as a Raymond James client.”

Appendix F – Goldman Sachs Policy Statement

www2.goldmansachs.com/disclosures/apr-reg-nms.pdf (Retrieved August 24, 2008)

Goldman, Sachs & Co. Policy Statement Regarding Compliance with Regulation NMS's Order Protection Rule

Dear Client:

As we recently informed you, the Securities and Exchange Commission adopted the Order Protection Rule as one of several market structure amendments adopted in Regulation NMS. Among other things, the Order Protection Rule imposes a series of order handling obligations on exchanges, market makers and broker-dealers. This statement confirms how Goldman, Sachs & Co. ("Goldman Sachs") handles customer orders in light of the requirements of the Order Protection Rule.

The Order Protection Rule prohibits exchanges, market makers and broker-dealers from "trading through" protected quotations for any NMS security, namely stocks. Protected quotations are the best bids and offers on each of the national and regional exchanges and the NASD's Alternative Display Facility ("ADF"). A "trade through" occurs when a market participant executes an order at a price that is inferior to the protected quotations displayed in these markets. Therefore, when executing your stock order, Goldman Sachs will be prohibited from effecting that transaction at a price that is lower (higher) than the best bids (offers) in the market, without first satisfying those better-priced protected quotations.

The Order Protection Rule contains various exceptions that, under certain circumstances, permit the execution of trades at prices that would otherwise constitute a trade-through. However, in instances where no other exception is available, we intend to use a special order type designated by the SEC (known as an "intermarket sweep order" ("ISO")) to sweep the market and execute any better-priced quotations. In any transaction where the firm commits capital, you may choose to waive the fills resulting from the ISOs. If you elect this option, Goldman Sachs will still be required to satisfy those better-priced quotations and the benefit of those executions will be factored into your negotiated price. Alternatively, you may elect to receive the ISO executions directly, in which case your transaction price will reflect the receipt of those better-priced executions and, accordingly, will differ from the originally-negotiated price. Although the mechanics may differ, with either choice, you will receive the benefit of the better priced quotations.

If you elect to receive fills resulting from ISOs directly, you need not take any action; we will provide you with those executions in the absence of any instructions to the contrary. If you elect to waive the fills resulting from ISOs, you may negotiate a waiver on an order-by-order basis or grant a blanket waiver by signing the attached "Consent of Waiver" form and returning it to your Goldman Sachs representative.

We look forward to providing you with the level of service and execution quality that you have come to expect from us. Please contact your Goldman Sachs representative should you have any questions.

Sincerely,

Goldman, Sachs & Co.

Consent to Waiver Form

By my signature, I acknowledge that I have read and understood the *Goldman, Sachs & Co. Policy Statement Regarding Compliance with Regulation NMS's Order Protection Rule* and, in instances where Goldman, Sachs & Co. uses one or more intermarket sweep orders ("ISOs") in compliance with the Order Protection Rule requirements of Regulation NMS, I hereby elect to waive receipt of any better-priced executions received by Goldman, Sachs & Co. in connection with those ISOs. I understand that Goldman, Sachs & Co. will still be required to satisfy any protected quotations in the market and that, by waiving receipt of any such executions, my order may not be executed at as favorable a price as may have been available had I accepted such executions.

Name of Client:

By:

Name:

Title:

Date:

Appendix G – A Review of the Empirical Measures of Trading Costs

Most of the literature that studies competition among venues and among orders compares measures of the bid/ask spread. Two of the most common measures include the quoted spread and the effective spread. The quoted spread captures the difference between the bid (selling price) and ask (buying price) available on the market and measures the cost of completing a round trip (buy and sell) transaction assuming the trade occurs at the quoted price. For a single trade (a buy or a sell), the quoted half-spread is used to measure transaction costs. The quoted half-spread is calculated as:

$$QS_{it} = (Ask_{it} - Bid_{it})/2)$$

or as a percent:

$$\%QS_{it} = 100 * (Ask_{it} - Bid_{it}) / (2 * M_{it})$$

where Ask_{it} and Bid_{it} are the posted ask price and bid price for security i at time t , respectively, and M_{it} is the quote midpoint or mean of Ask_{it} and Bid_{it} and a proxy for the true underlying security value.

For many trades, the quoted spread is just a starting point for negotiations between buyers and sellers trading securities, and many trades occur at prices inside and also outside the posted quotes. For instance, orders may execute at prices inside the quotes when the specialist on the NYSE floor decides to improve on the quote (Ready, 1999). Electronic markets also have *hidden limit orders* that are entered at prices inside the best quotes. The NASDAQ market recently disclosed that 20% of its order flow is non-displayed.³⁷

In addition, quoted prices pertain only to the quoted depth, and larger orders may need to walk-the-book, executing against limit orders at prices higher than the best quotes, leading to a weighted-average trade price outside the quotes. A better measure of trading costs when trades occur either *inside* or *outside* the quotes is the effective half-spread and the percentage effective half-spread which is based on the actual trade price. The effective half-spread is calculated as:

$$ES_{it} = D_{it} * (P_{it} - M_{it}) / 2$$

or as a percent:

$$\%ES_{it} = 100 * D_{it} * (P_{it} - M_{it}) / (2 * M_{it})$$

where P_{it} is the transaction price for security i at time t , D_{it} is an indicator variable that equals one for customer buy orders and negative one for customer sell orders, and M_{it} is the midpoint used as a proxy for the true underlying value of security i at time t . The

³⁷ Retrieved November 15, 2008 <http://www.nasdaqtrader.com/Trader.aspx?id=DarkLiquidity>

effective half-spread calculates the difference between the actual price and the true underlying value of the security. It can also be viewed as an estimate of the actual cost paid by traders and the gross revenue earned by liquidity providers.

An additional measure in the literature to assess trading costs is called the price affect of trades. This measure was first introduced by Kraus and Stoll (1972) and is designed to capture the informational component of trading costs included in the effective spread. It is based on the behavior of prices after a transaction and reflects the change in the estimate of the security's value as a result of order flow imbalance, i.e., the difference between buy and sell order quantities. When the number of buy orders is greater than the number of sell orders, the security is considered undervalued and liquidity providers tend to adjust their prices upward. When the number of sell orders is greater than the number of buy orders, the security is considered overvalued and liquidity providers tend to adjust their prices downward. These adjustments (or costs) reflect the magnitude of the imbalance between informed traders and liquidity traders and as such the extent of insider information held by informed traders (Bessembinder & Venkataraman, 2007). The costs incurred by liquidity traders can be estimated as:

$$\text{Price affect} = \text{PI}_{it} = D_{it} * (V_{it+n} - V_{it}) / V_{it}$$

where V_{it+n} denotes the security's value n periods after the transaction. The price adjustment from V_{it} to V_{it+n} captures the market's assessment of the private information conveyed by the trade (Huang & Stoll, 1996).³⁸ As a result of informed traders, liquidity traders earn less than the average effective spread for trades. This cost is captured as the price affect of trades and represents the informational component of the effective spread.

A fourth measure, called the realized spread, captures the *non-informational* component of the effective spread. The realized spread is calculated as the effective spread minus the price affect of trades:

$$\text{RS}_{it} = \text{ES}_{it} - \text{PI}_{it}$$

As a result, Seppi (1997) believes that trading costs are better measured by realized spreads than by effective spreads.

³⁸ Huang & Stoll (1996) use four different time intervals that vary from 5 to 35 minutes.

Appendix H: TAQ Database Codes

Quote Code (Mode)	Description
4	New dissemination: A regulatory halt used when relevant news influencing the stock is disseminated. Trading is suspended until the resultant affect has been assessed.
5	Slow quote on the offer due to an LRP or GAP Quote: A non-firm quote that, as of Reg. NMS activation will not be eligible for NBBO and may be traded through.
7	Order imbalance: A non-regulatory halt used when there is a severe buy or sell order imbalance. To prevent a disorderly market, trading is temporarily suspended.
9	Non-firm quote: A regulatory halt used when the level of trading activity in a security is such that the Exchange cannot collect, process, and disseminate quotes that accurately reflect market conditions. The specialist, with Floor approval, may switch to “non-firm mode” for 30 minutes.
11	New pending: Indicates a regulatory trading halt or delayed opening due to an expected news announcement which may influence trading in the stock. A trading halt or opening delay may be reversed once the news has been disseminated.
13	Trading halt due to related security: A non-regulatory halt used when events relating to one security will affect the price and performance of another security (e.g., a tender offer.)
14	Trading halt in view of common: A non-regulatory trading halt used when matters that affect the common stock of a company may affect the performance of other classes of securities for the same company.
15	Slow quote on the bid due to an LRP or GAP Quote: A non-firm quote that, as of Reg. NMS activation will not be eligible for NBBO and may be traded through.
19	Related Security News dissemination: a regulatory halt used when news relating to one security will affect trading in an associated security. For example, news pertaining to the common issues of a company may affect the preferred issued.
20	Related Security News pending: Same as above but refers to expected news.
22	Slow quote on the bid and offer due to an LRP or Gap Quote: A non-firm quote that, as of Reg. NMS activation will not be eligible for NBBO and may be traded through.
27	Additional information: A regulatory halt or delayed opening used if more disclosure of information for the security is requested by the exchange. If inadequate information is disclosed during a trading half or delayed opening due to news dissemination (mode 4) or news pending (mode 11),

	the reason could subsequently be reported as mode 27.
28	Additional information due to related security: A regulatory halt or delayed opening used if more disclosure of information for the security is requested for a related security.

Trade Code (Mode)	Description
2	Symbol correction (out of time sequence).
7	Trade cancelled due to error.
8	Trade cancelled.
9	Trade cancelled due to symbol correction
10	Cancel record (associated with 8).
11	Error record (associated with 7).
12	Correction record
A	Cash-Only Basis: All trading in that issue for the day is on a 'cash only' basis. Every trade for that day will have a condition of A.
C	Cash sale: A transaction which calls for the delivery and payment of securities on the same day the trade took place.
D	NASDAQ: Next day Settlement Only: All trading in that issue for that day is for 'next day settlement' only. Every trade for that day will have a condition of D.
F	Intermarket Sweep Order: ISO trades occur when an exchange sweeps its book without checking for a trade through. The broker agrees to be responsible for best execution. These trades were first reported on February 8, 2007, but were not commonly used until Reg. NMS went into effect on March 5, 2007.
N	Next day (N): Calls for delivery of securities on the first business day following the day of the contract.
O	Opened Last: An opening trade that occurs in sequence but is reported to the tape at a later time.
R	Seller: "Seller's Option". Delivery date is specified by the seller and must be between two and sixty calendar days following the day of the contract (but not on the third business day after the trade date, which is considered regular way).
Z	Sold Sale: A transaction that is reported to the tape at a time later than it occurred and when other trades occurred between the time of the transaction report time.

Appendix I: Statistical Formulas

Paired Sample T-Test

The paired sample t-test is a statistical technique used to compare two population means when two samples are correlated. Examples include before-after studies, cases of matched pairs, or control group studies. By using the paired sample t-test, we can statistically conclude whether or not there is a significance difference between the before and after period means.

There are four assumptions made in the paired sample t-test:

1. Only the matched pair can be used to perform the t-test.
2. Normal distributions are assumed.
3. Variance of the two samples is the same.
4. Independence of observations in paired sample t-test.

As in most cases of using the paired sample t-test, the significance level for this thesis set at 5%.

From SPSS the parameter formula for the t statistic for Equality of Means (t test algorithms):

$$t = D / SD$$

with $(W-1)$ degrees of freedom.

$$D = \bar{X} - \bar{Y}; \text{ the mean difference between the two samples}$$

$$SD = \sqrt{(S_{2X} + S_{2Y} - 2S_{XY}) / W}$$

; the sample variance and W is the sample size

Sign Test and the Wilcoxon Test

The sign test and the Wilcoxon test are both non parametric tests. They are generally used as an alternative to the paired sample t-test when the assumptions (normality or independence) are violated. For the sign test, the number of + and – signs are counted for a given distribution. A + sign is given for an observation value greater than the mean value, and a – sign is given for an observation value less than the mean value.

From SPSS the Sign Test (nonparametric tests algorithms) are:

For two related samples from a continuous field, this tests:

$$H_0: \theta = \text{Median}(X_1 - X_2) = 0$$

$$H_A: \theta < 0 \text{ or } \theta > 0$$

Counting Signs

For each record, the difference $d_i = x_{i1} - x_{i2}$ is computed and the number of positive ($n_{p,f}$) and negative ($n_{n,f}$) differences, incorporating the frequency weight, are counted:

$$n_{p,f} = n \sum_{i=1}^n f_i I(d_i > 0)$$

$$n_{n,f} = n \sum_{i=1}^n f_i I(d_i < 0)$$

Cases with $x_{i1} = x_{i2}$ are ignored.

Wilcoxon Matched-Pairs Signed-Rank Test (nonparametric tests algorithms)

From SPSS Help Topics:

Computation of Ranked Differences

For each case, the difference

$$D_i = X_i - Y_i$$

is computed, as well as the absolute value of D_i . All nonzero absolute differences are then sorted into ascending order, and ranks are assigned. In the case of ties, the average rank is used. The sums of the ranks corresponding to positive differences (S_p) and negative differences (S_n) are calculated. The average positive rank is

$$\bar{X}_p = S_p / n_p$$

and the average negative rank is

$$\bar{X}_n = S_n / n_n$$

where n_p is the number of cases with positive differences and n_n the number with negative differences.

Test Statistic and Significance Level

The test statistic is

$$Z = \frac{\min(S_p, S_n) - (n(n+1)/4)}{\sqrt{n(n+1)(2n+1)/24 - l \sum_{j=1}^l (t_j^3 - t_j)/48}}$$

where

n Number of cases with non-zero differences

l Number of ties

t_j Number of elements in the j -th tie, $j=1, \dots, l$

For large sample sizes the distribution of Z is approximately standard normal. A two-tailed probability level is printed.

