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Who Trades With Whom, and When?

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Abstract

This paper examines empirically how market participants meet on the NYSE to form trades. Pure floor trades, involving only floor brokers and the specialist, account for only 4% of trading volume in the average stock, while pure system trades, involving only orders submitted electronically, account for 50% and floor and system interaction trades account for 46% of trading volume in the average stock. Market quality analysis reveals that pure system trades involving automatic execution are the most informative, while floor-initiated interaction trades also have high information content. This study offers insight into how market design affects the interaction of liquidity supply and demand and resulting market quality.

1. Introduction

If the basic role of a market is to bring together potential buyers and sellers to reduce their search costs and facilitate trades, then understanding how participants meet to form trades would seem to be of fundamental importance. On the New York Stock Exchange (NYSE), customers can submit their trading interest electronically (as system participants) or through floor brokers, and a specialist serves as a dedicated market maker for each stock. This paper uses detailed transaction data to examine how market participants form trades on the NYSE, or, more succinctly, to address the question: Who trades with whom, and when?

Unfortunately, publicly available databases do not provide information on the types of participants involved in a trade. As a result, even the most basic questions, such as whether floor participants (floor brokers and specialists) trade mostly with other floor participants or with system participants, remain unresolved. These questions are key to understanding how market design impacts trading costs. Aitken, Cook, Harris, and McInish (2006) find that the NYSE has the lowest execution costs of seven major stock markets, a result they attribute to a combination of market design features, some of which are unique to the NYSE (such as floor brokers) and some of which are not (such as dedicated market makers, which are also found on the London Stock Exchange's SEAQ, Euronext Paris, and Xetra). The present paper illuminates how these market design features are manifested in trade interactions and how these trade interactions in turn relate to trading costs.

This paper considers two sets of empirical questions using non-public audit trail data from the NYSE. First, how do specialists, floor brokers, and system participants

interact on the NYSE? Specifically, under what conditions do trades occur between different types of participants? Are floor brokers primarily liquidity suppliers or demanders in trades involving floor brokers and system participants?

Second, how does market quality differ for trades involving different combinations of participants? Specifically, are spreads higher or lower for trades involving floor participants only, system participants only, or both? How does information content vary in trades between different participants?

The analysis of who trades with whom in this paper extends the traditional analysis of who trades.[1] For example, consider a stock in which there are two trades of 1000 shares each and, in total, floor brokers buy 1000 shares and sell 1000 shares and system participants buy 1000 shares and sell 1000 shares. Although each participant type accounts for 50% of twice total volume in the stock (who trades), buyers and sellers can meet in many in different combinations on the NYSE, giving rise to different trade compositions (who trades with whom). Two possibilities are illustrated in **Figure 1**. If one trade involves only floor brokers and the other trade involves only system participants, as in Scenario A, 50% of trading volume occurs in *pure floor* trades and 50% occurs in *pure system* trades. In contrast, if both trades involve both floor brokers and system participants, as in Scenario B, 100% of trading volume occurs in *floor and system interaction* trades.

Many interesting results emerge from this paper's analysis of who trades with whom. First, only 4% of the average stock's trading volume occurs in pure floor trades, 46% occurs in floor and system interaction trades, and 50% occurs in pure system trades.

[1] See, for example, Madhavan and Sofianos (1998) on specialist trading and Sofianos and Werner (2000) on floor broker trading.

These results are striking given that floor participants account for nearly 29% (comprised of 11% specialist and 18% floor brokers) and system participants account for 71% of the average stock's doubled trading volume. Thus floor trading and system trading are clearly not segmented on the NYSE. Relatively little trading volume is the result of floor brokers and specialists physically meeting on the trading floor.[2] Pure floor trades and floor and system interaction trades are relatively more common when quoted spreads are wide, quoted depth is low, volume is high, and volatility is low.

Second, most floor and system interaction trading volume occurs in trades with both floor and system participants on at least one side of the trade (rather than floor and system participants strictly on opposite sides of the trade). This finding suggests that the NYSE's auction mechanism consolidates liquidity from diverse sources on the same side of a trade. In trades with only floor participants on one side of the trade and only system participants on the other side, more trading volume is system-initiated than floor-initiated for the average stock. Across stocks, there is more floor-initiated than system-initiated trading volume in the largest stocks and more system-initiated than floor-initiated trading volume in smaller stocks. These patterns reflect the differences between the role of floor brokers, who represent investor orders and are typically more active in large stocks, and specialists, who are obligated to act as liquidity providers of last resort and account for more trading in small stocks.

Third, pure floor trades and floor and system interaction trades generally have lower effective spreads than pure system trades in the same stock, after controlling for trade price, quantity, and intraday spread patterns. Within floor and system interaction

[2] Although interactions on the floor account for only a small portion of trading volume, Battalio, Ellul, and Jennings (2005) find that stock relocations on the floor increase execution costs, suggesting that floor broker reputation plays an important role in liquidity on the NYSE.

trades, floor-initiated trades generally have lower effective spreads than system-initiated trades, likely reflecting floor participants' last-mover and informational advantages.

Finally, trades involving automatic execution have the highest information content, despite the current restrictions limiting automatic execution to fewer than 1100 shares and one trade per 30-second period. Floor-initiated interaction trades also have higher information content than pure floor and other interaction trades. There are several possible explanations for these results. Informed traders may prefer the speed and pre-trade anonymity offered by automatic execution.[3] Floor brokers may avoid trading with other floor brokers or the specialist when representing informed order flow for reputational reasons, as in Benveniste, Marcus, and Wilhelm (1992), choosing to trade with system participants instead. Floor participants may also use their last-mover and floor-based informational advantages to avoid interacting with informed orders that come through the system.

This paper is the first to use comprehensive data to examine how market participants meet to form trades, illuminating how the NYSE fulfills its basic role of matching buyers with sellers and complementing earlier work that examines order strategies and their execution quality implications. For example, Harris and Hasbrouck (1996) analyze market versus limit orders, and Keim and Madhavan (1996) examine upstairs versus downstairs trades. Werner (2003) finds that spreads and information content are affected by a trade's order composition, measured as the net order types involved in a trade. Werner identifies trades according to whether they include particular order types on the buy-side, sell-side, both, or neither, to examine how the net presence

[3] Barclay, Hendershott, and McCormick (2003) show that trades on Electronic Communication Networks (ECNs) are generally more informed than trades on the Nasdaq dealer market, a finding similar in spirit to the findings here for the NYSE, which encompasses auction and automatic execution in a single market.

of each order type affects a trade's execution. The present paper builds on this intuition in analyzing how the total composition of a trade is related to its execution quality.

The organization of the paper is as follows. Section 2 discusses the data and methodology. Section 3 analyzes who trades with whom across different types of stocks. Section 4 explores who trades with whom under different market conditions. Section 5 examines the relation between who trades with whom and market quality. Section 6 concludes.

2. Data and methodology

2.1. Sample construction and descriptive statistics

A sample of 200 common stocks is selected as follows. First, the market capitalizations of all domestic common stocks listed on the NYSE as of year-end 2003 are determined from CRSP. Second, the NYSE Master History file is used to eliminate stocks that were listed for only part of 2004 or changed symbol during the year. Third, stocks with prices below $1 or over $500 and stocks with two or fewer trades per day on average according to the NYSE Consolidated Trade (CT) file are eliminated. Finally, the remaining stocks are ranked by market capitalization and 20 stocks are selected randomly from each market capitalization decile.

The main sample period is the 252 trading days in 2004. For the trade-level analyses in Sections 4 and 5, a sub-period of forty sample days is selected as follows. The 252 trading days in 2004 are ranked by NYSE total volume, then four days are randomly selected from each volume decile. There are over 7.7 million trades in the forty days for the 200 sample stocks.