Appendix J: Crossed NBBOs with Volume

PRE						
Date_group	Total	Bid Vol	Ask Vol	Crossed	Bid Vol	Ask Vol
0619_1	375213	7704118	9777788	415	4185	2389
0619_2	312969	6158285	6619170	261	1329	1724
0619_3	92679	587936	567636	34	208	68
0619_4	85979	669679	665523	22	87	39
0620_1	434204	6671515	7987865	897	6859	9479
0620_2	368381	6404356	6937591	517	3511	3896
0620_3	107027	612799	651818	27	197	67
0620_4	103450	806915	712191	42	166	83
0621_1	454611	7637892	8113134	985	5382	4643
0621_2	382650	6058484	6733994	636	3607	4452
0621_3	105629	625511	582179	40	129	78
0621_4	102331	682383	600247	56	356	253
0622_1	445298	8168628	7927330	921	6970	11558
0622_2	398275	7333112	7689708	774	7287	10051
0622_3	107531	1376123	984559	46	276	114
0622_4	96345	752290	691564	78	540	459
0625_1	483946	7691444	8207117	1150	6349	8403
0625_2	404482	5798133	6606592	634	3386	3770
0625_3	123639	1033076	868468	65	612	162
0625_4	112994	678158	686130	52	231	117
0626_1	491498	7147149	8338505	1127	5895	5693
0626_2	406073	6478883	7135832	563	4777	3976
0626_3	120059	832212	803529	59	153	233
0626_4	102846	626877	609100	56	316	342
0627_1	491478	8495809	9396789	894	9901	8947
0627_2	395786	6606063	6929168	450	2872	2996
0627_3	115583	773111	747041	40	160	169
0627_4	108233	786764	679386	54	304	466
0628_1	437192	7072317	8918202	2456	12956	15434
0628_2	376305	5763857	5838843	1613	11393	8478
0628_3	108647	642205	676574	56	324	231
0628_4	93315	558047	575393	45	127	159
0629_1	434542	6245258	7089479	951	11187	6843
0629_2	381526	5820365	5858866	656	5006	7073
0629_3	112768	815696	676989	52	208	154
0629_4	101006	602579	618462	45	138	163
0702_1	375961	7872963	9163507	416	2844	2636
0702_2	316584	7009619	7586256	308	2028	2273
0702_3	92168	666600	664003	20	46	130
0702_4	89858	728086	623197	31	365	867
0703_1	216159	4059407	4536336	1281	10854	8957
0703_2	175710	3414803	3517949	810	4337	10037

0703_3	49389	320317	321725	11	22	25
0703_4	47646	381652	344685	17	159	337
0705_1	370186	7696414	8829585	1510	9358	8874
0705_2	312279	5770917	6484315	996	6482	7747
0705_3	88276	543885	547918	61	216	230
0705_4	85660	633446	603329	30	61	59
0706_1	372411	7177515	6632707	469	4780	3580
0706_2	317993	5639799	5453380	350	2082	1876
0706_3	74990	533370	500055	30	73	48
0706_4	80954	570272	547812	17	44	25
Totals	12440714	189737094	204859521	23126	161135	170863
%				0.19%	0.08%	0.08%

POST (with slow quotes)						
Date_group	Total	Bid Vol	Ask Vol	Crossed	Bid Vol	Ask Vol
0709_1	372617	7575694	6809061	374	4371	2116
0709_2	329037	6166322	5775570	286	1798	1326
0709_3	85267	578758	591745	17	63	48
0709_4	89574	629662	669599	28	131	57
0710_1	475809	8656865	7553515	783	6398	13315
0710_2	402520	6916079	6544988	508	4468	2098
0710_3	108239	656012	665797	26	64	38
0710_4	115837	738806	783838	34	76	67
0711_1	440835	7201776	7081731	757	7252	5135
0711_2	366297	6103758	6215058	530	4257	3398
0711_3	94222	611267	618432	85	532	554
0711_4	92180	679766	798144	67	171	366
0712_1	437904	9509583	9599512	705	5246	8733
0712_2	370998	8842294	7968921	514	5349	10095
0712_3	93274	578845	512859	46	205	98
0712_4	94371	668981	640006	41	405	151
0713_1	392390	10675045	8947602	546	6555	4319
0713_2	327373	5845602	5722709	345	1777	2161
0713_3	78935	452003	409519	29	50	100
0713_4	79735	634021	680247	24	84	115
0716_1	404496	7948987	7888976	491	2803	3719
0716_2	330610	6083417	5900287	341	2175	1736
0716_3	98256	569994	537014	22	77	44
0716_4	94898	694143	744343	15	23	34
0717_1	427997	7080406	6881242	719	4853	5011
0717_2	357969	6154147	5850372	492	2714	2771
0717_3	95843	567042	538457	22	60	73
0717_4	92511	628322	607526	24	66	179
0718_1	507332	7378147	7029792	1333	9727	8490
0718_2	437518	7470448	6875332	1094	11770	5745
0718_3	104075	530967	491181	34	140	90

0718_4	109011	670839	584626	41	105	202
0719_1	436442	6743890	6622397	838	6183	5766
0719_2	379171	6563941	6609699	669	3458	4222
0719_3	92493	526581	528492	53	210	494
0719_4	80511	496031	553627	23	51	78
0720_1	513089	7177105	6531800	1379	10024	13785
0720_2	432330	7121143	7315854	741	7396	3940
0720_3	109011	608895	511547	51	170	141
0720_4	122602	805204	625765	64	281	130
0723_1	453271	7538760	7252637	856	5674	6135
0723_2	387441	7216849	7573496	709	3933	5415
0723_3	99333	517164	544801	46	115	81
0723_4	101095	566789	608180	59	172	291
0724_1	561765	7793669	7111178	1491	14605	10256
0724_2	483661	7310954	6986407	1041	6326	6318
0724_3	147617	774995	691750	133	409	285
0724_4	140734	771032	748618	70	184	245
0725_1	602845	6756805	6473864	2148	14039	14501
0725_2	551849	6703301	6460509	1586	10034	8096
0725_3	161127	747874	709751	116	275	293
0725_4	142336	713355	694741	99	295	369
0726_1	769785	8101527	7783153	6088	50948	53648
0726_2	674084	6991377	6542708	3915	30321	24931
0726_3	193955	841491	782284	165	683	559
0726_4	178649	882319	774499	162	550	661
Totals	15723126	223769049	213555758	32875	250101	243024
%				0.21%	0.11%	0.11%

Appendix K: Mean Results and t-tests

Tables A1.1 – A1.3 NYSE Slow Quotes Mean Results and t-test

Table A1.1 5-Day Pairings Mean Results NYSE Pilot Phase Sample				
The table contains the mean pair-wise results for both slow and total quotes for NYSE Pilot Phase Stocks. This pairing contains 5 days of data on both sides of the event date. The results are divided into three time slice elements to isolate beginning and end of day volatility. The sign test and Wilcoxon test results are the p-value results.				
		Means		
Time Slice	Quote Type	Pre	Post	T-test
1 (9:30 - 10:00)	Slow	2.93	3.41	0.079
1	Total	2770	3001	0.000
2 (10:00 - 3:30)	Slow	14.99	18.57	0.014
2	Total	22657	25226	0.000
3 (3:30 - 4:00)	Slow	2.13	2.94	0.003
3	Total	2570	3163	0.000
5-Day Pairings Mean Results NYSE Matching Sample				
The table contains the mean pair-wise results for both slow and total quotes for NYSE Matching Sample Stocks. This pairing contains 5 days of data on both sides of the event date. The results are divided into three time slice elements to isolate beginning and end of day volatility. The sign test and Wilcoxon test results are the p-value results.				
		Means		
Time Slice	Quote Type	Pre	Post	T-test
1 (9:30 - 10:00)	Slow	2.75	3.08	0.219
1	Total	2424	2576	0.000
2 (10:00 - 3:30)	Slow	15.87	16.67	0.571
2	Total	20831	22293	0.025
3 (3:30 - 4:00)	Slow	1.98	2.108	0.629
3	Total	2277	2771	0.000

Table A1.2 3-Day Pairings Mean Results NYSE Pilot Phase Sample				
The table contains the mean pair-wise results for both slow and total quotes for NYSE Pilot Phase Stocks. This pairing contains 3 days of data on both sides of the event date. The results are divided into three time slice elements to isolate beginning and end of day volatility. The sign test and Wilcoxon test results are the p-value results.				
		Means		
Time Slice	Quote Type	Pre	Post	T-test
1 (9:30 - 10:00)	Slow	3.03	3.92	0.027
1	Total	2715	3140	0.000
2 (10:00 - 3:30)	Slow	13.35	19.39	0.000
2	Total	19883	26490	0.000
3 (3:30 - 4:00)	Slow	1.51	3.21	0.000
3	Total	1908	3323	0.000
3-Day Pairings Mean Results NYSE Matching Sample				
The table contains the mean pair-wise results for both slow and total quotes for NYSE Matching Sample Stocks. This pairing contains 3 days of data on both sides of the event date. The results are divided into three time slice elements to isolate beginning and end of day volatility. The sign test and Wilcoxon test results are the p-value results.				
		Means		
Time Slice	Quote Type	Pre	Post	T-test
1 (9:30 - 10:00)	Slow	2.64	3.54	0.016
1	Total	2346	2684	0.000
2 (10:00 - 3:30)	Slow	14.94	18.25	0.074
2	Total	18006	23473	0.000
3 (3:30 - 4:00)	Slow	1.53	2.5	0.002
3	Total	1656	2920	0.000

Table A1.3 1-Day Pairing Mean Results NYSE Pilot Sample				
The table contains the mean pair-wise results for both slow and total quotes for NYSE Pilot Phase Stocks. This pairing contains 1 day of data on both sides of the event date. The results are divided into three time slice elements to isolate beginning and end of day volatility. The sign test and Wilcoxon test results are the p-value results.				
		Means		
Time Slice	Quote Type	Pre	Post	T-test
1 (9:30 - 10:00)	Slow	2.84	3.17	0.595
1	Total	2930	3210	0.000
2 (10:00 - 3:30)	Slow	18.25	19.31	0.646
2	Total	22772	30501	0.000
3 (3:30 - 4:00)	Slow	2.49	3.25	0.147
3	Total	2848	3722	0.000
1-Day Pairing Mean Results NYSE Matching Sample				
The table contains the mean pair-wise results for both slow and total quotes for NYSE Matching Sample Stocks. This pairing contains 1 day of data on both sides of the event date. The results are divided into three time slice elements to isolate beginning and end of day volatility. The sign test and Wilcoxon test results are the p-value results.				
		Means		
Time Slice	Quote Type	Pre	Post	T-test
1 (9:30 - 10:00)	Slow	2.7	4.03	0.029
1	Total	2537	2774	0.000
2 (10:00 - 3:30)	Slow	20.76	18.44	0.571
2	Total	20379	27113	0.000
3 (3:30 - 4:00)	Slow	3.06	2.92	0.852
3	Total	2516	3270	0.000

Tables A2.1 – A2.16: Cumulative Mean Results for Quoting Behavior

<p>Table A2.1 NYSE Pilot Phase Sample Cumulative Means 5 Days Pairing</p> <p>This table contains the mean pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE pilot phase stocks. The pairings contain 5 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.</p>												
Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average # of Quotes</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	46.571%	45.311%	-1.260%	0.007	58.426%	59.176%	0.750%	0.396	58.555%	61.296%	2.742%	0.995
At Bid	17.354%	17.124%	-0.231%	0.580	14.533%	13.568%	-0.965%	0.891	15.445%	13.445%	-2.000%	0.159
At Ask	17.241%	17.110%	-0.131%	0.454	13.848%	13.690%	-0.159%	0.773	13.824%	13.804%	-0.020%	0.844
Inside NBBO	0.000%	0.012%	0.012%	0.000	0.000%	0.005%	0.005%	0.000	0.000%	0.002%	0.002%	0.001
Outside NBBO	18.833%	20.444%	1.611%	0.022	13.192%	13.561%	0.369%	0.114	12.176%	11.452%	-0.724%	0.223
Total Ave. # of Quotes	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Alone NBBO	24.151%	23.507%	-0.644%	0.868	27.708%	27.459%	-0.249%	0.412	23.474%	23.823%	0.349%	0.056
Alone Bid	5.262%	4.729%	-0.533%	0.171	3.979%	3.574%	-0.404%	0.556	3.708%	3.658%	-0.050%	0.127
Alone Ask	2.615%	2.415%	-0.200%	0.651	2.436%	2.313%	-0.122%	0.827	2.482%	25.284%	22.802%	0.583
<i>Average Vol in Shares</i>												
Vol at NBBO	66.417%	74.178%	7.761%	0.206	84.450%	84.856%	0.406%	0.014	85.888%	87.161%	1.273%	0.758
Vol at Bid	9.089%	7.269%	-1.819%	0.504	5.218%	5.370%	0.152%	0.033	5.662%	4.906%	-0.757%	0.204
Vol at Ask	9.700%	6.797%	-2.904%	0.333	5.581%	5.033%	-0.549%	0.743	5.067%	4.695%	-0.372%	0.012
Vol Inside	0.000%	0.007%	0.007%	0.000	0.000%	0.002%	0.002%	0.012	0.000%	0.001%	0.001%	0.010
Vol Outside	14.794%	11.749%	-3.045%	0.196	4.750%	4.739%	-0.011%	0.175	3.383%	3.238%	-0.145%	0.478
Total Volume	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Vol Alone NBBO	33.935%	28.763%	-5.172%	0.152	33.101%	32.628%	-0.473%	0.949	29.685%	20.045%	-9.640%	0.030
Vol Alone Bid	2.801%	2.212%	-0.589%	0.617	1.723%	1.581%	-0.142%	0.058	1.767%	1.553%	-0.214%	0.097
Vol Alone Ask	1.839%	1.417%	-0.422%	0.910	1.374%	1.163%	-0.211%	0.002	1.313%	1.165%	-0.148%	0.450

Table A2.2 NYSE Matching Sample Cumulative Means 5 Days Pairings												
This table contains the mean pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE matching sample stocks. The pairings contain 5 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.												
Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
Average # of Quotes	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	46.608%	47.642%	1.034%	0.432	60.014%	60.236%	0.223%	0.825	59.773%	61.648%	1.875%	0.083
At Bid	17.710%	17.161%	-0.550%	0.485	14.030%	13.664%	-0.366%	0.855	15.157%	13.695%	-1.462%	0.424
At Ask	16.745%	16.279%	-0.467%	0.607	13.654%	13.519%	-0.135%	0.401	14.079%	13.955%	-0.123%	0.063
Inside NBBO	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Outside NBBO	18.937%	18.919%	-0.018%	0.989	12.302%	12.581%	0.279%	0.517	10.991%	10.702%	-0.290%	0.104
Total Average # of Quotes	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Alone NBBO	26.402%	24.985%	-1.417%	0.016	29.645%	29.185%	-0.460%	0.695	26.749%	25.936%	-0.813%	0.234
Alone Bid	5.212%	4.939%	-0.273%	0.091	3.578%	3.544%	-0.034%	0.651	3.618%	3.465%	-0.153%	0.258
Alone Ask	2.677%	2.404%	-0.273%	0.037	2.224%	2.271%	0.047%	0.671	2.374%	2.390%	0.016%	0.663
Average Volume in Shares												
Vol at NBBO	69.784%	70.518%	0.734%	0.180	86.452%	85.739%	-0.713%	0.336	87.301%	88.444%	1.143%	0.006
Vol at Bid	8.541%	8.468%	-0.073%	0.761	4.843%	4.956%	0.113%	0.312	4.934%	4.582%	-0.352%	0.757
Vol at Ask	8.105%	7.638%	-0.467%	0.042	4.806%	4.678%	-0.128%	0.596	5.027%	4.287%	-0.740%	0.314
Vol Inside	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Vol Outside	13.570%	13.377%	-0.194%	0.891	3.900%	4.627%	0.728%	0.015	2.738%	2.687%	-0.051%	0.003
Total Volume	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Vol Alone NBBO	32.373%	30.157%	-2.216%	0.238	33.393%	29.542%	-3.851%	0.398	27.307%	21.175%	-6.132%	0.299
Vol Alone Bid	2.575%	2.479%	-0.096%	0.596	1.566%	1.684%	0.118%	0.474	1.476%	1.375%	-0.101%	0.282
Vol Alone Ask	1.813%	1.384%	-0.429%	0.109	1.127%	1.133%	0.006%	0.174	1.297%	1.167%	-0.130%	0.285