Table 1 provides summary statistics for the sample of 200 stocks for the full year

2004. The sample has wide cross-sectional dispersion by design.

2.2. Who trades and who trades with whom methodology

The main data source for this analysis is the NYSE internal Consolidated Audit Trail (CAUD) file, which contains detailed information about all trades executed on the NYSE.[4] The CAUD file matches buyers and sellers for each trade, providing information about all of the parties (floor as well as system) on each side of a trade in addition to the time, price, and quantity traded. Note that there can be more than one type of participant on each side of a single trade. For example, on January 8, 2004 at 10:26:37 there is trade print for 2400 shares at $13.04 in symbol AAI. The publicly available Trades and Quotes (TAQ) database reports the time, price, and quantity of the trade, but provides no information about who is trading. The CAUD file shows that the trade involves system participants buying 2400 shares versus system participants selling 400 shares, floor brokers selling 1000 shares, and the specialist selling 1000 shares. With this information it is possible to determine how much trading volume is attributable to each type of market participant (who trades) as well as how they meet to form trades (who trades with whom).

Who trades is computed by summing the purchases and sales by each type of market participant (system, floor broker, and specialist) and dividing by twice total volume, since the numerator double-counts volume. The AAI trade described above has a who-trades composition of 58% system, 21% floor brokers, and 21% specialist.

Who trades with whom is determined by identifying all of the types of market

[4] For a detailed description of the CAUD file, see Hasbrouck, Sofianos, and Sosebee (1993) and Sofianos and Werner (2000). CAUD data are filtered to remove opening and closing trades, trades with incomplete information, and trades with unequal total purchase and sale quantities. Such records represent approximately 6% of the original trades.

participants involved in each trade and then categorizing the trade as follows:[5]

Pure Floor = Specialist and Floor Brokers, or
Floor Brokers only;

Pure System = System participants only;

Floor and System Interaction = Specialist and System participants, or
Floor Brokers and System participants, or
Specialist, Floor Brokers, and System participants.

Note that in general the specialist and floor brokers choose whether or not to interact with system participants; the exception is when a floor broker or specialist has posted liquidity at the inside quote and is hit by an incoming automatic execution order. The AAI trade described above would be categorized as a floor and system interaction trade, because it involves the specialist, floor brokers, and system participants. Who-trades-with-whom percentages are calculated by summing volume across trades in each category, then dividing by total traded volume.

The CAUD data are also used to identify automatic execution (Direct+) system, percentage (CAP), and upstairs-arranged trades. Direct+ trades are executed without any manual involvement from the specialist, are restricted to fewer than 1100 shares, and can occur at the inside quote only. Direct+ represents about 7% of twice total volume for the average sample stock.

Floor brokers leave CAPs with the specialist to execute based on a preset strategy, typically to participate up to 50% of the total volume in every trade satisfying the CAP's limit price until the desired quantity is attained. CAPs are similar to VWAP (volume-

[5] Percentage (CAP) executions are included as floor broker executions. Incoming Intermarket Trading System (ITS) executions are included as system participant executions.

weighted average price) trades, but if there is insufficient liquidity available at a price the CAP may not participate in the same percentage of every trade's volume and thus may not achieve the volume-weighted average price over the trading interval (see Werner (2003) for a more detailed discussion of CAPs). A CAP is a pre-set strategy that in practice may be either liquidity-demanding or liquidity-supplying, depending whether it is triggered by a liquidity demander on the same side or the opposite side of the market. For example, if a buy CAP is triggered by a market buy order, the CAP is liquidity-demanding, while if the CAP is triggered by a market sell order, it is liquidity-supplying. CAPs represent about 11.5% of twice total volume for the average sample stock.

Upstairs-arranged trades are identified as those trades having the same floor broker on both the buy and sell sides for at least a portion of the trade, as in Madhavan and Cheng (1997). Upstairs-arranged trades, which account for only 1.4% of trading volume for the average sample stock, are excluded from the analysis in this paper, as they take place outside of the trading mechanisms examined here.

2.3. Market quality methodology

Market quality is measured by effective and realized spreads and information content. To control for any effects caused purely by stock price differences, percentage spreads are calculated, that is, dollar spread divided by the trade price.

Spreads are calculated from trade prices in the CAUD file and quotes in the NYSE Consolidated Quote (CQ) file.[6] The effective spread is defined as: Effective $\text{Spread}_t = 2I(P_t - M_t)$, where t denotes the trade, I is an indicator variable that equals one

[6] Regular quote records are filtered to remove quotes that are indicated to be errors, related to special mode conditions, and locked or crossed bid and ask. Also excluded are quotes with zero or missing bid or ask prices, quotes that change 20% or more from the previous quote, and quotes whose spread exceeds 20% of the quote midpoint. These filters remove less than 0.1% of the quote records.

for buyer-initiated trades and negative one for seller-initiated trades, P_t is the trade price, and M_t is the quote midpoint at the time of the trade. Trades with Direct+ or market orders on only the buy (sell) side are identified as buyer-initiated (seller-initiated). The remaining trades are categorized as buyer-initiated (seller-initiated) if they occur above (below) the prevailing quote midpoint; trades occurring at the quote midpoint are categorized using the Lee and Ready (1991) algorithm, assuming no lag between quote and trade times. The effective spread captures the immediate price impact of a trade.

The realized spread is defined as: Realized Spread$_t = 2I(P_t - M_{t+5})$, where M_{t+5} is the quote midpoint five minutes after the trade. Realized spreads are also calculated using the quote midpoint 30 minutes after the trade, as a robustness check. The realized spread measures the price reversal after a trade, approximating the liquidity provider's profit net of the trade's price impact.

The difference between the effective spread (what liquidity demanders pay) and the realized spread (what liquidity providers earn) is used as a measure of the information content of a trade. The information content is equal to the signed difference between the quote midpoints at the time of the trade and five minutes after the trade.

3. Who trades with whom analysis

This section first presents an overall analysis of who trades and who trades with whom. Next it examines floor and system interaction trades to determine to what extent the trades are floor-initiated or system-initiated. The section concludes by analyzing the prevalence of Direct+ (automatic) executions in different types of trades.

3.1. Who trades versus who trades with whom

Figure 2 depicts who trades for the average sample stock. Specialists account for

11%, floor brokers account for 18%, and system participants account for 71% of twice total volume. These percentages reveal a significant shift over recent years: Sofianos and Werner (2000) document that in 1997, although specialists represented 11% as now, floor brokers represented 44% and system participants represented only 45% of twice total volume, and Cooney and Sias (2003) find that floor brokers represented an even larger proportion of volume in the 1990-1991 period covered by the NYSE TORQ database. In 2004 as in 1997, specialists tend to trade more on a percentage basis in smaller stocks, while floor brokers trade more in larger stocks and system participants trade more in the middle deciles.

Figure 3 depicts how market participants come together to form trades, or who trades with whom. Each trade is categorized by the combination of participants involved in the trade, and trade-type volumes are divided by total volume to determine trade-type percentages. Pure floor trades (trades involving only floor brokers or floor brokers and specialist) are the least common trades on the NYSE, averaging 4% of the average stock's trading volume.[7] Pure system trades (involving only system participants) and floor and system interaction trades (involving a combination of floor and system participants) account for 46% and 50% of the average stock's trading volume.

Figure 4 depicts how who trades with whom varies across stocks. Floor and system interaction trades involve a higher percentage of volume than pure system trades in the largest and smallest stocks, while pure system trades peak on a relative basis in the middle deciles. **Table 2** disaggregates each trade type into finer categories, revealing the

[7] Note that who-trades-with-whom percentages are based on share volume, not number of trades. The results would be more extreme if percentages were based on the number of trades, as pure floor trades have an average trade size of 2810 shares, compared to 817 shares for floor and system interaction trades and 351 shares for pure system trades.

precise combinations behind the general patterns. Pure floor broker trades are more common in the largest stocks, reflecting the greater frequency with which a crowd of more than one floor broker assembles in larger than in smaller stocks. The convex shape of the floor and system interaction trade type percentages across deciles is driven by two sub-categories of interaction trades: specialist and system trades, which rise sharply for smaller stocks, and trades involving all three participant types, which are highest for the largest stocks. The small-stock results are consistent with the intuition of Glosten (1989) that specialists are more likely to act as dealers in less-active stocks, providing liquidity to incoming system orders. The large-stock results provide the clearest illustration of all three sources of liquidity supply and demand (from the specialist, floor brokers, and system participants) coming together in the NYSE auction to form a single trade.

A natural question is how these trade-type results compare to expectations. There are two potentially useful benchmarks for what percentage of trading might occur between different participant types in a market where both floor and electronic order submission are possible: complete segmentation and random interaction. If floor and system participants were completely segmented, volume would be split between pure floor trades and pure system trades in the same ratio as overall trading volume: about 29% pure floor, 71% pure system, and 0% floor and system interaction trades. Clearly this is not a realistic model for trading at the NYSE, as floor and system interaction trades represent 45% of trading volume in the average stock.

Alternatively, if floor and system participants met randomly, volume would be split according to the probability of each participant type meeting the same type or another type. **Table 3** compares the actual trade-type percentages to baseline estimates

calculated from each stock's percentage of trading by specialist, floor broker, and system participants, assuming traders meet randomly but that a specialist cannot trade with himself. Floor and system interaction trades are significantly more common (46% actual versus 38% baseline) and pure floor trades and pure system trades are both less common than the baseline percentages. This divergence implies that market participants do not meet randomly to form trades on the NYSE, suggesting that at least some participants benefit from interacting with other types of participants.

The following sections analyze each trade type in more detail to explore the subtleties of who trades with whom. For example, is the higher-than-random incidence of floor and system interaction trades driven by either floor or system participants aggressively seeking liquidity from the other? Or is it a sign of the NYSE's auction mechanism consolidating multiple sources of liquidity supply and demand? What role do automatic executions play in pure system trades and floor and system interaction trades?

3.2. Floor and system interaction trade initiators

Table 4 separates floor and system interaction trades by which participant type initiates the trade. Trades are categorized as buyer-initiated or seller-initiated as described in Section 2.3, and then trades which have only floor participants on one side (buy or sell) and only system participants on the other side are categorized as floor-initiated or system-initiated.[8] For example, a trade that occurs above the midquote with system participants buying and floor participants selling is categorized as system-initiated. Trades with a mix of floor and system participants on at least one side, such as the AAI example in Section 2.2, are categorized as mixed-initiator.

[8] Robustness of the results to possible misclassification of buyer- versus seller-initiated trades is checked by excluding trades within the bid-ask spread, as recommended by Odders-White (2000). Results are qualitatively similar and are available on request.

Table 4 shows that there is more system-initiated than floor-initiated trading volume in all but the three largest stock deciles, where floor brokers are most active. These results are consistent with Sofianos and Werner's (2000) conjecture that a floor broker's services as a "smart limit order book" are more often used in the most active stocks, where a floor broker's last-mover and informational advantages are greatest. Nonetheless, over half of the floor and system interaction trading volume is in the mixed-initiator category, suggesting that liquidity supply and demand usually come from more than one source simultaneously on the NYSE.

3.3. Direct+ analysis

Table 5 analyzes the composition of trades involving Direct+, or automatic execution. Trades involving Direct+ constitute about 15% of the average stock's volume in this sample. Most trades involving Direct+ are pure system trades, but they can be floor and system interaction trades if a specialist or floor broker is part of the inside quote at the time a Direct+ execution occurs. Because all public limit orders on the book must be filled before the specialist trades at the same price under NYSE rules, it is not surprising that the specialist participates in few automatic execution trades. Trades involving Direct+ are relatively more common in the middle market-capitalization deciles, although more Direct+ shares traded on an absolute basis in the largest stock deciles, given their higher volume levels.

4. When does who trade with whom?

This section analyzes how who trades with whom is related to market conditions, first at the daily level and then at the trade level. The association between daily who-trades-with-whom percentages and market conditions is examined with the following

regression, estimated for each stock over 252 trading days using GMM with Newey-West standard errors:

$$WTWW\%_t = \alpha + \beta_1 LogPrice_t + \beta_2 LogVolume_t + \beta_3 Volatility_t + \beta_4 LogMktVolume_t + \beta_5 MktVolatility_t + \varepsilon_t , \quad (1)$$

where *t* denotes the day, WTWW% is the demeaned percentage of trading volume in a particular who-trades-with-whom category (pure floor, floor and system interaction, or pure system), LogPrice is the natural logarithm of the stock's closing price, LogVolume is the natural logarithm of the stock's daily volume, Volatility is 100 times the daily stock return squared, LogMktVolume is the natural logarithm of the NYSE's daily volume, and MktVolatility is 100 times the daily S&P500 return squared.[9]

Table 6 presents the results for regression Eq. (1) of the pure floor percentage in Panel A, the floor and system interaction percentage in Panel B, and the pure system percentage in Panel C. Mean coefficient estimates and percentages of coefficients that are significantly positive and negative at the 5% level are reported for the full stock sample and the top two and bottom two deciles. There is relatively more pure floor trading, more floor and system interaction trading, and less pure system trading on higher volume days. This finding suggests a time-series analog to floor broker behavior in the cross section: Just as floor brokers are more likely to congregate (and therefore potentially interact with each other and the specialist) in more active than less active stocks, they are more likely to congregate around a given stock on days when that stock's trading volume is higher. Overall, there is relatively less pure floor trading and interaction trading when a stock is more volatile, suggesting that in volatile periods system trading dominates floor activity.

[9] Robustness checks using the VIX options volatility index as a proxy for market volatility yield qualitatively similar results.

An exception occurs in small stocks: Floor and system interaction trading is higher for some small stocks when volatility is higher, perhaps because heightened volatility makes the services of a floor broker more valuable or encourages the specialist to step in and provide liquidity to system participants. Finally, after adjusting for a stock's own daily volume, its pure floor trading percentage is negatively related to market-wide volume, and this effect is particularly prominent in large stocks. This result suggests that floor brokers and specialists focus less on a particular stock when other stocks are more active, consistent with Corwin and Coughenour's (2005) analysis of limited attention and specialist trading.