Table A2.3 NYSE Pilot Phase Sample Cumulative Means 3 Days Pairings												
<p>This table contains the mean pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE pilot phase stocks.</p> <p>The pairings contain 3 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility.</p> <p>The sign test and the Wilcoxon test are the p-value results.</p>												
Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
Average # of Quotes	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	47.743%	44.159%	-3.583%	0.000	59.579%	58.026%	-1.553%	0.001	64.219%	59.424%	-4.796%	0.000
At Bid	16.713%	17.638%	0.925%	0.031	14.075%	14.141%	0.065%	0.064	13.168%	14.658%	1.489%	0.000
At Ask	17.244%	17.352%	0.108%	0.442	13.567%	13.962%	0.396%	0.678	12.729%	14.198%	1.469%	0.289
Inside NBBO	0.000%	0.011%	0.011%	0.000	0.000%	0.004%	0.004%	0.000	0.000%	0.000%	0.000%	0.005
Outside NBBO	18.301%	20.840%	2.539%	0.012	12.779%	13.867%	1.088%	0.018	9.884%	11.719%	1.835%	0.003
Total Average # of Quotes	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	-0.002%	
Alone NBBO	24.371%	22.273%	-2.097%	0.178	29.003%	27.095%	-1.908%	0.634	3.967%	3.394%	-0.573%	0.441
Alone Bid	4.975%	4.757%	-0.217%	0.877	3.788%	3.755%	-0.033%	0.216	0.467%	0.562%	0.095%	0.000
Alone Ask	2.462%	2.438%	-0.024%	0.503	2.331%	2.356%	0.025%	0.089	0.333%	0.394%	0.061%	0.012
Average Volume in Shares												
Vol at NBBO	68.214%	68.205%	-0.009%	0.078	85.368%	82.672%	-2.696%	0.001	88.201%	85.547%	-2.654%	0.000
Vol at Bid	8.583%	8.396%	-0.187%	0.765	5.214%	5.993%	0.778%	0.010	4.860%	5.674%	0.814%	0.094
Vol at Ask	8.959%	7.972%	-0.986%	0.395	5.281%	5.764%	0.484%	0.581	4.524%	5.164%	0.640%	0.001
Vol Inside	0.000%	0.011%	0.011%	0.004	0.000%	0.001%	0.001%	0.001	0.000%	0.000%	0.000%	0.093
Vol Outside	14.245%	15.415%	1.171%	0.165	4.137%	5.569%	1.433%	0.065	2.416%	3.614%	1.199%	0.451
Total Volume	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Vol Alone NBBO	34.021%	28.276%	-5.745%	0.108	35.623%	29.994%	-5.629%	0.639	31.274%	21.936%	-9.338%	0.151
Vol Alone Bid	2.696%	2.727%	0.030%	0.734	1.631%	1.780%	0.150%	0.165	1.511%	1.787%	0.276%	0.002
Vol Alone Ask	1.700%	1.650%	-0.049%	0.501	1.322%	1.248%	-0.073%	0.004	1.172%	1.300%	0.128%	0.078

<p align="center">Table A2.4 NYSE Matching Sample Cumulative Means 3 Days Pairings</p> <p>This table contains the mean pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE matching sample stocks. The pairings contain 3 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.</p>												
Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average # of Quotes</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	47.660%	47.887%	0.227%	0.807	61.436%	60.409%	-1.027%	0.246	65.077%	61.410%	-3.667%	0.000
At Bid	16.767%	17.242%	0.476%	0.439	13.552%	13.658%	0.106%	0.340	12.908%	14.067%	1.159%	0.009
At Ask	16.409%	16.159%	-0.249%	0.488	13.204%	13.469%	0.266%	0.799	12.993%	14.323%	1.329%	0.013
Inside NBBO	0.000%	0.000%	0.000%		0.000%	0.000%	0.000%		0.000%	0.000%	0.000%	
Outside NBBO	19.165%	18.712%	-0.453%	0.804	11.808%	12.464%	0.655%	0.613	9.022%	10.201%	1.179%	0.002
Total Average # of Quotes	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Alone NBBO	27.386%	24.630%	-2.757%	0.017	31.582%	28.084%	-3.498%	0.008	29.993%	25.684%	-4.309%	0.000
Alone Bid	5.061%	5.011%	-0.051%	0.777	3.467%	3.653%	0.186%	0.821	2.854%	3.568%	0.714%	0.069
Alone Ask	2.545%	2.426%	-0.119%	0.346	2.169%	2.342%	0.174%	0.721	2.105%	2.461%	0.356%	0.145
<i>Average Volume in Shares</i>												
Vol at NBBO	69.897%	70.602%	0.704%	0.046	86.952%	84.169%	-2.783%	0.020	89.843%	87.338%	-2.504%	0.000
Vol at Bid	8.613%	8.704%	0.090%	0.257	4.684%	5.640%	0.957%	0.748	3.849%	5.045%	1.196%	0.005
Vol at Ask	8.017%	7.717%	-0.300%	0.026	4.572%	5.188%	0.615%	0.896	4.156%	4.656%	0.501%	0.013
Vol Inside	0.000%	0.000%	0.000%		0.000%	0.000%	0.000%		0.000%	0.000%	0.000%	
Vol Outside	13.472%	12.977%	-0.495%	0.796	3.792%	5.003%	1.211%	0.007	2.153%	2.960%	0.807%	0.000
Total Volume	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Vol Alone NBBO	34.052%	29.994%	-4.058%	0.060	37.500%	30.536%	-6.964%	0.195	28.494%	19.207%	-9.287%	0.380
Vol Alone Bid	2.473%	2.525%	0.052%	0.894	1.502%	1.844%	0.342%	0.442	1.133%	1.637%	0.504%	0.675
Vol Alone Ask	1.569%	1.365%	-0.203%	0.228	1.121%	1.265%	0.144%	0.455	1.212%	1.303%	0.091%	0.889

<p align="center">Table A2.5 NYSE Pilot Phase Sample Cumulative Means 1 Day Pairing (+1 to -1)</p> <p>This table contains the mean pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE pilot phase stocks. The pairings contain 1 day of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.</p>												
Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
Average # of Quotes	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	47.140%	44.027%	-3.113%	0.000	59.111%	56.150%	-2.962%	0.126	61.471%	56.477%	-4.995%	0.079
At Bid	16.485%	17.820%	1.335%	0.001	14.748%	15.025%	0.276%	0.078	13.782%	15.347%	1.566%	0.006
At Ask	17.163%	16.885%	-0.278%	0.913	13.268%	14.060%	0.792%	0.113	14.029%	15.333%	1.304%	0.603
Inside NBBO	0.000%	0.009%	0.009%	0.001	0.000%	0.004%	0.004%	0.002	0.000%	0.004%	0.004%	0.008
Outside NBBO	19.212%	21.259%	2.048%	0.036	12.873%	14.762%	1.890%	0.072	10.718%	12.838%	2.121%	0.668
Total Average # of Quotes	100.0%	100.0%	0.000%		100.0%	100.0%	0.000%		100.0%	100.0%	0.000%	
Alone NBBO	24.102%	21.402%	-2.701%	0.526	30.051%	22.335%	-7.716%	0.003	24.337%	21.426%	-2.911%	0.886
Alone Bid	4.828%	4.590%	-0.238%	0.450	3.376%	3.700%	0.323%	0.011	3.329%	3.923%	0.594%	0.002
Alone Ask	2.389%	2.446%	0.057%	0.234	2.344%	2.300%	-0.045%	0.286	2.489%	2.818%	0.329%	0.743
Average Volume in Shares												
Vol at NBBO	62.930%	66.333%	3.403%	0.090	87.001%	80.845%	-6.156%	0.035	87.318%	84.510%	-2.808%	0.253
Vol at Bid	9.625%	9.476%	-0.149%	0.579	4.818%	6.229%	1.411%	0.005	5.177%	5.626%	0.449%	0.871
Vol at Ask	9.367%	8.328%	-1.039%	0.589	4.491%	6.118%	1.628%	0.807	4.889%	5.888%	0.999%	0.002
Vol Inside	0.000%	0.004%	0.004%	0.034	0.000%	0.001%	0.001%	0.003	0.000%	0.001%	0.001%	0.130
Vol Outside	18.078%	15.860%	-2.218%	0.042	3.691%	6.807%	3.117%	0.886	2.616%	3.976%	1.359%	0.185
Total Volume	100.0%	100.0%	0.000%		100.0%	100.0%	0.000%		100.0%	100.0%	0.000%	
Vol Alone NBBO	34.908%	29.965%	-4.943%	0.199	26.928%	25.507%	-1.421%	0.670	28.511%	19.957%	-8.554%	0.575
Vol Alone Bid	2.811%	2.694%	-0.117%	0.279	1.314%	1.942%	0.628%	0.998	1.781%	1.724%	-0.057%	0.631
Vol Alone Ask	1.590%	1.522%	0.00	0.467	1.149%	1.347%	0.198%	0.029	1.370%	1.379%	0.009%	0.283

<p align="center">Table A2.6 NYSE Matching Sample Cumulative Means 1 Day Pairing (+1 to -1)</p>												
<p>This table contains the mean pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE matching sample stocks. The pairings contain 1 day of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.</p>												
Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
Average # of Quotes	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	46.570%	47.166%	0.596%	0.101	62.540%	56.769%	-5.771%	0.002	61.987%	58.478%	-3.509%	0.113
At Bid	15.901%	16.728%	0.827%	0.944	13.272%	14.437%	1.165%	0.014	13.888%	14.517%	0.629%	0.431
At Ask	17.355%	16.672%	-0.682%	0.954	12.588%	14.144%	1.555%	0.287	14.191%	15.943%	1.752%	0.254
Inside NBBO	0.000%	0.000%	0.000%		0.000%	0.000%	0.000%		0.000%	0.000%	0.000%	
Outside NBBO	20.175%	19.434%	-0.741%	0.034	11.600%	14.650%	3.050%	0.333	9.933%	11.062%	1.128%	0.711
Total Average # of Quotes	100.0%	100.0%	0.000%		100.0%	100.0%	0.000%		100.0%	100.0%	0.000%	
Alone NBBO	26.509%	25.546%	-0.962%	0.285	29.868%	25.550%	-4.318%	0.159	27.463%	23.102%	-4.362%	0.056
Alone Bid	4.790%	4.950%	0.159%	0.783	3.158%	3.691%	0.532%	0.009	3.117%	3.722%	0.605%	0.107
Alone Ask	2.524%	2.491%	-0.034%	0.442	2.041%	2.374%	0.332%	0.155	2.437%	2.593%	0.156%	0.333
Average Volume in Shares												
Vol at NBBO	68.385%	66.512%	-1.872%	0.021	87.703%	84.553%	-3.149%	0.001	89.260%	86.108%	-3.152%	0.000
Vol at Bid	9.460%	9.135%	-0.325%	0.763	4.680%	5.330%	0.650%	0.352	4.002%	5.267%	1.266%	0.013
Vol at Ask	7.439%	9.177%	1.738%	0.007	3.933%	4.654%	0.721%	0.732	4.183%	5.235%	1.052%	0.069
Vol Inside	0.000%	0.000%	0.000%		0.000%	0.000%	0.000%		0.000%	0.000%	0.000%	
Vol Outside	14.717%	15.176%	0.459%	0.196	3.685%	5.463%	1.779%	0.001	2.555%	3.390%	0.834%	0.040
Total Volume	100.0%	100.0%	0.000%		100.0%	100.0%	0.000%		100.0%	100.0%	0.000%	
Vol Alone NBBO	27.978%	29.128%	1.150%	0.048	39.756%	21.158%	-18.598%	0.124	23.664%	17.895%	-5.769%	0.438
Vol Alone Bid	2.545%	2.874%	0.329%	0.669	1.510%	1.558%	0.048%	0.276	1.174%	1.696%	0.522%	0.769
Vol Alone Ask	1.524%	1.489%	-0.034%	0.604	0.964%	1.127%	0.163%	0.630	1.330%	1.379%	0.049%	0.155

Table A2.7
NYSE Pilot Phase Sample Cumulative Means Event Day Matching (+0 to -1)

This table contains the mean pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE pilot phase stocks.
The pairings contain 1 day of data before the event day and the event day. The results are divided in three time slices to isolate beginning and end of day volatility.
The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average # of Quotes</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	52.485%	53.371%	0.886%	0.679	75.108%	74.704%	-0.404%	0.837	69.440%	69.376%	-0.064%	0.606
At Bid	5.858%	6.046%	0.188%	0.007	1.036%	1.054%	0.017%	0.145	5.652%	6.159%	0.507%	0.011
At Ask	19.617%	18.599%	-1.018%	0.084	9.116%	9.149%	0.033%	0.066	13.729%	13.374%	-0.355%	0.165
Inside NBBO	0.000%	0.010%	0.010%	0.000	0.000%	0.004%	0.004%	0.000	0.000%	0.004%	0.004%	0.026
Outside NBBO	22.039%	21.973%	-0.066%	0.911	14.740%	15.090%	0.350%	0.564	11.179%	11.087%	-0.092%	0.999
Total Average # of Quotes	100.0%	100.0%	0.000%		100.0%	100.0%	0.000%		100.0%	100.0%	0.000%	
Alone NBBO	26.229%	27.930%	1.701%	0.298	8.704%	8.808%	0.104%	0.216	25.736%	26.624%	0.889%	0.985
Alone Bid	0.569%	0.612%	0.043%	0.008	0.089%	0.093%	0.004%	0.279	0.508%	0.525%	0.017%	0.965
Alone Ask	2.417%	2.340%	-0.078%	0.083	2.398%	2.292%	-0.106%	0.001	2.347%	2.083%	-0.264%	0.124
<i>Average Volume in Shares</i>												
Vol at NBBO	69.297%	70.127%	0.830%	0.734	67.472%	67.648%	0.176%	0.891	81.719%	83.659%	1.941%	0.208
Vol at Bid	8.111%	7.043%	-1.067%	0.639	8.336%	8.170%	-0.165%	0.542	6.903%	6.279%	-0.623%	0.292
Vol at Ask	7.855%	7.645%	-0.210%	0.743	8.158%	8.375%	0.217%	0.422	6.655%	5.875%	-0.780%	0.947
Vol Inside	0.000%	0.014%	0.014%	0.012	0.000%	0.004%	0.004%	0.000	0.000%	0.003%	0.003%	0.028
Vol Outside	14.738%	15.171%	0.433%	0.992	16.034%	15.803%	-0.231%	0.813	4.723%	4.184%	-0.540%	0.073
Total Volume	100.0%	100.0%	0.000%		100.0%	100.0%	0.000%		100.0%	100.0%	0.000%	
Vol Alone NBBO	28.550%	32.556%	4.006%	0.114	121.030%	121.431%	0.401%	0.520	40.168%	41.471%	1.303%	0.357
Vol Alone Bid	1.960%	1.705%	-0.255%	0.889	1.069%	1.131%	0.062%	0.918	1.159%	1.091%	-0.068%	0.792
Vol Alone Ask	1.235%	1.120%	0.00	0.603	3.575%	3.932%	0.357%	0.421	1.889%	1.586%	-0.303%	0.032