The combination of participants in an individual trade is likely to be related to the market conditions preceding the trade as well as intraday volume and volatility. The following probit regression is used to examine these relations for each stock in the 40-day sub-period:

$$\begin{aligned}\text{Probability(WTWW)}_n = {} & \alpha + \beta_1 \text{LogTradePrice}_n + \beta_2 \text{LogTradeSize}_n \\ & + \beta_3 \text{QuotedSpread}_n + \beta_4 \text{QuotedDepth}_n + \beta_5 \text{Volume15}_n \\ & + \beta_6 \text{Volatility15}_n + \beta_7 \text{PureFloor}_{n-1} + \beta_8 \text{PureSystem}_{n-1} \\ & + \sum_{i=1}^{10} \gamma_i \text{VolumeDecile}_n + \sum_{j=1}^{13} \delta_j \text{HalfHourInterval}_n + \varepsilon_n \,, \end{aligned} \tag{2}$$

where *n* denotes the trade; WTWW is the trade type (pure floor, floor and system interaction, or pure system); LogTradePrice is the natural logarithm of the trade price; LogTradeSize is the natural logarithm of the trade size; QuotedSpread is percentage best bid-ask spread at the time of the trade; QuotedDepth is the average number of shares at the best bid and best ask quotes at the time of the trade; Volume15 is the dollar volume traded in the previous 15 minutes; and Volatility15 is the absolute value of the stock

return over the previous 15 minutes. The last four variables are controls: $PureFloor_{n-1}$ and $PureSystem_{n-1}$ equal one if the previous trade was a pure floor trade or a pure system trade, respectively, else zero; VolumeDecile equals one if the trade occurs during a particular volume-decile day (based on market volume), else zero; HalfHourInterval equals one if the trade occurs during a particular half hour during the day, else zero.[10]

Table 7 presents the results for regression Eq. (2) of the pure floor trade probability in Panel A, floor and system interaction trade probability in Panel B, and pure system trade probability in Panel C. Mean coefficient estimates, mean linear probability slopes, and the percentages of coefficients that are significantly positive and negative at the 5% level are presented for the full stock sample and the top two and bottom two deciles. Pure floor trades and interaction trades occur with higher probability when quoted spreads are wide and quoted depth is low. These are times when the services of a floor broker are likely to be most valuable and the specialist is more likely to act as liquidity provider of last resort. Pure floor trades and interaction trades are also more likely to occur when trading volume is higher, controlling for trade size, and volatility is lower. These results extend the intuition from the daily regressions in Table 6 to the intraday level, showing that who trades with whom is affected by quote conditions at the time of the trade in addition to volume and volatility conditions.

5. Who trades with whom and market quality

This section examines the association between market quality and who trades with whom trade types. The following regression is estimated for each stock in the 40-

[10] Robustness checks show that including more lags of the trade-type indicators does not affect the coefficients of interest.

day sub-period, using GMM with Newey-West standard errors:[11]

$$\begin{aligned} MQstat_n = {} & \alpha + \beta_1 LogTradePrice_n + \beta_2 LogTradeSize_n + \beta_3 PureFloor_n \\ & + \beta_4 Interaction_n + \beta_5\ Int\_FlrInit_n + \beta_6\ Int\_SysInit_n \\ & + \beta_7 Specialist_n + \beta_8 CAP_n + \beta_9 Direct+_n \\ & + \sum_{i=1}^{10} \gamma_i VolumeDecile_n + \sum_{j=1}^{13} \delta_j HalfHourInterval_n + \varepsilon_n \end{aligned} \qquad (3)$$

where *n* denotes the trade, MQStat is the market quality statistic (effective spread, realized spread, or information content), and LogTradePrice, LogTradeSize, VolumeDecile, and HalfHourInterval are defined as in Eq. (2). The remaining variables are indicator variables set equal to one if the trade is in the category, else zero: PureFloor indicates that the trade involves floor participants (specialist and floor brokers) only; Interaction indicates that the trade involves both floor and system participants; Int_FlrInit indicates that the trade is an interaction trade initiated by the floor participants; Int_SysInit indicates that the trade is an interaction trade initiated by the system participants; Specialist indicates that the specialist participates in the trade; CAP indicates that the trade involves execution of a CAP; and Direct+ indicates that the trade involves automatic execution.

Table 8 presents the results for regression Eq. (3) of effective spreads in Panel A, realized spreads in Panel B, and information content in Panel C.[12] Mean coefficient estimates and the percentages of coefficients that are significantly positive and negative at the 5% level are presented for regressions on selected subsets of the right-side variables, building up to the full specification. The first two right-side variables control for basic trade characteristics other than who trades with whom.

[11] Pooled regressions with stock fixed effects yield identical inference and are available on request.
[12] Results reported in Table 8 are based on five-minute realized spread and information content measures; results using 30-minute measures are qualitatively similar and are available on request.

Several results linked to who trades with whom are apparent from Table 8. Note that since the right-side variables include pure floor trades and floor and system interaction trades, pure system trades are implicitly captured in the regression constant and serve as the baseline against which the other trade types are measured.

First, pure floor trades have lower effective spreads than pure system trades overall, but this effect arises specifically from pure floor trades involving CAPs, which are passive trading strategies. Pure floor trades that do not involve CAPs actually have higher effective spreads on average. Similarly, the higher realized spreads and lower information content for pure floor trades are attributable to the presence of CAPs, which as preset, patient trading strategies are not likely to be used for informed trades.

Second, floor and system interaction trades in general have higher realized spreads and lower information content than pure system trades. By initiator type, floor-initiated interaction trades have significantly lower effective and realized spreads and higher information content. Together with the pure floor trade findings, these results suggest that floor brokers handling an informed order tend to trade with system orders rather than with other floor brokers or the specialist, consistent with theories of the importance of reputation in a face-to-face trading environment with repeated interactions (Benveniste, Marcus, and Wilhelm (1992), Battalio, Ellul, and Jennings (2005)). Since investors choose whether to submit system orders or use floor brokers to represent their orders on the floor, in equilibrium the lower effective spread for floor-initiated trades should offset the higher cost of using a floor broker to work a trade. Mixed-initiator interaction trades, which represent the greatest consolidation of trading interest, reveal far less information than floor-initiated trades.

Third, taken together, the pure floor trade and floor and system interaction trade results show that trades involving the floor generally have lower information content than pure system trades. Floor-initiated interaction trades are more informative than pure system trades, consistent with Werner's (2003) finding that liquidity-demanding floor broker orders are the most informative order type in 1997 data, but they are no longer the most informative trades on the NYSE. The most informative trades are now Direct+, suggesting that despite the size and frequency restrictions, Direct+ is regularly used by informed traders. Informed traders' use of Direct+ likely reflects their desire for execution speed as well as pre-trade anonymity.

Finally, trades involving the specialist generally have higher realized spreads, reflecting the specialist's role as liquidity provider of last resort, and lower information content, suggesting that the specialist's last-mover advantage and relationships on the floor enable him to avoid participating in most informed trades.

6. Conclusions

This paper examines how market participants meet to form trades on the NYSE. Little trading volume is currently executed in pure floor trades, and nearly half of trading volume in the average stock involves floor and system participants trading together, usually with both participant types on at least one side of the trade. This result suggests that the NYSE's predominant auction mechanism blends liquidity arriving through many routes, a consolidation that may explain why trading costs are lower on the NYSE than on other exchanges with different market structures. The market quality analysis suggests that neither floor brokers nor specialists necessarily lead to lower trading costs in isolation. Rather, their interactions with other market participants may lead to enhanced

consolidation of trading interest and therefore lower transaction costs.

When floor and system participants are on opposite sides of a trade, floor-initiated trades generally have lower effective spreads than system-initiated trades. This result probably reflects the last-mover and informational advantages of floor participants, and in equilibrium should offset the higher cost of an investor's using a floor broker instead of submitting a system order. Information content is highest for trades involving automatic execution, but floor-initiated interaction trades also have high information content. These results are consistent with informed traders' desire for speed and anonymity as well as predictions that floor brokers avoid representing informed orders in trades with other floor brokers or the specialist to preserve their reputations on the trading floor.

References

Aitken, Michael J., Rowan M. Cook, Frederick H. DeB. Harris, and Thomas H, Mcinish, 2006, Market design and execution cost for matched securities across seven tier-one markets, Unpublished working paper.

Barclay, Michael J., Terrence Hendershott, and D. Timothy McCormick, 2003, Competition among trading venues: Information and trading on electronic communication networks, *Journal of Finance* 58, 2637 – 2665.

Battalio, Robert, Andrew Ellul, and Robert Jennings, 2005, Reputation effects in trading on the New York Stock Exchange, *Journal of Finance,* forthcoming.

Benveniste, Lawrence, Alan Marcus, and William Wilhelm, 1992, What's so special about the specialist? *Journal of Financial Economics* 32, 61-86.

Cooney, John W. and Richard W. Sias, 2004, Informed trading and order type, *Journal of Banking and Finance* 28, 1711-1743.

Corwin, Shane A. and Jay F. Coughenour, 2005, Limited attention and the allocation of effort in securities trading, Unpublished working paper.

Glosten, Lawrence R., 1989, Insider trading, liquidity, and the role of the monopolist specialist, *Journal of Business* 62, 211-235.

Harris, Lawrence and Joel Hasbrouck, 1996, Market vs. limit orders: The SuperDOT evidence on order submission strategy, *Journal of Financial and Quantitative Analysis* 31, 213-231.

Hasbrouck, Joel, George Sofianos, and Deborah Sosebee, 1993, New York Stock Exchange systems and trading procedures, NYSE Working paper.

Keim, Donald B. and Ananth Madhavan, 1996, The upstairs market for large-block

transactions: Analysis and measurement of price effects, *Review of Financial Studies* 9, 1-36.

Lee, Charles M. C. and Mark M. Ready, 1991, Inferring trade direction from intraday data, *Journal of Finance* 46, 733-746.

Madhavan, Ananth and Minder Cheng, 1997, In search of liquidity: Block trades in the upstairs and downstairs markets, *Review of Financial Studies* 10, 175-203.

Madhavan, Ananth and George Sofianos, 1998, An empirical analysis of NYSE specialist trading, *Journal of Financial Economics* 48, 189-210.

Odders-White, Elizabeth, 2000, On the occurrence and consequences of inaccurate trade classification, *Journal of Financial Markets* 3, 259-286.

Sofianos, George and Ingrid M. Werner, 2000, The trades of NYSE floor brokers, *Journal of Financial Markets* 3, 139-176.

Werner, Ingrid M., 2003, NYSE order flow, spreads, and information, *Journal of Financial Markets* 6, 309-335.

Figure 1: Example of Who Trades versus Who Trades with Whom

Pure Floor trades have only floor participants (floor brokers and specialist) on both sides of the trade; Pure System trades have only system participants on both sides of the trade; Floor and System Interaction trades have both floor and system participants involved in the trade. Who Trades is calculated as the total shares bought and sold by each participant type, divided by twice total volume. Who Trades with Whom is calculated as the number of shares traded in each trade type, divided by total volume.

Trade 1	Trade 2	Who Trades	Who Trades with Whom
Scenario A			
Floor broker buys 1000 shares Floor broker sells 1000 shares	System buys 1000 shares System sells 1000 shares		
		50% Floor Broker 50% System	
Trade type: Pure Floor	Trade type: Pure System		50% Pure Floor 50% Pure System
Scenario B			
Floor broker buys 1000 shares System sells 1000 shares	System buys 1000 shares Floor broker sells 1000 shares		
		50% Floor Broker 50% System	
Trade type: Floor and System Interaction	Trade type: Floor and System Interaction		100% Floor and System Interaction

Figures 2 & 3
Who Trades depicts the percentage of twice daily volume accounted for by the purchases and sales of specialist, floor broker, and system participants, respectively. Who Trades with Whom depicts the percentage of daily volume accounted for by trades involving floor participants (specialist and floor brokers) only, floor and system participants together, and system participants only. Average daily percentages are calculated for each symbol across 252 trading days in 2004, and mean percentages are reported across 200 stocks in the full sample. Data are from NYSE CAUD file.