<p align="center">Table A2.8 NYSE Matching Sample Cumulative Means Event Day Matching (+0 to -1)</p>												
<p>This table contains the mean pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NYSE matching sample stocks. The pairings contain 1 day of data before the event day and the event day. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.</p>												
Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
Average # of Quotes	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	53.149%	53.859%	0.710%	0.036	75.023%	75.097%	0.074%	0.316	69.457%	69.206%	-0.251%	0.561
At Bid	6.805%	7.660%	0.855%	0.012	1.225%	1.197%	-0.028%	0.666	6.790%	6.802%	0.013%	0.520
At Ask	18.483%	17.771%	-0.712%	0.937	9.787%	9.928%	0.142%	0.652	13.716%	13.574%	-0.142%	0.585
Inside NBBO	0.000%	0.000%	0.000%		0.000%	0.000%	0.000%		0.000%	0.000%	0.000%	
Outside NBBO	21.563%	20.711%	-0.853%	0.787	13.965%	13.778%	-0.187%	0.126	10.037%	10.417%	0.380%	0.465
Total Average # of Quotes	100.0%	100.0%	0.000%		100.0%	100.0%	0.000%		100.0%	100.0%	0.000%	
Alone NBBO	27.609%	30.670%	3.061%	0.675	9.734%	9.294%	-0.440%	0.037	27.601%	29.869%	2.268%	0.356
Alone Bid	0.633%	0.701%	0.068%	0.148	0.100%	0.095%	-0.006%	0.760	0.552%	0.583%	0.031%	0.247
Alone Ask	2.342%	2.187%	-0.155%	0.583	2.247%	2.144%	-0.103%	0.019	2.244%	1.961%	-0.283%	0.017
Average Volume in Shares												
Vol at NBBO	69.867%	72.507%	2.640%	0.234	69.336%	69.699%	0.363%	0.429	82.738%	84.858%	2.120%	0.481
Vol at Bid	8.338%	6.694%	-1.644%	0.191	8.871%	8.986%	0.116%	0.965	6.180%	5.754%	-0.426%	0.212
Vol at Ask	7.896%	7.682%	-0.214%	0.221	9.070%	8.689%	-0.381%	0.177	7.000%	5.800%	-1.200%	0.878
Vol Inside	0.000%	0.000%	0.000%		0.000%	0.000%	0.000%		0.000%	0.000%	0.000%	
Vol Outside	13.899%	13.117%	-0.782%	0.241	12.723%	12.625%	-0.097%	0.112	4.081%	3.588%	-0.493%	0.981
Total Volume	100.0%	100.0%	0.000%		100.0%	100.0%	0.000%		100.0%	100.0%	0.000%	
Vol Alone NBBO	32.785%	38.102%	5.317%	0.217	127.454%	127.220%	-0.234%	0.153	44.435%	47.891%	3.455%	0.667
Vol Alone Bid	1.989%	1.680%	-0.309%	0.739	1.235%	1.149%	-0.086%	0.371	1.113%	1.137%	0.024%	0.807
Vol Alone Ask	1.307%	1.422%	0.115%	0.304	3.724%	3.461%	-0.263%	0.110	2.321%	1.631%	-0.690%	0.028

<p align="center">Table A2.9 Nasdaq Pilot Sample Cumulative Means 5 Days Pairings</p>												
<p>This table contains the mean pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ pilot phase stocks.</p> <p>The pairings contain 5 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility.</p> <p>The sign test and the Wilcoxon test are the p-value results.</p>												
Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average # of Quotes</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	57.446%	57.088%	-0.359%	0.415	65.460%	65.948%	0.488%	0.214	67.303%	69.651%	2.349%	0.113
At Bid	14.066%	13.912%	-0.155%	0.894	12.213%	11.824%	-0.388%	0.330	12.084%	10.689%	-1.395%	0.341
At Ask	14.287%	14.474%	0.187%	0.201	12.260%	11.848%	-0.412%	0.821	10.899%	11.207%	0.308%	0.000
Inside NBBO	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Outside NBBO	14.201%	14.527%	0.326%	0.827	10.068%	10.380%	0.312%	0.122	9.714%	8.452%	-1.262%	0.568
Total Average # of Quotes	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Alone NBBO	42.670%	43.006%	0.336%	0.431	48.736%	47.572%	-1.164%	0.372	42.263%	47.398%	5.135%	0.139
Alone Bid	4.613%	4.895%	0.282%	0.613	3.222%	3.277%	0.055%	0.567	3.321%	3.019%	-0.302%	0.328
Alone Ask	1.609%	1.628%	0.019%	0.418	1.616%	1.517%	-0.098%	0.252	1.764%	1.580%	-0.185%	0.637
<i>Average Volume in Shares</i>												
Vol at NBBO	75.142%	73.139%	-2.002%	0.394	85.477%	83.510%	-1.967%	0.968	88.347%	88.474%	0.127%	0.858
Vol at Bid	5.794%	6.514%	0.721%	0.192	3.768%	4.109%	0.341%	0.168	3.847%	3.417%	-0.430%	0.071
Vol at Ask	6.274%	6.081%	-0.193%	0.278	4.020%	3.902%	-0.118%	0.560	3.562%	3.459%	-0.103%	0.025
Vol Inside	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Vol Outside	12.790%	14.266%	1.475%	0.337	6.735%	8.479%	1.744%	0.671	4.244%	4.650%	0.406%	0.557
Total Volume	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Vol Alone NBBO	54.017%	57.293%	3.276%	0.328	59.714%	63.966%	4.252%	0.856	54.682%	64.163%	9.480%	0.788
Vol Alone Bid	2.894%	2.821%	-0.073%	0.409	1.579%	1.629%	0.050%	0.659	1.534%	1.422%	-0.112%	0.267
Vol Alone Ask	1.086%	0.937%	-0.150%	0.173	0.889%	0.832%	-0.057%	0.400	0.900%	0.775%	-0.125%	0.495

Table A2.10 Nasdaq Matching Sample Cumulative Means 5 Days Pairings												
This table contains the mean pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ matching sample stocks. The pairings contain 5 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.												
Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average # of Quotes</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	56.622%	56.925%	0.303%	0.281	65.994%	66.567%	0.573%	0.933	66.029%	70.022%	3.992%	0.757
At Bid	14.700%	14.274%	-0.426%	0.286	11.772%	11.456%	-0.316%	0.642	12.073%	10.270%	-1.803%	0.234
At Ask	14.015%	14.223%	0.207%	0.211	11.955%	11.759%	-0.196%	0.784	11.588%	10.830%	-0.758%	0.170
Inside NBBO	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Outside NBBO	14.663%	14.578%	-0.085%	0.121	10.279%	10.218%	-0.061%	0.325	10.310%	8.879%	-1.431%	0.476
Total Average # of Quotes	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Alone NBBO	42.905%	43.115%	0.210%	0.087	45.221%	50.562%	5.341%	0.020	42.369%	45.400%	3.032%	0.960
Alone Bid	4.937%	4.796%	-0.141%	0.713	3.155%	3.237%	0.082%	0.371	3.536%	3.026%	-0.510%	0.442
Alone Ask	1.638%	1.624%	-0.014%	0.968	1.613%	1.566%	-0.046%	0.826	1.827%	1.661%	-0.166%	0.321
<i>Average Volume in Shares</i>												
Vol at NBBO	72.204%	73.602%	1.398%	0.031	86.288%	87.158%	0.870%	0.999	88.483%	89.447%	0.963%	0.126
Vol at Bid	6.432%	6.367%	-0.064%	0.660	3.639%	3.206%	-0.433%	0.544	3.716%	3.206%	-0.510%	0.699
Vol at Ask	6.516%	6.410%	-0.106%	0.458	3.398%	3.302%	-0.096%	0.094	3.294%	3.633%	0.340%	0.007
Vol Inside	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Vol Outside	14.848%	13.621%	-1.227%	0.032	6.675%	6.334%	-0.341%	0.496	4.507%	3.714%	-0.793%	0.928
Total Volume	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Vol Alone NBBO	56.598%	52.698%	-3.900%	0.462	55.116%	55.272%	0.157%	0.666	48.621%	48.722%	0.101%	0.007
Vol Alone Bid	2.856%	2.835%	-0.020%	0.452	1.516%	1.421%	-0.094%	0.312	1.736%	1.359%	-0.377%	0.093
Vol Alone Ask	1.567%	1.530%	-0.036%	0.385	0.995%	0.917%	-0.079%	0.462	1.449%	1.391%	-0.058%	0.298

Table A2.11
Nasdaq Pilot Phase Sample Cumulative Means 3 Days Pairings

This table contains the mean pair-wise differences for the percentage of quotes at the NBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ pilot phase stocks.

The pairings contain 3 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility.

The sign test and the Wilcoxon test are the p-value results.

Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average # of Quotes</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	57.471%	57.380%	-0.091%	0.732	66.255%	65.514%	-0.741%	0.844	70.515%	71.350%	0.836%	0.000
At Bid	14.165%	13.856%	-0.309%	0.790	11.907%	11.971%	0.063%	0.636	10.621%	9.971%	-0.649%	0.115
At Ask	14.029%	14.305%	0.276%	0.222	11.889%	11.735%	-0.154%	0.621	10.178%	10.466%	0.287%	0.000
Inside NBBO	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Outside NBBO	14.334%	14.459%	0.125%	0.698	9.948%	10.780%	0.832%	0.509	8.686%	8.213%	-0.474%	0.286
Total Average # of Quotes	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Alone NBBO	44.375%	43.586%	-0.788%	0.856	48.634%	48.425%	-0.210%	0.092	44.260%	50.274%	6.014%	0.061
Alone Bid	4.741%	4.910%	0.169%	0.942	3.176%	3.337%	0.162%	0.512	2.851%	2.917%	0.066%	0.001
Alone Ask	1.509%	1.597%	0.088%	0.242	1.569%	1.462%	-0.106%	0.264	1.574%	1.289%	-0.285%	0.756
<i>Average Volume in Shares</i>												
Vol at NBBO	73.598%	73.052%	-0.546%	0.895	84.600%	83.064%	-1.535%	0.916	88.273%	89.299%	1.027%	0.082
Vol at Bid	6.008%	6.462%	0.454%	0.482	4.002%	4.252%	0.250%	0.611	3.662%	3.114%	-0.548%	0.441
Vol at Ask	6.284%	5.970%	-0.314%	0.445	4.000%	3.985%	-0.015%	0.748	3.575%	3.018%	-0.557%	0.352
Vol Inside	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Vol Outside	14.110%	14.516%	0.406%	0.873	7.398%	8.699%	1.300%	0.512	4.490%	4.568%	0.078%	0.202
Total Volume	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Vol Alone NBBO	57.525%	59.143%	1.618%	0.173	64.955%	64.180%	-0.775%	0.501	60.754%	65.313%	4.559%	0.859
Vol Alone Bid	2.759%	2.775%	0.016%	0.285	1.585%	1.620%	0.035%	0.672	1.448%	1.221%	-0.227%	0.167
Vol Alone Ask	0.917%	0.911%	-0.006%	0.468	0.935%	0.814%	-0.121%	0.406	0.869%	0.621%	-0.248%	0.470

<p align="center">Table A2.12 Nasdaq Matching Sample Cumulative Means 3 Days Pairings</p> <p>This table contains the mean pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ matching sample stocks. The pairings contain 3 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.</p>												
Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average # of Quotes</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	56.454%	57.350%	0.897%	0.837	66.120%	66.290%	0.170%	0.684	69.787%	71.629%	1.842%	0.382
At Bid	14.602%	14.066%	-0.536%	0.137	11.864%	11.416%	-0.448%	0.775	10.881%	9.583%	-1.298%	0.819
At Ask	14.071%	13.792%	-0.280%	0.880	11.821%	11.813%	-0.008%	0.400	10.518%	10.149%	-0.369%	0.581
Inside NBBO	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Outside NBBO	14.873%	14.792%	-0.081%	0.300	10.195%	10.481%	0.286%	0.881	8.814%	8.639%	-0.175%	0.239
Total Average # of Quotes	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Alone NBBO	41.483%	44.577%	3.093%	0.352	48.442%	50.966%	2.525%	0.271	46.138%	47.085%	0.948%	0.731
Alone Bid	4.934%	4.814%	-0.120%	0.574	3.186%	3.177%	-0.009%	0.636	3.110%	2.978%	-0.131%	0.602
Alone Ask	1.636%	1.544%	-0.092%	0.627	1.561%	1.478%	-0.083%	0.992	1.585%	1.446%	-0.139%	0.533
<i>Average Volume in Shares</i>												
Vol at NBBO	72.893%	73.079%	0.185%	0.019	87.706%	86.840%	-0.866%	0.657	89.770%	90.184%	0.414%	0.005
Vol at Bid	6.219%	6.714%	0.495%	0.272	3.336%	3.342%	0.006%	0.723	3.510%	3.010%	-0.500%	0.097
Vol at Ask	6.621%	6.244%	-0.377%	0.861	3.006%	3.345%	0.339%	0.367	2.856%	3.391%	0.535%	0.121
Vol Inside	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Vol Outside	14.267%	13.964%	-0.303%	0.021	5.952%	6.473%	0.520%	0.781	3.863%	3.415%	-0.449%	0.078
Total Volume	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Vol Alone NBBO	56.256%	54.625%	-1.632%	0.834	48.987%	55.292%	6.305%	0.416	50.144%	48.271%	-1.873%	0.049
Vol Alone Bid	2.941%	2.889%	-0.051%	0.312	1.369%	1.441%	0.072%	0.627	1.398%	1.264%	-0.134%	0.481
Vol Alone Ask	1.567%	1.404%	-0.162%	0.133	0.901%	0.954%	0.053%	0.412	1.194%	1.172%	-0.023%	0.789

<p align="center">Table A2.13 Nasdaq Pilot Phase Sample Cumulative Means 1 Day Pairing (+1 to -1)</p>												
<p>This table contains the mean pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ pilot phase stocks. The pairings contain 1 day of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.</p>												
Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
Average # of Quotes	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	56.965%	57.278%	0.313%	0.606	65.895%	62.948%	-2.947%	0.095	68.348%	66.142%	-2.206%	0.465
At Bid	13.459%	13.381%	-0.078%	0.396	12.617%	13.332%	0.715%	0.073	11.004%	11.131%	0.127%	0.657
At Ask	14.094%	14.781%	0.687%	0.351	11.853%	12.854%	1.001%	0.343	11.261%	13.035%	1.775%	0.076
Inside NBBO	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Outside NBBO	15.482%	14.561%	-0.921%	0.434	9.635%	10.866%	1.231%	0.656	9.387%	9.691%	0.305%	0.871
Total Average # of Quotes	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Alone NBBO	44.586%	42.427%	-2.159%	0.960	50.967%	46.868%	-4.099%	0.298	42.164%	42.593%	0.429%	0.188
Alone Bid	4.707%	5.111%	0.404%	0.410	3.232%	3.530%	0.298%	0.084	2.864%	3.382%	0.518%	0.006
Alone Ask	1.479%	1.625%	0.146%	0.681	1.715%	1.633%	-0.082%	0.893	1.747%	1.842%	0.095%	0.348
Average Volume in Shares												
Vol at NBBO	72.769%	68.337%	-4.433%	0.003	83.612%	81.645%	-1.967%	0.188	86.977%	86.971%	-0.007%	0.734
Vol at Bid	6.241%	7.009%	0.769%	0.025	4.345%	4.473%	0.129%	0.115	4.093%	3.652%	-0.440%	0.296
Vol at Ask	6.336%	5.832%	-0.504%	0.779	3.904%	4.106%	0.202%	0.668	3.673%	3.981%	0.309%	0.504
Vol Inside	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Vol Outside	14.654%	18.822%	4.168%	0.014	8.139%	9.775%	1.637%	0.542	5.257%	5.396%	0.139%	0.449
Total Volume	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Vol Alone NBBO	61.369%	61.217%	-0.151%	0.403	71.962%	58.279%	-13.682%	0.490	61.518%	59.038%	-2.481%	0.303
Vol Alone Bid	2.833%	3.356%	0.523%	0.725	1.553%	1.739%	0.185%	0.094	1.480%	1.593%	0.114%	0.292
Vol Alone Ask	0.934%	1.103%	0.169%	0.426	1.022%	0.946%	-0.076%	0.524	1.040%	0.987%	-0.053%	0.149