Figure 2: Who Trades

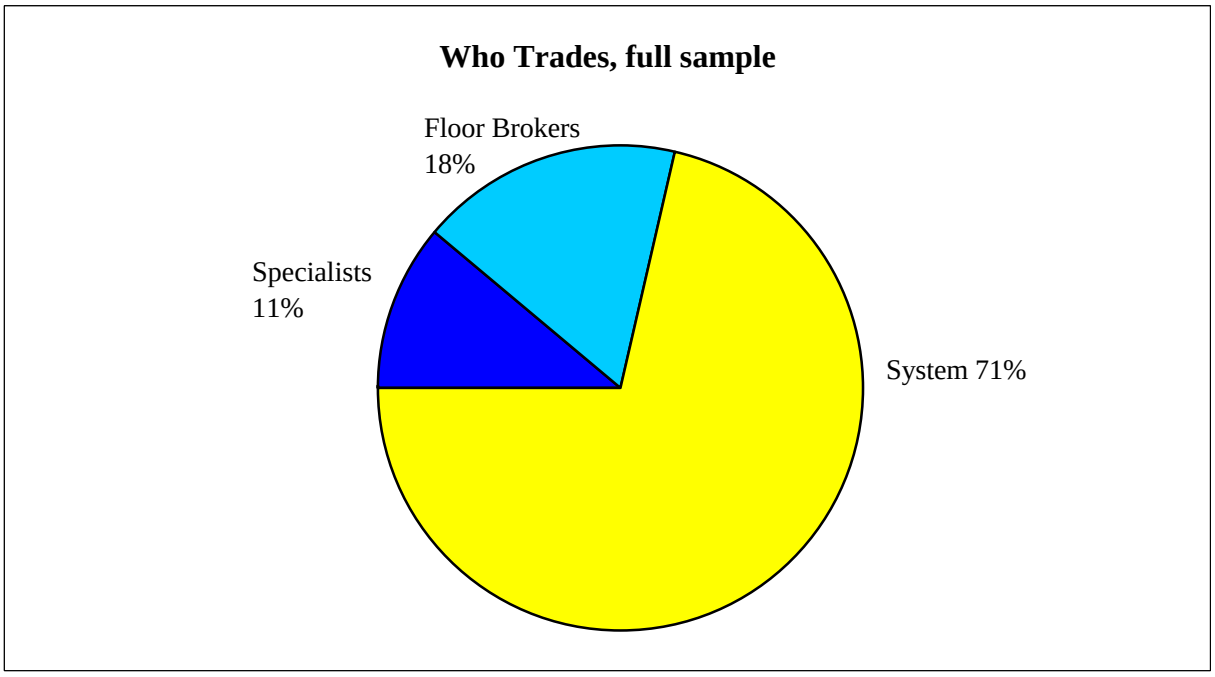

Figure 3: Who Trades with Whom

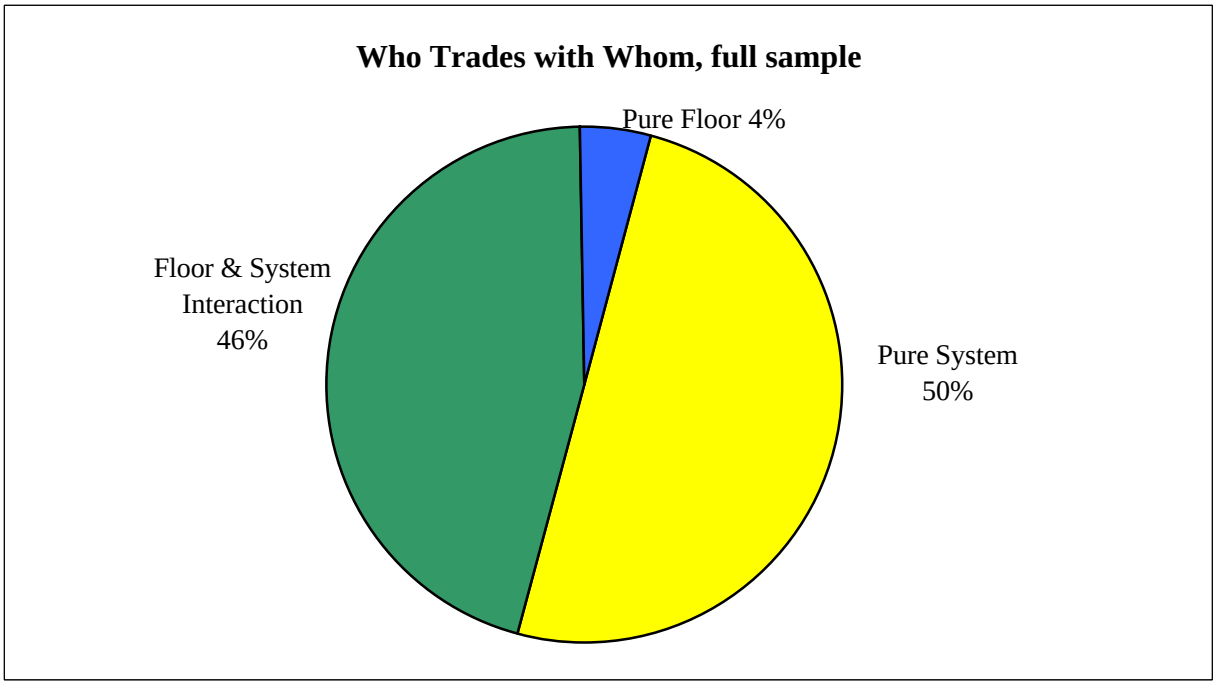

Figure 4: Who Trades with Whom by Decile

The figure depicts the percentage of daily volume accounted for by trades involving floor participants (specialist and floor brokers) only, floor and system participants together, and system participants only. Average daily percentages are calculated for each symbol across 252 trading days in 2004, and mean percentages across 20 stocks each market capitalization decile are depicted in the graph below. Data are from NYSE CAUD file.

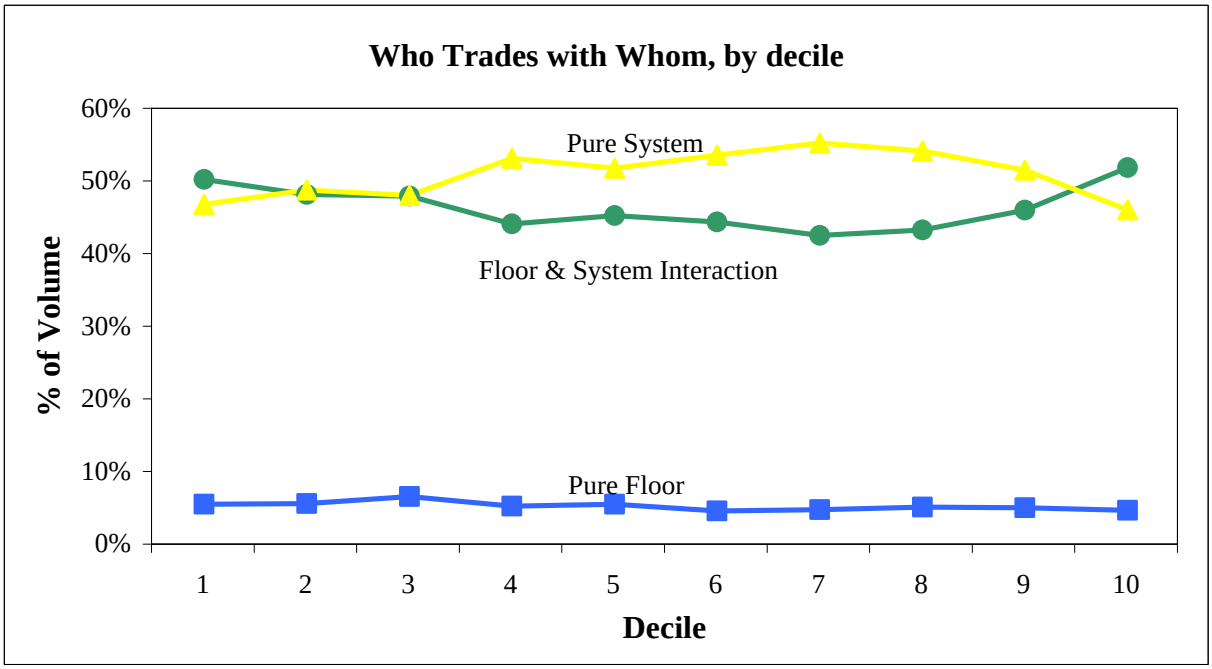

Table 1: Sample Descriptive Statistics

Average closing price, share volume, and number of trades per day are calculated for each symbol across 252 trading days in 2004, and statistics are reported across 200 stocks in the full sample, 20 stocks in each market-capitalization decile. Data are from CRSP and NYSE CAUD files.

	Average daily closing price				Average daily share volume				Average number of trades per day			
	Mean	**Median**	**Min**	**Max**	**Mean**	**Median**	**Min**	**Max**	**Mean**	**Median**	**Min**	**Max**
Full Sample	40.94	35.14	2.24	364.00	704,425	300,280	4,332	9,731,303	967	697	6	4,942
By decile:												
Largest stocks = 1	63.71	57.13	25.07	110.45	2,937,054	2,601,114	644,345	9,731,303	2,745	2,216	1,606	4,942
2	50.19	45.38	22.36	126.89	1,218,132	1,047,028	460,645	2,340,615	1,717	1,640	1,098	2,860
3	39.30	34.43	13.87	94.47	808,702	715,196	182,020	1,931,093	1,239	1,145	515	2,615
4	64.59	47.28	18.13	364.00	488,411	351,046	13,791	1,980,046	909	775	74	1,857
5	40.50	39.47	16.80	76.50	446,372	402,856	73,673	887,490	898	917	248	1,446
6	44.95	36.40	5.86	147.78	525,924	214,865	34,144	2,056,896	790	686	107	1,506
7	33.08	30.83	15.17	70.03	227,695	171,698	9,357	1,043,446	538	570	41	1,267
8	30.16	30.05	17.61	51.05	135,595	104,145	21,648	469,348	381	358	98	887
9	29.62	29.16	6.78	56.92	147,892	91,956	24,381	651,106	319	287	113	823
Smallest stocks = 10	13.28	11.88	2.24	27.65	108,469	40,050	4,332	744,646	133	103	6	365

Table 2: Who Trades with Whom

The table depicts the percentage of daily volume accounted for by trades involving floor participants (specialist and floor brokers) only, floor and system participants together, and system participants only. Average daily percentages are calculated for each symbol across 252 trading days in 2004, and mean percentages are reported across 200 stocks in the full sample, 20 stocks in each market capitalization decile. Data are from NYSE CAUD file.

	Pure Floor			Floor & System Interaction				Pure System
	Floor Brokers Only	Floor Brokers & Specialist	Subtotal	Floor Brokers & System	Floor Brokers, Specialist, & System	Specialist & System	Subtotal	System Only
Full Sample	1.5%	2.9%	4.4%	12.3%	15.6%	17.6%	45.5%	50.1%
By decile:								
Largest stocks = 1	2.1%	2.6%	4.7%	12.3%	22.9%	14.2%	49.4%	46.0%
2	1.9%	2.8%	4.7%	13.5%	20.2%	13.6%	47.3%	47.9%
3	2.2%	3.5%	5.7%	15.0%	19.9%	12.2%	47.1%	47.2%
4	1.5%	2.9%	4.4%	13.2%	15.4%	14.7%	43.3%	52.3%
5	1.6%	3.1%	4.7%	13.3%	16.1%	15.0%	44.4%	50.9%
6	1.2%	2.6%	3.8%	11.9%	14.5%	17.1%	43.5%	52.7%
7	1.1%	2.8%	3.9%	11.1%	12.9%	17.6%	41.7%	54.4%
8	1.2%	3.1%	4.3%	12.5%	12.4%	17.5%	42.4%	53.3%
9	1.1%	3.1%	4.2%	11.5%	11.1%	22.6%	45.2%	50.6%
Smallest stocks = 10	1.0%	2.9%	3.8%	9.2%	10.7%	31.1%	51.0%	45.2%

Table 3: Who Trades with Whom Actual versus Baseline

Actual depicts the percentage of daily volume accounted for by trades involving floor participants only (pure floor), both floor and system participants together (floor and system interaction), and system participants only (pure system). Baseline reports the percentage of daily volume that would be expected to occur in pure floor, floor and system interaction, and pure system trades if participants met randomly to form trades. Actual minus Baseline differences are calculated for each symbol and day, then averaged across days by symbol, and p-values are reported across 200 stocks in the full sample, 20 stocks in each market capitalization decile. Data are from NYSE CAUD file.