Table A2.14 Nasdaq Matching Sample Cumulative Means 1 Day Pairing (+1 to -1)												
This table contains the mean pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ pilot phase stocks. The pairings contain 1 day of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.												
Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
Average # of Quotes	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	56.316%	58.307%	1.991%	0.751	66.990%	63.712%	-3.278%	0.011	66.705%	66.649%	-0.056%	0.098
At Bid	14.380%	13.767%	-0.613%	0.930	12.099%	12.383%	0.284%	0.903	11.723%	10.657%	-1.065%	0.037
At Ask	13.714%	13.490%	-0.223%	0.722	11.156%	12.762%	1.606%	0.030	12.123%	12.339%	0.216%	0.262
Inside NBBO	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Outside NBBO	15.591%	14.436%	-1.155%	0.962	9.755%	11.142%	1.388%	0.007	9.449%	10.355%	0.906%	0.412
Total Average # of Quotes	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Alone NBBO	40.725%	42.262%	1.537%	0.384	48.391%	46.565%	-1.826%	0.388	45.031%	40.993%	-4.038%	0.094
Alone Bid	4.996%	4.589%	-0.407%	0.841	2.892%	3.398%	0.506%	0.080	3.391%	3.416%	0.025%	0.818
Alone Ask	1.653%	1.648%	-0.005%	0.300	1.574%	1.642%	0.068%	0.214	2.019%	2.010%	-0.009%	0.368
Average Volume in Shares												
Vol at NBBO	69.632%	73.512%	3.879%	0.147	87.672%	84.701%	-2.971%	0.804	88.717%	85.005%	-3.712%	0.020
Vol at Bid	6.477%	6.706%	0.229%	0.127	3.374%	3.942%	0.568%	0.135	3.424%	3.923%	0.498%	0.266
Vol at Ask	7.021%	5.486%	-1.536%	0.502	2.972%	3.792%	0.820%	0.809	3.647%	5.851%	2.204%	0.234
Vol Inside	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Vol Outside	16.869%	14.296%	-2.573%	0.141	5.981%	7.565%	1.584%	0.194	4.211%	5.221%	1.010%	0.085
Total Volume	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Vol Alone NBBO	57.207%	51.977%	-5.230%	0.428	42.334%	58.465%	16.131%	0.875	54.727%	45.801%	-8.925%	0.271
Vol Alone Bid	2.991%	2.918%	-0.073%	0.895	1.249%	1.671%	0.422%	0.856	1.640%	2.035%	0.395%	0.397
Vol Alone Ask	1.553%	1.329%	-0.224%	0.486	0.915%	1.113%	0.198%	0.870	1.723%	1.982%	0.259%	0.545

Table A2.15 Nasdaq Pilot Phase Sample Cumulative Means Event Day Matching (+0 to -1)												
This table contains the mean pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ pilot phase stocks. The pairings contain 1 day of data before the event day and the event day. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.												
Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
Average # of Quotes	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	58.925%	59.280%	0.355%	0.191	74.527%	74.555%	0.028%	0.597	69.629%	71.546%	1.916%	0.168
At Bid	12.420%	12.312%	-0.108%	0.294	2.561%	2.078%	-0.482%	0.082	10.470%	10.339%	-0.132%	0.828
At Ask	14.042%	14.432%	0.390%	0.215	12.182%	12.777%	0.596%	0.988	11.059%	10.576%	-0.483%	0.185
Inside NBBO	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Outside NBBO	14.613%	13.975%	-0.637%	0.679	10.731%	10.589%	-0.141%	0.494	8.841%	7.539%	-1.302%	0.607
Total Average # of Quotes	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Alone NBBO	45.330%	43.409%	-1.921%	0.002	28.045%	26.811%	-1.234%	0.023	44.809%	42.909%	-1.901%	0.022
Alone Bid	1.627%	1.225%	-0.402%	0.959	0.272%	0.262%	-0.010%	0.929	1.419%	1.350%	-0.069%	0.699
Alone Ask	1.356%	1.575%	0.219%	0.056	1.615%	1.759%	0.144%	0.276	1.693%	1.736%	0.044%	0.254
Average Volume In Shares												
Vol at NBBO	75.696%	75.689%	-0.007%	0.498	83.175%	84.208%	1.033%	0.575	89.042%	88.778%	-0.264%	0.523
Vol at Bid	5.633%	5.035%	-0.598%	0.881	4.202%	3.882%	-0.319%	0.137	3.464%	3.478%	0.013%	0.395
Vol at Ask	5.455%	6.083%	0.628%	0.464	3.933%	3.766%	-0.167%	0.087	2.902%	3.296%	0.393%	0.546
Vol Inside	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Vol Outside	13.217%	13.193%	-0.024%	0.759	8.690%	8.144%	-0.546%	0.261	4.591%	4.448%	-0.143%	0.411
Total Volume	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Vol Alone NBBO	59.273%	55.089%	-4.183%	0.090	82.925%	70.830%	-12.095%	0.084	56.608%	54.199%	-2.409%	0.002
Vol Alone Bid	2.495%	2.045%	-0.450%	0.905	1.457%	1.345%	-0.112%	0.723	1.190%	1.323%	0.132%	0.188
Vol Alone Ask	0.799%	0.947%	0.147%	0.309	0.980%	0.908%	-0.072%	0.415	0.859%	0.866%	0.007%	0.714

Table A2.16 Nasdaq Matching Sample Cumulative Means Event Day Matching (+0 to -1)												
This table contains the mean pair-wise differences for the percentage of quotes at the NBBBO, at the Bid, at the Ask, Inside the NBBO, Outside the NBBO, Alone at the NBBO, Alone at the Bid, Alone at the Ask and the corresponding volume statistics for NASDAQ matching sample stocks. The pairings contain 1 day of data before the event day and the event day. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.												
Pre Phase	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
Average # of Quotes	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
At NBBO	59.176%	60.171%	0.995%	0.142	74.985%	74.073%	-0.912%	0.041	69.112%	70.734%	1.622%	0.113
At Bid	12.744%	11.352%	-1.392%	0.279	2.363%	2.188%	-0.175%	0.003	9.608%	9.582%	-0.026%	0.628
At Ask	13.911%	14.216%	0.305%	0.200	12.011%	12.331%	0.320%	0.026	11.793%	10.961%	-0.832%	0.066
Inside NBBO	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Outside NBBO	14.169%	14.260%	0.091%	0.962	10.642%	11.409%	0.767%	0.011	9.488%	8.723%	-0.765%	0.484
Total Average # of Quotes	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Alone NBBO	44.313%	43.341%	-0.972%	0.875	26.910%	25.022%	-1.889%	0.000	43.467%	43.288%	-0.178%	0.557
Alone Bid	1.480%	1.331%	-0.149%	0.826	0.277%	0.232%	-0.045%	0.006	1.373%	1.227%	-0.147%	0.049
Alone Ask	1.574%	1.651%	0.077%	0.532	1.649%	1.628%	-0.021%	0.937	1.821%	1.737%	-0.084%	0.209
Average Volume in Shares												
Vol at NBBO	73.542%	74.692%	1.150%	0.244	83.701%	80.745%	-2.956%	0.003	89.025%	89.169%	0.144%	0.123
Vol at Bid	6.100%	4.924%	-1.176%	0.287	4.565%	4.694%	0.129%	0.073	3.407%	3.484%	0.076%	0.937
Vol at Ask	6.045%	5.709%	-0.335%	0.069	3.895%	4.248%	0.353%	0.210	3.703%	3.361%	-0.341%	0.080
Vol Inside	0.000%	0.000%			0.000%	0.000%			0.000%	0.000%		
Vol Outside	14.313%	14.675%	0.361%	0.867	7.839%	10.313%	2.474%	0.003	3.865%	3.986%	0.122%	0.613
Total Volume	100.00%	100.00%	0.000%		100.00%	100.00%	0.000%		100.00%	100.00%	0.000%	
Vol Alone NBBO	54.470%	53.467%	-1.003%	0.795	85.220%	91.846%	6.626%	0.344	49.430%	52.913%	3.483%	0.398
Vol Alone Bid	2.544%	2.180%	-0.364%	0.389	1.398%	1.465%	0.067%	0.104	1.353%	1.207%	-0.147%	0.391
Vol Alone Ask	1.036%	1.058%	0.021%	0.729	1.068%	1.026%	-0.042%	0.427	1.050%	0.984%	-0.066%	0.317

Table A3.1: NYSE Pilot Sample Cumulative Means 5 Days Pairings

This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 5 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average Descriptives</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	84708.58	102504.96	17796.38	0.001	408717.16	450860.05	42142.89	0.000	111562.48	105416.04	-6146.44	0.153
Ave. Trade Size	431.87	572.82	140.95	0.186	845.3	938.47	93.17	0.599	365.47	318.37	-47.10	0.306
Ave. Trade Price	47.69	47.92	0.23	0.000	47.70	47.95	0.25	0.000	46.78	46.94	0.16	0.000
% # of buy trades	50.292%	49.236%	-1.06%	0.007	49.986%	49.022%	-0.96%	0.100	52.006%	47.096%	-4.91%	0.000
% # of sell trades	49.708%	50.764%	1.06%	0.007	50.014%	50.978%	0.96%	0.100	47.994%	52.904%	4.91%	0.000
% # of trades inside NBBO	19.80%	18.34%	-1.46%	0.966	15.07%	16.03%	0.96%	0.096	10.67%	11.51%	0.84%	0.043
% # of trades outside NBBO	9.86%	11.52%	1.66%	0.000	5.21%	5.54%	0.34%	0.024	5.88%	4.91%	-0.97%	0.407
% # of buy trades at ask	35.27%	34.29%	-0.98%	0.000	39.80%	38.28%	-1.52%	0.000	43.61%	39.04%	-4.56%	0.000
% # of sell trades at bid	35.07%	35.85%	0.78%	0.643	39.92%	40.15%	0.22%	0.467	39.84%	44.54%	4.69%	0.000
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.022615	0.019464	-0.003151	0.010	0.009582	0.009518	-0.000064	0.770	0.008614	0.008076	-0.000538	0.221
% quoted half spread	0.071600%	0.060457%	-0.011143%	0.012	0.033137%	0.033960%	0.000823%	0.193	0.033722%	0.032513%	-0.001209%	0.533
Bid vol at quoted spread	9.25	11.75	2.50	0.257	13.12	13.97	0.85	0.092	22.79	20.48	-2.31	0.426
% bid vol at quoted spread	47.242%	49.935%	2.69%	0.009	48.324%	49.935%	1.61%	0.000	50.882%	49.935%	-0.95%	0.011
Ask vol at quoted spread	10.33	9.45	-0.88	0.061	14.03	12.80	-1.23	0.002	22.00	19.91	-2.09	0.041
% Ask vol at quoted spread	52.758%	50.065%	-2.69%	0.009	51.676%	50.065%	-1.61%	0.000	49.118%	50.065%	0.95%	0.011
Total Vol at QS	19.58	21.20	1.62	0.488	27.15	26.77	-0.38	0.623	44.79	40.39	-4.40	0.198
Effective half spread	0.008561	0.008346	-0.000215	0.635	0.004962	0.005162	0.000200	0.438	0.003952	0.003538	-0.000414	0.040
% effective half spread	0.026322%	0.023993%	-0.002329%	0.096	0.015405%	0.016057%	0.000652%	0.143	0.014757%	0.014073%	-0.000684%	0.309

<p align="center">Table A3.2 NYSE Matching Sample Cumulative Means 5 days pairings</p>												
<p>This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 5 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.</p>												
No F Trades	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average Descriptives</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	61802.33	69703.16	7900.83	0.003	331747.33	358479.19	26731.86	0.006	86261.49	77185.97	-9075.52	0.002
Ave. Trade Size	337.38	336.63	-0.75	0.973	454.83	1403.53	948.70	0.045	289.88	438.91	149.03	0.242
Ave. Trade Price	48.18	48.30	0.12	0.001	47.89	48.05	0.16	0.000	47.46	47.59	0.13	0.002
% # of buy trades	51.038%	49.189%	-1.85%	0.000	50.052%	49.701%	-0.35%	0.294	51.516%	47.626%	-3.89%	0.018
% # of sell trades	48.962%	50.811%	1.85%	0.000	49.948%	50.299%	0.35%	0.294	48.484%	52.374%	3.89%	0.018
Total % of trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	21.77%	20.47%	-1.30%	0.222	16.40%	17.78%	1.38%	0.001	11.81%	13.32%	1.50%	0.000
% # of trades outside NBBO	8.57%	10.13%	1.56%	0.005	4.44%	4.89%	0.45%	0.093	4.89%	4.85%	-0.04%	0.323
% # of buy trades at ask	35.70%	34.15%	-1.55%	0.000	39.58%	38.30%	-1.28%	0.004	43.13%	38.60%	-4.53%	0.001
% # of sell trades at bid	33.96%	35.25%	1.29%	0.010	39.58%	39.03%	-0.55%	0.301	40.17%	43.23%	3.06%	0.501
# of total trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.023635	0.023485	-0.000150	0.907	0.011101	0.011294	0.000193	0.429	0.009976	0.009379	-0.000597	0.344
% quoted half spread	0.054584%	0.055357%	0.000773%	0.795	0.026515%	0.026405%	-0.000110%	0.860	0.024735%	0.023261%	-0.001474%	0.418
Bid vol at quoted spread	7.56	8.22	0.66	0.346	9.96	9.73	-0.23	0.402	15.71	15.56	-0.15	0.740
% bid vol at quoted spread	47.015%	49.935%	2.92%	0.004	48.023%	49.935%	1.91%	0.000	45.802%	49.935%	4.13%	0.008
Ask vol at quoted spread	8.52	7.25	-1.27	0.002	10.78	9.66	-1.12	0.000	18.59	15.74	-2.85	0.000
% Ask vol at quoted spread	52.985%	50.065%	-2.92%	0.004	51.977%	50.065%	-1.91%	0.000	54.198%	50.065%	-4.13%	0.008
Total Vol at QS	16.08	15.47	-0.61	0.466	20.74	19.39	-1.35	0.003	34.30	31.30	-3.00	0.000
Effective half spread	0.008557	0.008216	-0.000341	0.291	0.005188	0.005520	0.000332	0.108	0.004484	0.003972	-0.000512	0.111
% effective half spread	0.020066%	0.019558%	-0.000508%	0.496	0.012329%	0.013175%	0.000846%	0.068	0.011349%	0.009981%	-0.001368%	0.135