	Pure Floor				Floor & System Interaction				Pure System			
	Actual	Baseline	Actual - Baseline	p-value	Actual	Baseline	Actual - Baseline	p-value	Actual	Baseline	Actual - Baseline	p-value
Full Sample	4.4%	8.7%	-4.3%	<.0001	45.5%	37.6%	7.9%	<.0001	50.1%	53.7%	-3.6%	<.0001
By decile:												
Largest stocks = 1	4.7%	10.3%	-5.6%	<.0001	49.4%	41.2%	8.2%	<.0001	46.0%	48.5%	-2.6%	0.0005
2	4.7%	10.6%	-5.8%	<.0001	47.3%	40.5%	6.8%	0.0255	47.9%	48.9%	-1.0%	0.0797
3	5.7%	12.0%	-6.3%	<.0001	47.1%	40.1%	7.0%	<.0001	47.2%	47.9%	-0.8%	0.1113
4	4.4%	8.6%	-4.2%	<.0001	43.3%	36.8%	6.4%	<.0001	52.3%	54.5%	-2.2%	0.0026
5	4.7%	8.9%	-4.2%	<.0001	44.4%	38.1%	6.3%	<.0001	50.9%	53.0%	-2.1%	0.0390
6	3.8%	7.3%	-3.5%	<.0001	43.5%	36.1%	7.4%	0.0378	52.7%	56.6%	-3.9%	0.0001
7	3.9%	7.3%	-3.4%	<.0001	41.7%	34.4%	7.3%	<.0001	54.4%	58.3%	-3.9%	<.0001
8	4.3%	7.9%	-3.6%	<.0001	42.4%	35.1%	7.3%	<.0001	53.3%	57.0%	-3.7%	<.0001
9	4.2%	7.3%	-3.1%	<.0001	45.2%	36.4%	8.7%	<.0001	50.6%	56.3%	-5.6%	<.0001
Smallest stocks = 10	3.8%	7.2%	-3.5%	<.0001	51.0%	37.4%	13.6%	<.0001	45.2%	55.4%	-10.2%	<.0001

Table 4: Who Trades with Whom in Floor & System Interaction Trades by Trade Initiator

This table reports the percentage of daily volume accounted for by floor and system interaction trades analyzed by initiator type: trades are identified by whether they appear to be initiated by floor participants, system participants, or mixed floor and system participants. Average daily percentages are calculated for each symbol across 252 trading days in 2004, and mean percentages are reported across 200 stocks in the full sample, 20 stocks in each market capitalization decile. Data are from NYSE CAUD file.

	Floor-Initiated	System-Initiated	Mixed-Initiator	Total Interaction
Full Sample	10.0%	12.3%	23.2%	45.5%
By decile:				
Largest stocks = 1	8.2%	6.1%	35.2%	49.4%
2	9.1%	7.6%	30.6%	47.3%
3	9.8%	8.8%	28.5%	47.1%
4	9.8%	11.0%	22.6%	43.3%
5	10.4%	11.1%	22.9%	44.4%
6	9.9%	11.8%	21.9%	43.5%
7	9.9%	12.6%	19.1%	41.7%
8	10.0%	15.2%	17.2%	42.4%
9	11.1%	16.4%	17.7%	45.2%
Smallest stocks = 10	11.6%	22.3%	17.1%	51.0%

Table 5: Who Trades with Whom -- Direct+

The table reports the percentage of daily volume accounted for by trades involving Direct+ (automatic execution), analyzed by the participant types involved. Average daily percentages are calculated for each symbol across 252 trading days in 2004, and mean percentages are reported across 200 stocks in the full sample, 20 stocks in each market capitalization decile. Data are from NYSE CAUD file.

	System Only	Specialist & System	Floor Brokers & System	Floor Brokers, Specialist, & System	Total Volume % in Trades with Direct+
Full Sample	13.1%	0.9%	0.6%	0.2%	14.8%
By decile:					
Largest stocks = 1	12.1%	0.9%	0.2%	0.1%	13.3%
2	12.9%	0.9%	0.5%	0.2%	14.6%
3	12.2%	0.7%	0.5%	0.2%	13.7%
4	13.8%	0.9%	0.7%	0.3%	15.6%
5	14.2%	0.9%	0.7%	0.3%	16.1%
6	15.5%	1.0%	0.6%	0.3%	17.4%
7	16.4%	0.9%	0.6%	0.3%	18.3%
8	15.3%	1.4%	0.9%	0.4%	18.0%
9	13.1%	1.1%	0.7%	0.3%	15.1%
Smallest stocks = 10	5.3%	0.5%	0.3%	0.1%	6.2%

Table 6: Who-Trades-With-Whom Time Series Regressions

GMM regressions with Newey-West standard errors (10 lags) are run for each symbol over the 252 trading days in 2004. Mean coefficient estimates and the percentage of positive, negative, significantly positive, and significantly negative coefficient estimates, at the 5% significance level, are reported in the table below for the full sample, for deciles 1&2 combined, and for deciles 9&10 combined.

The dependent variables are the demeaned percentage of daily trading volume that occurs in pure floor (%PureFloor), floor and system interaction (%Interaction), and pure system (%PureSystem) trades. LogPrice is the natural logarithm of the daily closing price. LogVolume is the natural logarithm of the stock's daily trading volume. Volatility is 100 times the daily stock return squared. LogMktVolume is the natural logarithm of the market's daily trading volume. MktVolatility is 100 times the daily S&P500 return squared. Data are from CRSP and the NYSE CAUD file.

	Full Sample					Deciles 1&2 = 40 Large stocks			Deciles 9&10 = 40 Small stocks		
	Mean Estimate	% Positive	% Negative	% Sig Positive	% Sig Negative	Mean Estimate	% Sig Positive	% Sig Negative	Mean Estimate	% Sig Positive	% Sig Negative
Panel A: Dependent Variable = %PureFloor											
Constant	-0.136	41%	59%	4%	13%	-0.112	5%	18%	-0.090	0%	10%
LogPrice	-0.023	42%	58%	15%	27%	-0.011	26%	23%	-0.027	5%	18%
LogVolume	0.037	99%	1%	95%	1%	0.044	95%	0%	0.035	93%	0%
Volatility	-0.080	22%	78%	4%	34%	-0.139	3%	31%	-0.037	0%	30%
LogMktVolume	-0.012	27%	73%	2%	16%	-0.022	0%	28%	-0.010	5%	5%
MktVolatility	-0.029	46%	54%	2%	2%	0.021	0%	0%	-0.144	0%	3%
Panel B: Dependent Variable = %Interaction											
Constant	-0.716	28%	72%	5%	21%	-1.105	0%	28%	-0.137	5%	5%
LogPrice	-0.057	44%	56%	16%	27%	0.005	23%	15%	-0.044	20%	23%
LogVolume	0.091	96%	4%	86%	2%	0.115	100%	0%	0.049	65%	10%
Volatility	-0.184	17%	83%	4%	39%	-0.451	0%	59%	0.122	18%	5%
LogMktVolume	-0.012	43%	57%	3%	10%	-0.025	3%	13%	-0.016	3%	8%
MktVolatility	0.167	56%	44%	3%	2%	0.037	3%	0%	-0.192	3%	3%
Panel C: Dependent Variable = %Pure System											
Constant	0.852	69%	31%	20%	5%	1.217	28%	0%	0.227	5%	3%
LogPrice	0.080	56%	44%	30%	17%	0.007	23%	23%	0.026	10%	0%
LogVolume	-0.129	3%	97%	1%	91%	-0.159	0%	100%	0.072	23%	20%
Volatility	0.263	84%	16%	44%	2%	0.590	64%	0%	-0.084	3%	78%
LogMktVolume	0.024	58.6%	41.4%	14%	2%	0.047	18%	0%	-0.084	10%	8%
MktVolatility	-0.138	46%	54%	2%	5%	-0.058	0%	8%	0.336	3%	5%