<p align="center">Table A3.3 NYSE Pilot Phase Sample Cumulative Means 3 Days Pairings</p> <p>This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 3 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.</p>												
No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average Descriptives</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	81080.00	105285.05	24205.05	0.000	373305.59	489925.46	116619.87	0.000	93397.60	117490.35	24092.75	0.000
Ave. Trade Size	412.54	668.17	255.63	0.144	632.73	975.75	343.02	0.117	290.39	339.68	49.29	0.056
Ave. Trade Price	47.73	47.59	-0.14	0.000	47.85	47.67	-0.18	0.000	47.21	46.64	-0.57	0.000
% # of buy trades	49.734%	49.661%	-0.07%	0.194	49.935%	49.050%	-0.89%	0.064	50.591%	46.381%	-4.21%	0.000
% # of sell trades	50.266%	50.339%	0.07%	0.194	50.065%	50.950%	0.89%	0.064	49.409%	53.619%	4.21%	0.000
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	19.67%	18.44%	-1.23%	0.769	15.41%	15.71%	0.31%	0.366	11.52%	11.34%	-0.17%	0.564
% # of trades outside NBBO	9.12%	11.65%	2.53%	0.000	5.04%	5.88%	0.84%	0.000	4.04%	5.48%	1.44%	0.002
% # of buy trades at ask	35.25%	34.67%	-0.58%	0.005	39.65%	38.24%	-1.42%	0.000	42.77%	38.10%	-4.67%	0.000
% # of sell trades at bid	35.95%	35.24%	-0.71%	0.922	39.90%	40.17%	0.27%	0.350	41.68%	45.08%	3.40%	0.000
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.022374	0.018464	-0.003910	0.018	0.009803	0.009521	-0.000282	0.415	0.009227	0.007883	-0.001344	0.090
% quoted half spread	0.074766%	0.059979%	-0.014787%	0.028	0.033680%	0.033830%	0.000150%	0.871	0.033189%	0.030593%	-0.002596%	0.274
Bid vol at quoted spread	9.37	10.01	0.64	0.33	13.73	13.71	-0.02	0.965	21.16	20.09	-1.07	0.371
% bid vol at quoted spread	46.991%	49.935%	2.94%	0.12	48.585%	49.935%	1.35%	0.000	48.299%	49.935%	1.64%	0.034
Ask vol at quoted spread	10.57	9.02	-1.55	0.006	14.53	12.05	-2.48	0.000	22.65	17.87	-4.78	0.000
% Ask vol at quoted spread	53.009%	50.065%	-2.94%	0.12	51.415%	50.065%	-1.35%	0.000	51.701%	50.065%	-1.64%	0.034
Total Vol at QS	19.94	19.03	-0.91	0.282	28.26	25.76	-2.50	0.000	43.81	37.96	-5.85	0.004
Effective half spread	0.008115	0.008315	0.000200	0.741	0.004763	0.005423	0.000660	0.089	0.004030	0.003586	-0.000444	0.241
% effective half spread	0.025928%	0.023748%	-0.002180%	0.192	0.014869%	0.016127%	0.001258%	0.039	0.014561%	0.013666%	-0.000895%	0.398

Table A3.4
NYSE Matching Sample Cumulative Means 3 days Pairings

This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 3 days of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average Descriptives</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	58993.82	76594.94	17601.12	0.000	304608.45	401827.63	97219.18	0.000	74585.49	87438.10	12852.61	0.002
Ave. Trade Size	330.48	368.39	37.91	0.261	422.04	713.26	291.22	0.038	305.32	599.81	294.49	0.252
Ave. Trade Price	48.25	47.94	-0.31	0.000	48.22	47.93	-0.29	0.000	47.74	47.13	-0.61	0.000
% # of buy trades	50.874%	49.516%	-1.36%	0.000	49.730%	49.415%	-0.31%	0.025	50.306%	46.536%	-3.77%	0.175
% # of sell trades	49.126%	50.484%	1.36%	0.000	50.270%	50.585%	0.31%	0.025	49.694%	53.464%	3.77%	0.175
Total % of trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	21.45%	19.98%	-1.47%	0.576	16.78%	17.40%	0.62%	0.083	12.81%	13.04%	0.23%	0.036
% # of trades outside NBBO	7.92%	10.06%	2.14%	0.000	4.27%	5.05%	0.78%	0.015	3.48%	5.36%	1.88%	0.000
% # of buy trades at ask	35.96%	34.75%	-1.22%	0.000	39.17%	38.08%	-1.09%	0.000	42.09%	37.34%	-4.75%	0.001
% # of sell trades at bid	34.67%	35.21%	0.54%	0.015	39.79%	39.48%	-0.31%	0.292	41.62%	44.26%	2.64%	0.584
Total % of trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.020946	0.022981	0.002035	0.165	0.011190	0.011147	-0.000043	0.827	0.011116	0.009803	-0.001313	0.270
% quoted half spread	0.048564%	0.055906%	0.007342%	0.037	0.026562%	0.026504%	-0.000058%	0.889	0.027899%	0.024402%	-0.003497%	0.323
Bid vol at quoted spread	7.73	9.03	1.30	0.262	10.00	10.09	0.09	0.830	15.41	15.70	0.29	0.633
% bid vol at quoted spread	46.651%	49.935%	3.28%	0.026	47.801%	49.935%	2.13%	0.000	46.655%	49.935%	3.28%	0.013
Ask vol at quoted spread	8.84	7.56	-1.28	0.046	10.92	9.83	-1.09	0.008	17.62	15.59	-2.03	0.000
% Ask vol at quoted spread	53.349%	50.065%	-3.28%	0.026	52.199%	50.065%	-2.13%	0.000	53.345%	50.065%	-3.28%	0.013
Total Vol at QS	16.57	16.59	0.02	0.988	20.92	19.92	-1.00	0.105	33.03	31.29	-1.74	0.080
Effective half spread	0.007594	0.007968	0.000374	0.207	0.004822	0.005639	0.000817	0.001	0.004919	0.004333	-0.000586	0.343
% effective half spread	0.018205%	0.019526%	0.001322%	0.100	0.011747%	0.013616%	0.001869%	0.003	0.012678%	0.010756%	-0.001922%	0.285

Table A3.5
NYSE Pilot Phase Sample Cumulative Means 1 Day Pairing (+1 to -1)

This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 1 day of data on both sides of the event date. The results are divided in three time slices to isolate beginning and end of day volatility. The sign test and the Wilcoxon test are the p-value results.

No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average Descriptives</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	79194.29	96443.06	17248.77	0.004	398459.32	478896.44	80437.12	0.000	87918.40	134079.53	46161.13	0.000
Ave. Trade Size	474.79	995.75	520.96	0.307	678.41	1126.55	448.14	0.373	263.89	343.19	79.30	0.069
Ave. Trade Price	47.42	47.41	-0.01	0.713	47.72	47.37	-0.35	0.000	47.56	46.80	-0.76	0.000
% # of buy trades	47.833%	47.733%	-0.10%	0.788	49.074%	46.744%	-2.33%	0.208	48.128%	42.661%	-5.47%	0.001
% # of sell trades	52.167%	52.267%	0.10%	0.788	50.926%	53.256%	2.33%	0.208	51.872%	57.339%	5.47%	0.001
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	19.52%	18.77%	-0.75%	0.048	15.32%	15.40%	0.08%	0.583	11.54%	10.41%	-1.13%	0.755
% # of trades outside NBBO	9.62%	10.14%	0.51%	0.133	4.97%	5.67%	0.71%	0.947	4.17%	5.93%	1.76%	0.023
% # of buy trades at ask	33.19%	33.47%	0.27%	0.536	38.79%	36.20%	-2.59%	0.146	40.27%	34.67%	-5.59%	0.000
% # of sell trades at bid	37.67%	37.63%	-0.04%	0.661	40.92%	42.73%	1.81%	0.050	44.02%	48.98%	4.96%	0.000
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.021252	0.019249	-0.002003	0.297	0.009610	0.009344	-0.000266	0.393	0.007717	0.007442	-0.000275	0.123
% quoted half spread	0.074734%	0.065113%	-0.009621%	0.345	0.032655%	0.032905%	0.000250%	0.752	0.027765%	0.028162%	0.000397%	0.581
Bid vol at quoted spread	9.01	10.36	1.35	0.163	12.82	13.92	1.10	0.272	18.90	19.71	0.81	0.517
% bid vol at quoted spread	51.048%	49.935%	-1.11%	0.207	50.552%	49.935%	-0.62%	0.009	51.387%	49.935%	-1.45%	0.192
Ask vol at quoted spread	8.64	8.66	0.02	0.980	12.54	10.51	-2.03	0.002	17.88	18.03	0.15	0.867
% Ask vol at quoted spread	48.952%	50.065%	1.11%	0.207	49.448%	50.065%	0.62%	0.009	48.613%	50.065%	1.45%	0.192
Total Vol at QS	17.65	19.02	1.37	0.199	25.36	24.43	-0.93	0.430	36.78	37.74	0.96	0.538
Effective half spread	0.007986	0.007168	-0.000819	0.091	0.004498	0.004793	0.000295	0.497	0.003387	0.003542	0.000155	0.132
% effective half spread	0.027193%	0.023968%	-0.003225%	0.357	0.014069%	0.015165%	0.001096%	0.121	0.012217%	0.012778%	0.000561%	0.178

<p align="center">Table A3.6 NYSE Matching Sample Cumulative Means 1 Day Pairing (+1 to -1)</p>												
<p>This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 1day of data on both sides of the event. The results are divided in 3 times to isolate beginning and end of day volatility. The sign and the Wilcoxon test are the p-value results.</p>												
No F Trades	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average Descriptives</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	56547.47	73618.46	17070.99	0.000	337634.51	391994.70	54360.19	0.006	76279.04	97170.68	20891.64	0.001
Ave. Trade Size	336.04	388.86	52.82	0.359	488.36	782.19	293.83	0.341	309.10	406.85	97.75	0.448
Ave. Trade Price	48.14	48.09	-0.05	0.121	48.26	47.86	-0.40	0.000	48.08	47.33	-0.75	0.000
% # of buy trades	48.022%	47.382%	-0.64%	0.571	49.482%	47.761%	-1.72%	0.375	47.999%	42.798%	-5.20%	0.139
% # of sell trades	51.978%	52.618%	0.64%	0.571	50.518%	52.239%	1.72%	0.375	52.001%	57.202%	5.20%	0.139
Total % of trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	21.41%	21.03%	-0.39%	0.907	17.03%	17.15%	0.12%	0.622	12.67%	12.31%	-0.36%	0.326
% # of trades outside NBBO	7.71%	9.04%	1.34%	0.020	4.71%	4.78%	0.07%	0.004	3.95%	5.60%	1.64%	0.000
% # of buy trades at ask	33.48%	32.65%	-0.83%	0.924	38.55%	36.55%	-2.00%	0.249	39.85%	33.83%	-6.02%	0.009
% # of sell trades at bid	37.40%	37.28%	-0.12%	0.193	39.71%	41.52%	1.81%	0.888	43.52%	48.26%	4.74%	0.911
Total % of trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.020436	0.022720	0.002284	0.225	0.011026	0.011126	0.000100	0.762	0.009647	0.009712	0.000065	0.896
% quoted half spread	0.049595%	0.056285%	0.006690%	0.214	0.025876%	0.025993%	0.000117%	0.840	0.023434%	0.024677%	0.001243%	0.349
Bid vol at quoted spread	7.70	7.59	-0.11	0.764	9.16	9.35	0.19	0.739	13.71	16.22	2.51	0.004
% bid vol at quoted spread	50.691%	49.935%	-0.76%	0.887	48.389%	49.935%	1.55%	0.000	46.569%	49.935%	3.37%	0.079
Ask vol at quoted spread	7.49	7.50	0.01	0.996	9.77	8.79	-0.98	0.083	15.73	15.23	-0.50	0.500
% Ask vol at quoted spread	49.309%	50.065%	0.76%	0.887	51.611%	50.065%	-1.55%	0.000	53.431%	50.065%	-3.37%	0.079
Total Vol at QS	15.19	15.09	-0.10	0.879	18.93	18.14	-0.79	0.386	29.44	31.45	2.01	0.151
Effective half spread	0.007455	0.008242	0.000787	0.151	0.004451	0.005520	0.001069	0.004	0.004251	0.004564	0.000313	0.487
% effective half spread	0.018347%	0.020018%	0.001671%	0.254	0.010848%	0.013626%	0.002779%	0.022	0.010683%	0.011375%	0.000692%	0.442

Table A3.7 NYSE Pilot Phase Sample Cumulative Means Event Day Matching (+0 to -1)												
This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 1day of data before the event and the event day. The results are divided in 3 times to isolate beginning and end of day volatility. The sign and the Wilcoxon test are the p-value results.												
No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
Average Descriptives	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	79411.98	88152.28	8740.30	0.085	393152.28	414797.82	21645.54	0.179	87742.68	93859.11	6116.43	0.117
Ave. Trade Size	477.95	521.33	43.38	0.805	683.32	838.95	155.63	0.643	265.76	372.95	107.19	0.161
Ave. Trade Price	47.54	48.04	0.50	0.000	47.58	47.73	0.15	0.000	47.34	47.41	0.07	0.007
% # of buy trades	47.832%	49.076%	1.24%	0.909	49.083%	49.076%	-0.01%	0.565	48.130%	48.984%	0.85%	0.422
% # of sell trades	52.168%	50.924%	-1.24%	0.909	50.917%	50.924%	0.01%	0.565	51.870%	51.016%	-0.85%	0.422
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	19.53%	20.96%	1.43%	0.787	15.31%	15.78%	0.48%	0.445	11.52%	11.76%	0.24%	0.360
% # of trades outside NBBO	9.62%	10.29%	0.67%	0.582	4.96%	5.15%	0.18%	0.676	4.17%	4.42%	0.25%	0.017
% # of buy trades at ask	33.19%	33.71%	0.52%	0.111	38.80%	38.50%	-0.30%	0.658	40.29%	40.66%	0.37%	0.825
% # of sell trades at bid	37.66%	35.04%	-2.62%	0.122	40.93%	40.56%	-0.36%	0.152	44.02%	43.16%	-0.87%	0.073
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.017088	0.015847	-0.001241	0.492	0.008383	0.008392	0.000009	0.977	0.006886	0.007734	0.000848	0.057
% quoted half spread	0.057862%	0.047629%	-0.010233%	0.203	0.028122%	0.028311%	0.000189%	0.784	0.024136%	0.034926%	0.010790%	0.168
Bid vol at quoted spread	7.91	7.59	-0.32	0.321	11.57	11.83	0.26	0.703	17.95	17.45	-0.50	0.672
% bid vol at quoted spread	51.032%	51.077%	0.04%	0.817	50.304%	51.323%	1.02%	0.385	51.849%	52.355%	0.51%	0.369
Ask vol at quoted spread	7.59	7.27	-0.32	0.506	11.43	11.22	-0.21	0.753	16.67	15.88	-0.79	0.320
% Ask vol at quoted spread	48.968%	48.923%	-0.04%	0.817	49.696%	48.677%	-1.02%	0.385	48.151%	47.645%	-0.51%	0.369
Total Vol at QS	15.50	14.86	-0.64	0.312	23.00	23.05	0.05	0.959	34.62	33.33	-1.29	0.439
Effective half spread	0.006380	0.007446	0.001066	0.131	0.004210	0.003777	-0.000433	0.201	0.003021	0.003542	0.000521	0.157
% effective half spread	0.021106%	0.020465%	-0.000641%	0.826	0.012705%	0.012541%	-0.000163%	0.812	0.010611%	0.012778%	0.002167%	0.220

Table A3.8
NYSE Matching Sample Cumulative Means Event Day Matching (+0 to -1)

This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 1day of data before the event and the event day. The results are divided in 3 times to isolate beginning and end of day volatility. The sign and the Wilcoxon test are the p-value results.

No F Trades	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average Descriptives</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	56465.24	65535.31	9070.07	0.001	336637.20	342826.98	6189.78	0.640	76661.39	69898.85	-6762.54	0.078
Ave. Trade Size	313.33	418.13	104.80	0.003	293.51	799.41	505.90	0.194	309.91	280.85	-29.06	0.553
Ave. Trade Price	48.35	48.81	0.46	0.000	48.32	48.46	0.14	0.000	47.72	47.77	0.05	0.150
% # of buy trades	47.988%	49.446%	1.46%	0.007	49.490%	49.255%	-0.24%	0.211	48.000%	48.203%	0.20%	0.027
% # of sell trades	52.012%	50.554%	-1.46%	0.007	50.510%	50.745%	0.24%	0.211	52.000%	51.797%	-0.20%	0.027
Total % of trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	21.41%	23.18%	1.78%	0.957	17.01%	18.13%	1.12%	0.485	12.70%	13.24%	0.54%	0.617
% # of trades outside NBBO	7.71%	8.36%	0.65%	0.223	4.71%	4.03%	-0.68%	0.558	3.95%	3.96%	0.01%	0.007
% # of buy trades at ask	33.47%	33.30%	-0.17%	0.005	38.56%	38.09%	-0.46%	0.456	39.85%	39.48%	-0.37%	0.089
% # of sell trades at bid	37.41%	35.16%	-2.25%	0.000	39.72%	39.75%	0.02%	0.130	43.50%	43.32%	-0.18%	0.049
Total % of trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.017253	0.016155	-0.001098	0.340	0.010300	0.009711	-0.000589	0.329	0.008222	0.009138	0.000916	0.419
% quoted half spread	0.040384%	0.036214%	-0.004170%	0.118	0.026181%	0.022819%	-0.003362%	0.238	0.020120%	0.022838%	0.002718%	0.169
Bid vol at quoted spread	6.46	5.75	-0.71	0.028	8.21	8.89	0.68	0.049	12.19	13.46	1.27	0.007
% bid vol at quoted spread	50.826%	46.037%	-4.79%	0.051	47.900%	50.283%	2.38%	0.026	44.619%	49.576%	4.96%	0.772
Ask vol at quoted spread	6.25	6.74	0.49	0.181	8.93	8.79	-0.14	0.796	15.13	13.69	-1.44	0.173
% Ask vol at quoted spread	49.174%	53.963%	4.79%	0.051	52.100%	49.717%	-2.38%	0.026	55.381%	50.424%	-4.96%	0.772
Total Vol at QS	12.71	12.49	-0.22	0.704	17.14	17.68	0.54	0.377	27.32	27.15	-0.17	0.884
Effective half spread	0.006334	0.007328	0.000994	0.106	0.004122	0.004150	0.000028	0.920	0.003637	0.004214	0.000577	0.516
% effective half spread	0.015139%	0.015493%	0.000354%	0.771	0.011039%	0.010309%	-0.000731%	0.594	0.009209%	0.009483%	0.000274%	0.751

Table A3.9
Nasdaq Pilot Phase Sample Cumulative Means 5 Days Pairings

This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 5 days of data on both sides of the event. The results are divided in 3 times to isolate beginning and end of day volatility. The sign and the Wilcoxon test are the p-value results.

No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	13452.08	13671.36	219.28	0.820	74795.63	74157.92	-637.71	0.849	19286.22	16437.43	-2848.79	0.002
Ave. Trade Size	323.89	317.81	-6.08	0.810	265.42	259.26	-6.16	0.682	237.89	283.35	45.46	0.118
Ave. Trade Price	23.01	23.31	0.30	0.000	22.97	23.3	0.33	0.000	22.86	23.17	0.31	0.000
% # of buy trades	51.044%	50.783%	-0.26%	0.076	49.621%	50.412%	0.79%	0.019	51.176%	49.916%	-1.26%	0.191
% # of sell trades	48.956%	49.217%	0.26%	0.076	50.379%	49.588%	-0.79%	0.019	48.824%	50.084%	1.26%	0.191
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	31.85%	32.97%	1.12%	0.419	23.80%	26.58%	2.78%	0.000	18.89%	19.51%	0.62%	0.001
% # of trades outside NBBO	8.78%	8.68%	-0.09%	0.277	6.17%	6.75%	0.58%	0.058	6.74%	6.73%	-0.02%	0.002
% # of buy trades at ask	30.75%	29.58%	-1.17%	0.029	34.93%	33.62%	-1.31%	0.516	38.30%	36.56%	-1.73%	0.002
% # of sell trades at bid	28.63%	28.76%	0.14%	0.059	35.09%	33.05%	-2.05%	0.002	36.07%	37.20%	1.13%	0.158
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.040706	0.039488	-0.001218	0.594	0.028852	0.026394	-0.002458	0.080	0.019204	0.020340	0.001136	0.426
% quoted half spread	0.269750%	0.241152%	-0.028598%	0.079	0.207514%	0.183357%	-0.024157%	0.040	0.134346%	0.156514%	0.022168%	0.240
Bid vol at quoted spread	3.84	5.38	1.54	0.004	5.15	5.12	-0.03	0.911	6.14	6.67	0.53	0.373
% bid vol at quoted spread	42.619%	49.935%	7.32%	0.006	47.075%	49.935%	2.86%	0.001	48.195%	49.935%	1.74%	0.701
Ask vol at quoted spread	5.17	4.81	-0.36	0.410	5.79	5.32	-0.47	0.159	6.60	6.31	-0.29	0.575
% Ask vol at quoted spread	57.381%	50.065%	-7.32%	0.006	52.925%	50.065%	-2.86%	0.001	51.805%	50.065%	-1.74%	0.701
Total Vol at QS	9.01	10.19	1.18	0.074	10.94	10.44	-0.50	0.238	12.74	12.98	0.24	0.765
Effective half spread	0.014248	0.013988	-0.000260	0.747	0.011188	0.009845	-0.001343	0.016	0.007711	0.007469	-0.000242	0.647
% effective half spread	0.095236%	0.084326%	-0.010910%	0.083	0.080795%	0.069057%	-0.011738%	0.019	0.053329%	0.062126%	0.008797%	0.330

Table A3.10
Nasdaq Matching Sample Cumulative Means 5 Days Pairings

This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 5 days of data on both sides of the event. The results are divided in 3 times to isolate beginning and end of day volatility. The sign and the Wilcoxon test are the p-value results.

No F Trades	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average Descriptives</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	14009.98	15656.27	1646.29	0.100	76109.43	82678.81	6569.38	0.046	23901.65	18669.41	-5232.24	0.071
Ave. Trade Size	294.39	289.16	-5.23	0.733	361.50	274.89	-86.61	0.397	260.85	264.98	4.13	0.856
Ave. Trade Price	23.17	23.35	0.18	0.000	22.65	22.77	0.12	0.000	23.18	23.29	0.11	0.004
% # of buy trades	51.432%	48.275%	-3.16%	0.015	50.333%	48.986%	-1.35%	0.386	51.419%	48.684%	-2.74%	0.757
% # of sell trades	48.568%	51.725%	3.16%	0.015	49.667%	51.014%	1.35%	0.386	48.581%	51.316%	2.74%	0.757
Total % of trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	30.49%	30.22%	-0.27%	0.619	23.53%	24.50%	0.97%	0.007	17.38%	18.37%	0.98%	0.001
% # of trades outside NBBO	8.23%	8.82%	0.59%	0.992	6.07%	6.18%	0.11%	0.863	7.32%	6.99%	-0.33%	0.055
% # of buy trades at ask	31.58%	29.33%	-2.25%	0.603	35.52%	33.86%	-1.67%	0.839	38.64%	35.65%	-2.98%	0.042
% # of sell trades at bid	29.70%	31.63%	1.93%	0.31	34.87%	35.46%	0.59%	0.020	36.66%	38.99%	2.33%	0.976
Total % of trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.042734	0.042192	-0.000542	0.843	0.026227	0.025311	-0.000916	0.445	0.016951	0.018517	0.001566	0.297
% quoted half spread	0.255149%	0.250254%	-0.004895%	0.847	0.175933%	0.167281%	-0.008652%	0.401	0.116903%	0.116665%	-0.000238%	0.983
Bid vol at quoted spread	4.46	4.37	-0.09	0.813	5.55	5.46	-0.09	0.878	7.07	6.09	-0.98	0.356
% bid vol at quoted spread	50.452%	49.935%	-0.52%	0.879	51.772%	49.935%	-1.84%	0.186	55.105%	49.935%	-5.17%	0.929
Ask vol at quoted spread	4.38	4.89	0.51	0.264	5.17	5.37	0.20	0.468	5.76	6.01	0.25	0.472
% Ask vol at quoted spread	49.548%	50.065%	0.52%	0.879	48.228%	50.065%	1.84%	0.186	44.895%	50.065%	5.17%	0.929
Total Vol at QS	8.84	9.26	0.42	0.428	10.72	10.83	0.11	0.870	12.83	12.10	-0.73	0.539
Effective half spread	0.014382	0.014309	-0.000073	0.920	0.009732	0.009799	0.000067	0.872	0.007136	0.007405	0.000269	0.687
% effective half spread	0.086587%	0.087305%	0.000718%	0.943	0.066704%	0.066106%	-0.000598%	0.890	0.050234%	0.045736%	-0.004498%	0.361

Table A3.11
Nasdaq Pilot Phase Sample Cumulative Means 3 Days Pairings

This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 3 days of data on both sides of the event. The results are divided in 3 times to isolate beginning and end of day volatility. The sign and the Wilcoxon test are the p-value results.

No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average Descriptives</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	12287.17	15652.76	3365.59	0.003	65515.88	91104.84	25588.96	0.000	16164.66	20615.78	4451.12	0.000
Ave. Trade Size	324.55	330.89	6.34	0.861	243.94	260.96	17.02	0.071	226.62	276.09	49.47	0.228
Ave. Trade Price	22.90	23.00	0.10	0.000	22.94	23.06	0.12	0.000	23.13	23.06	-0.07	0.043
% # of buy trades	49.723%	50.684%	0.96%	0.614	50.245%	50.403%	0.16%	0.987	51.016%	50.280%	-0.74%	0.090
% # of sell trades	50.277%	49.316%	-0.96%	0.614	49.755%	49.597%	-0.16%	0.987	48.984%	49.720%	0.74%	0.090
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	31.94%	33.07%	1.14%	0.583	23.62%	25.78%	2.16%	0.000	19.33%	18.56%	-0.77%	0.060
% # of trades outside NBBO	8.96%	8.41%	-0.55%	0.283	6.36%	7.09%	0.74%	0.192	6.64%	6.92%	0.27%	0.536
% # of buy trades at ask	29.78%	29.95%	0.17%	0.452	35.45%	33.81%	-1.64%	0.018	38.10%	37.18%	-0.91%	0.001
% # of sell trades at bid	29.32%	28.56%	-0.76%	0.430	34.57%	33.32%	-1.25%	0.173	35.93%	37.34%	1.41%	0.178
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.040651	0.038276	-0.002375	0.397	0.028788	0.027504	-0.001284	0.468	0.019412	0.022224	0.002812	0.252
% quoted half spread	0.272150%	0.228855%	-0.043295%	0.031	0.215621%	0.193738%	-0.021883%	0.226	0.131688%	0.168377%	0.036689%	0.153
Bid vol at quoted spread	3.90	4.69	0.79	0.067	5.00	5.04	0.04	0.906	6.16	6.73	0.57	0.456
% bid vol at quoted spread	42.299%	49.935%	7.64%	0.215	44.366%	49.935%	5.57%	0.001	45.867%	49.935%	4.07%	0.281
Ask vol at quoted spread	5.32	5.29	-0.03	0.958	6.27	5.83	-0.44	0.408	7.27	6.84	-0.43	0.655
% Ask vol at quoted spread	57.701%	50.065%	-7.64%	0.215	55.634%	50.065%	-5.57%	0.001	54.133%	50.065%	-4.07%	0.281
Total Vol at QS	9.22	9.98	0.76	0.279	11.27	10.87	-0.40	0.506	13.43	13.57	0.14	0.908
Effective half spread	0.014299	0.013660	-0.000639	0.516	0.010868	0.010337	-0.000531	0.445	0.008121	0.008252	0.000131	0.882
% effective half spread	0.097585%	0.081240%	-0.016345%	0.037	0.082525%	0.074189%	-0.008336%	0.287	0.051900%	0.066804%	0.014903%	0.224

Table A3.12
Nasdaq Matching Sample Cumulative Means 3 Days Pairings

This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 3 days of data on both sides of the event. The results are divided in 3 times to isolate beginning and end of day volatility. The sign and the Wilcoxon test are the p-value results.

No F Trades	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average Descriptives</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	14206.41	17962.60	3756.19	0.004	73435.30	101322.12	27886.82	0.000	25063.55	24252.29	-811.26	0.888
Ave. Trade Size	283.31	274.31	-9.00	0.562	437.99	293.09	-144.90	0.400	269.09	270.83	1.74	0.951
Ave. Trade Price	22.99	23.01	0.02	0.654	22.63	22.57	-0.06	0.017	23.39	23.14	-0.25	0.000
% # of buy trades	50.460%	47.968%	-2.49%	0.769	50.797%	48.698%	-2.10%	0.875	51.688%	48.098%	-3.59%	0.016
% # of sell trades	49.540%	52.032%	2.49%	0.769	49.203%	51.302%	2.10%	0.875	48.312%	51.902%	3.59%	0.016
Total % of trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	29.58%	29.91%	0.32%	0.337	22.91%	23.96%	1.05%	0.222	16.56%	17.87%	1.31%	0.139
% # of trades outside NBBO	8.58%	8.99%	0.42%	0.240	5.98%	6.38%	0.40%	0.865	7.96%	7.75%	-0.21%	0.844
% # of buy trades at ask	31.14%	29.36%	-1.77%	0.194	36.26%	33.75%	-2.51%	0.571	38.74%	34.82%	-3.92%	0.000
% # of sell trades at bid	30.71%	31.74%	1.03%	0.394	34.85%	35.91%	1.06%	0.608	36.73%	39.56%	2.83%	0.004
Total % of trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.040099	0.043625	0.003526	0.376	0.028178	0.027250	-0.000928	0.625	0.015857	0.019321	0.003464	0.113
% quoted half spread	0.234214%	0.234875%	0.000661%	0.979	0.187034%	0.175777%	-0.011257%	0.461	0.108053%	0.123770%	0.015717%	0.124
Bid vol at quoted spread	4.51	4.66	0.15	0.764	6.23	5.54	-0.69	0.472	8.59	6.58	-2.01	0.362
% bid vol at quoted spread	51.018%	49.935%	-1.08%	0.972	52.841%	49.935%	-2.91%	0.124	58.158%	49.935%	-8.22%	0.830
Ask vol at quoted spread	4.33	4.96	0.63	0.282	5.56	5.05	-0.51	0.064	6.18	5.97	-0.21	0.720
% Ask vol at quoted spread	48.982%	50.065%	1.08%	0.972	47.159%	50.065%	2.91%	0.124	41.842%	50.065%	8.22%	0.830
Total Vol at QS	8.84	9.62	0.78	0.226	11.79	10.59	-1.20	0.213	14.77	12.55	-2.22	0.366
Effective half spread	0.013294	0.014604	0.001310	0.178	0.010161	0.010286	0.000125	0.844	0.006478	0.008074	0.001596	0.137
% effective half spread	0.077366%	0.079607%	0.002241%	0.716	0.068803%	0.067103%	-0.001700%	0.781	0.043459%	0.048257%	0.004798%	0.264

Table A3.13
Nasdaq Pilot Sample Cumulative Means 1 Day Pairing (+1 to -1)

This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 1 day of data on both sides of the event. The results are divided in 3 times to isolate beginning and end of day volatility. The sign and the Wilcoxon test are the p-value results.

No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average Descriptives</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	12311.77	17520.64	5208.87	0.010	64213.56	90047.97	25834.41	0.000	15134.64	20864.43	5729.79	0.000
Ave. Trade Size	344.71	399.33	54.62	0.547	240.69	253.78	13.09	0.454	225.49	239.62	14.13	0.294
Ave. Trade Price	22.87	22.89	0.02	0.365	23.36	23.29	-0.07	0.022	23.71	23.51	-0.20	0.000
% # of buy trades	45.291%	49.039%	3.75%	0.868	50.588%	49.399%	-1.19%	0.027	49.323%	48.872%	-0.45%	0.458
% # of sell trades	54.709%	50.961%	-3.75%	0.868	49.412%	50.601%	1.19%	0.027	50.677%	51.128%	0.45%	0.458
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	31.64%	32.25%	0.61%	0.460	24.74%	26.79%	2.05%	0.000	20.11%	18.39%	-1.72%	0.050
% # of trades outside NBBO	10.32%	7.82%	-2.49%	0.14	6.49%	5.73%	-0.75%	0.410	7.34%	7.84%	0.50%	0.262
% # of buy trades at ask	25.36%	29.52%	4.17%	0.228	34.97%	33.11%	-1.86%	0.705	36.19%	35.76%	-0.43%	0.019
% # of sell trades at bid	32.68%	30.40%	-2.28%	0.746	33.80%	34.37%	0.56%	0.007	36.35%	38.01%	1.66%	0.900
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.042117	0.039159	-0.002958	0.551	0.026488	0.027755	0.001267	0.571	0.019230	0.024417	0.005187	0.206
% quoted half spread	0.273134%	0.244877%	-0.028257%	0.345	0.206171%	0.199726%	-0.006445%	0.871	0.124636%	0.160474%	0.035838%	0.126
Bid vol at quoted spread	3.82	5.63	1.81	0.072	5.09	4.83	-0.26	0.62	6.31	6.30	-0.01	0.993
% bid vol at quoted spread	41.164%	49.935%	8.77%	0.131	48.064%	49.935%	1.87%	0.192	47.195%	49.935%	2.74%	0.432
Ask vol at quoted spread	5.46	5.69	0.23	0.865	5.50	6.64	1.14	0.226	7.06	7.56	0.50	0.756
% Ask vol at quoted spread	58.836%	50.065%	-8.77%	0.131	51.936%	50.065%	-1.87%	0.192	52.805%	50.065%	-2.74%	0.432
Total Vol at QS	9.28	11.32	2.04	0.219	10.59	11.47	0.88	0.372	13.37	13.86	0.49	0.789
Effective half spread	0.014347	0.014124	-0.000223	0.873	0.011144	0.010529	-0.000615	0.582	0.008110	0.008652	0.000542	0.700
% effective half spread	0.094583%	0.091849%	-0.002734%	0.784	0.087565%	0.080239%	-0.007326%	0.716	0.049499%	0.059876%	0.010377%	0.333

Table A3.14
Nasdaq Matching Sample Cumulative Means 1 Day Pairing (+1 to -1)

This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 1 day of data on both sides of the event. The results are divided in 3 times to isolate beginning and end of day volatility. The sign and the Wilcoxon test are the p-value results.

No F Trades	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average Descriptives</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	13889.37	18555.90	4666.53	0.032	80206.63	112079.53	31872.90	0.000	30989.52	25281.27	-5708.25	0.596
Ave. Trade Size	263.89	291.49	27.60	0.276	757.08	279.45	-477.63	0.335	273.63	276.08	2.45	0.956
Ave. Trade Price	23.25	23.19	-0.06	0.202	23.27	23.03	-0.24	0.000	23.47	23.10	-0.37	0.000
% # of buy trades	47.856%	45.650%	-2.21%	0.813	51.974%	47.280%	-4.69%	0.456	49.608%	45.494%	-4.11%	0.463
% # of sell trades	52.144%	54.350%	2.21%	0.813	48.026%	52.720%	4.69%	0.456	50.392%	54.506%	4.11%	0.463
Total % of trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	29.71%	28.66%	-1.05%	0.701	23.53%	24.37%	0.84%	0.204	15.00%	18.73%	3.73%	0.008
% # of trades outside NBBO	9.36%	9.10%	-0.26%	0.166	6.13%	6.36%	0.22%	0.512	9.47%	8.20%	-1.26%	0.895
% # of buy trades at ask	28.61%	26.98%	-1.63%	0.739	36.72%	32.10%	-4.62%	0.264	37.18%	31.52%	-5.66%	0.001
% # of sell trades at bid	32.32%	35.27%	2.95%	0.554	33.62%	37.18%	3.55%	0.787	38.36%	41.55%	3.19%	0.346
Total % of trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.039788	0.051550	0.011762	0.264	0.024113	0.026517	0.002404	0.388	0.014539	0.018113	0.003574	0.039
% quoted half spread	0.208646%	0.279146%	0.070500%	0.127	0.160297%	0.185285%	0.024988%	0.397	0.104817%	0.120017%	0.015200%	0.227
Bid vol at quoted spread	5.07	4.73	-0.34	0.698	5.22	5.82	0.60	0.287	5.53	6.27	0.74	0.473
% bid vol at quoted spread	55.229%	49.935%	-5.29%	0.393	49.106%	49.935%	0.83%	0.032	47.427%	49.935%	2.51%	0.346
Ask vol at quoted spread	4.11	5.58	1.47	0.311	5.41	4.70	-0.71	0.125	6.13	6.59	0.46	0.604
% Ask vol at quoted spread	44.771%	50.065%	5.29%	0.383	50.894%	50.065%	-0.83%	0.032	52.573%	50.065%	-2.51%	0.346
Total Vol at QS	9.18	10.31	1.13	0.295	10.63	10.52	-0.11	0.880	11.66	12.86	1.20	0.496
Effective half spread	0.014227	0.016095	0.001868	0.365	0.008836	0.010317	0.001481	0.146	0.006050	0.008119	0.002069	0.200
% effective half spread	0.076846%	0.086839%	0.009993%	0.317	0.057062%	0.072977%	0.015915%	0.206	0.043477%	0.047657%	0.004180%	0.487

Table A3.15
Nasdaq Pilot Sample Cumulative Means Event Day Matching (+0 to -1)

This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 1 day before the event and the event day. The results are divided in 3 times to isolate beginning and end of day volatility. The sign and the Wilcoxon test are the p-value results.

No F Trades (Raw Counts)	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
<i>Average Descriptives</i>	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	12201.74	16760.64	4558.90	0.020	62908.91	75261.00	12352.09	0.010	15034.94	20584.72	5549.78	0.003
Ave. Trade Size	348.91	342.91	-6.00	0.923	240.00	242.75	2.75	0.835	224.12	251.84	27.72	0.145
Ave. Trade Price	22.65	22.88	0.23	0.000	23.00	23.05	0.05	0.002	23.89	23.96	0.07	0.007
% # of buy trades	45.271%	48.971%	3.70%	0.578	50.562%	49.329%	-1.23%	0.158	49.219%	50.440%	1.22%	0.453
% # of sell trades	54.729%	51.029%	-3.70%	0.578	49.438%	50.671%	1.23%	0.158	50.781%	49.560%	-1.22%	0.453
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	31.70%	32.67%	0.97%	0.285	24.76%	25.40%	0.65%	0.196	20.19%	18.34%	-1.85%	0.090
% # of trades outside NBBO	10.30%	8.12%	-2.19%	0.031	6.49%	5.89%	-0.60%	0.741	7.34%	5.55%	-1.79%	0.446
% # of buy trades at ask	25.33%	29.02%	3.69%	0.115	34.94%	33.34%	-1.60%	0.442	36.06%	38.63%	2.57%	0.595
% # of sell trades at bid	32.67%	30.20%	-2.47%	0.330	33.81%	35.37%	1.55%	0.101	36.41%	37.48%	1.07%	0.359
Total % of Trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.020161	0.019614	-0.000547	0.834	0.016224	0.015719	-0.000505	0.698	0.011646	0.010641	-0.001005	0.448
% quoted half spread	0.131756%	0.113948%	-0.017808%	0.289	0.128388%	0.107165%	-0.021223%	0.272	0.076118%	0.079590%	0.003472%	0.655
Bid vol at quoted spread	4.48	4.30	-0.18	0.707	6.16	6.36	0.20	0.629	8.35	8.06	-0.29	0.623
% bid vol at quoted spread	49.394%	43.434%	-5.96%	0.167	50.783%	49.379%	-1.40%	0.650	51.928%	47.440%	-4.49%	0.594
Ask vol at quoted spread	4.59	5.60	1.01	0.09	5.97	6.52	0.55	0.255	7.73	8.93	1.20	0.122
% Ask vol at quoted spread	50.606%	56.566%	5.96%	0.167	49.217%	50.621%	1.40%	0.650	48.072%	52.560%	4.49%	0.594
Total Vol at QS	9.07	9.90	0.83	0.228	12.13	12.88	0.75	0.231	16.08	16.99	0.91	0.350
Effective half spread	0.006834	0.007361	0.000527	0.541	0.006829	0.005986	-0.000843	0.168	0.004923	0.004185	-0.000738	0.211
% effective half spread	0.045094%	0.041813%	-0.003280%	0.533	0.054485%	0.042027%	-0.012457%	0.197	0.030727%	0.029048%	-0.001678%	0.553

Table A3.16
Nasdaq Matching Sample Cumulative Means Event Day Matching (+0 to -1)

This table contains the mean pair-wise differences for several variables including the total trade volume, the average trade size, and the average trade price. Also included are the % # of buy and sell trades, % of trades inside, outside, buy trades at the ask, and sell trades at the bid. Execution costs are also provided and include quoted half spreads, % quoted half spreads, the effective half spreads and % effective half spreads. The pairings contain 1 day before the event and the event day. The results are divided in 3 times to isolate beginning and end of day volatility. The sign and the Wilcoxon test are the p-value results.

No F Trades	1st Time Slice 9:30 am - 10:00 am				2nd Time Slice 10:00 am - 3:30 pm				3rd Time Slice 3:30 pm - 4:00pm			
	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test	Pre	Post	Dif	t-test
Trade Volume	14039.88	17137.84	3097.96	0.146	79729.59	92529.81	12800.22	0.044	30000.48	21107.19	-8893.29	0.403
Ave. Trade Size	264.00	332.18	68.18	0.042	261.14	241.53	-19.61	0.366	268.15	329.28	61.13	0.528
Ave. Trade Price	23.40	23.58	0.18	0.000	23.59	23.62	0.03	0.364	23.86	23.87	0.01	0.817
% # of buy trades	47.841%	46.179%	-1.66%	0.871	51.977%	48.432%	-3.55%	0.925	49.534%	48.920%	-0.61%	0.495
% # of sell trades	52.159%	53.821%	1.66%	0.871	48.023%	51.568%	3.55%	0.925	50.466%	51.080%	0.61%	0.495
# of total trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
% # of trades inside NBBO	29.71%	29.93%	0.22%	0.313	23.53%	23.93%	0.40%	0.593	15.00%	17.03%	2.03%	0.439
% # of trades outside NBBO	9.35%	9.77%	0.42%	0.865	6.13%	6.80%	0.67%	0.159	9.45%	6.28%	-3.17%	0.667
% # of buy trades at ask	28.62%	26.27%	-2.34%	0.753	36.72%	33.35%	-3.37%	0.233	37.13%	37.21%	0.08%	0.631
% # of sell trades at bid	32.32%	34.03%	1.71%	0.373	33.61%	35.92%	2.31%	0.957	38.42%	39.48%	1.06%	0.962
# of total trades	100.00%	100.00%	0.00		100.00%	100.00%	0.00		100.00%	100.00%	0.00	
Quoted half spread	0.019418	0.018914	-0.000504	0.822	0.015728	0.015102	-0.000626	0.690	0.008169	0.011905	0.003736	0.106
% quoted half spread	0.100198%	0.114916%	0.014718%	0.250	0.106009%	0.091866%	-0.014143%	0.173	0.057092%	0.089189%	0.032097%	0.248
Bid vol at quoted spread	4.03	4.18	0.15	0.718	5.95	6.03	0.08	0.840	7.14	7.34	0.20	0.697
% bid vol at quoted spread	52.474%	49.351%	-3.12%	0.986	50.985%	49.917%	-1.07%	0.200	49.721%	45.449%	-4.27%	0.790
Ask vol at quoted spread	3.65	4.29	0.64	0.078	5.72	6.05	0.33	0.495	7.22	8.81	1.59	0.068
% Ask vol at quoted spread	47.526%	50.649%	3.12%	0.986	49.015%	50.083%	1.07%	0.200	50.279%	54.551%	4.27%	0.790
Total Vol at QS	7.68	8.47	0.79	0.092	11.67	12.08	0.41	0.505	14.36	16.15	1.79	0.024
Effective half spread	0.007235	0.006450	-0.000785	0.395	0.005872	0.006230	0.000358	0.518	0.003412	0.004808	0.001396	0.195
% effective half spread	0.037354%	0.040876%	0.003521%	0.519	0.038475%	0.037674%	-0.000801%	0.814	0.023716%	0.039437%	0.015722%	0.237