Table 7: Probit Who-Trades-With-Whom Trade Regressions

Probit regressions are run for all trades in each symbol on 40 trading day in 2004. Mean coefficient estimates, mean linear probability slopes, and the percentage of positive, negative, significantly positive, and significantly negative coefficient estimates, at the 5% significance level, are reported in the table below for the full sample, for deciles 1&2 combined, and for deciles 9&10 combined.

The dependent variable is the probability of a trade being pure floor, floor and system interaction, or pure system. LogTradePrice is the natural logarithm of the trade price. LogTradeSize is the natural logarithm of the trade size. Quoted Spread is the quoted spread at the time of the trade, normalized by the midquote. Quoted depth is the average quoted depth at the inside bid and ask at the time of the trade. 15-min. Volume is the dollar volume traded in the stock in the 15 minutes preceding the trade. 15-min. Volatility is the absolute stock return in the 15 minutes preceding the trade. Intercepts and control variables for previous trade type, daily volume, and half-hour intraday intervals are included in the regressions but not reported here. Data are from NYSE CAUD and CQ files, for 40 days in 2004.

	Full Sample = 200 stocks						Deciles 1&2 = 40 Large stocks			Deciles 9&10 = 40 Small stocks		
	Mean Estimate	Mean Prob. Slope	% Positive	% Negative	% Sig Positive	% Sig Negative	Mean Prob. Slope	% Sig Positive	% Sig Negative	Mean Prob. Slope	% Sig Positive	% Sig Negative
Panel A: Dependent Variable = Probability of Pure Floor Trade												
LogTradePrice	-1.613	-3.308	47%	53%	29%	33%	-0.388	33%	33%	-14.447	31%	31%
LogTradeSize	0.234	1.336	98%	2%	93%	0%	1.653	100%	0%	2.814	82%	0%
Quoted Spread	0.011	0.175	96%	4%	84%	0%	0.071	97%	0%	0.472	51%	0%
Quoted Depth	-0.029	-0.197	15%	85%	3%	53%	-0.041	3%	77%	-0.821	3%	26%
15-min. Volume	0.000	0.104	77%	23%	48%	8%	0.019	36%	15%	0.340	38%	0%
15-min. Volatility	45.410	0.109	22%	78%	5%	47%	-0.037	0%	56%	0.729	10%	26%
Panel B: Dependent Variable = Probability of Interaction Trade												
LogTradePrice	0.057	0.063	53%	47%	38%	36%	-0.239	38%	41%	0.722	48%	15%
LogTradeSize	0.247	1.362	99%	1%	98%	1%	1.792	100%	0%	1.004	90%	3%
Quoted Spread	0.023	0.220	99%	1%	98%	0%	0.238	100%	0%	0.235	95%	0%
Quoted Depth	-0.003	-0.019	28%	72%	14%	56%	-0.021	8%	82%	-0.030	5%	45%
15-min. Volume	0.000	0.030	76%	24%	59%	14%	0.005	46%	36%	0.029	53%	0%
15-min. Volatility	-11.289	-0.024	19%	81%	9%	64%	-0.041	0%	95%	-0.005	23%	25%
Panel C: Dependent Variable = Probability of Pure System Trade												
LogTradePrice	-0.036	-0.014	49%	51%	38%	40%	0.271	41%	44%	-0.522	23%	45%
LogTradeSize	-0.283	-1.558	1%	99%	1%	98%	-2.007	0%	100%	-1.210	3%	90%
Quoted Spread	-0.025	-0.237	1%	99%	0%	98%	-0.257	0%	100%	-0.242	0%	95%
Quoted Depth	0.003	0.023	77%	23%	60%	10%	0.024	82%	5%	0.038	50%	5%
15-min. Volume	0.000	-0.039	23%	77%	15%	64%	-0.009	38%	46%	-0.045	3%	58%
15-min. Volatility	13.148	0.028	82%	18%	69%	8%	0.045	100%	0%	0.005	25%	18%

Table 8: Market Quality Regressions on Who-Trades-with-Whom Trade Types

GMM regressions with Newey-West standard errors (10 lags) are run across all trades for each symbol. Mean coefficient estimates and the percentage of significantly positive and significantly negative coefficient estimates, at the 5% significance level, are reported in the table below. Effective spread is twice the signed difference between the trade price and the quote midpoint at the time of the trade. Realized spread is twice the signed difference between the trade price and the quote midpoint five minutes after the trade. Effective and realized spreads are normalized by the trade price. Information content is the difference between the effective spread and the realized spread.

LogTradePrice is the natural logarithm of the trade price. LogTradeSize is the natural logarithm of the trade size. The remaining variables are indicator variables set equal to one if the trade is in the category, else zero: Pure Floor indicates that the trade involves floor participants (specialist and floor brokers) only; Interaction indicates that the trade involves both floor and system participants; Interaction: Floor-initiated indicates that the trade is an interaction trade initiated by floor participants; Interaction: System-initiated indicates that the trade is an interaction trade initiated by system participants; Specialist indicates that the specialist participates in the trade; CAP indicates that the trade involves execution of a CAP; Direct+ indicates that the trade involves automatic execution. Intercepts and control variables for daily volume and half-hour intraday intervals are included in the regressions but not reported here. Data are from NYSE CAUD and CQ files, for 40 days in 2004.

	Mean Estimate	% Sig Positive	% Sig Negative	Mean Estimate	% Sig Positive	% Sig Negative	Mean Estimate	% Sig Positive	% Sig Negative
Panel A: Dependent Variable = Effective Spread (bp)									
LogTradePrice	-10.3528	7%	75%	-10.2494	7%	75%	-10.5970	6%	75%
LogTradeSize	1.2053	96%	0%	1.0315	94%	0%	1.1628	96%	0%
Pure Floor	-1.1583	10%	31%	-1.0256	10%	29%	0.6647	22%	7%
Interaction	-0.3846	26%	41%	0.9265	46%	17%	1.2815	40%	4%
Interaction: Floor-initiated				-2.6904	1%	76%	-2.5435	2%	66%
Interaction: System-initiated				-0.8742	2%	57%	-0.6933	2%	42%
Specialist							0.1614	21%	15%
CAP							-1.8730	1%	79%
Direct+							-2.2267	6%	88%

	Mean Estimate	% Sig Positive	% Sig Negative	Mean Estimate	% Sig Positive	% Sig Negative	Mean Estimate	% Sig Positive	% Sig Negative
Panel B: Dependent Variable = Realized Spread (bp)									
LogTradePrice	-7.1227	6%	23%	-7.2246	6%	22%	-7.4144	5%	22%
LogTradeSize	-0.6870	1%	42%	-0.8701	0%	56%	-0.6709	2%	46%
Pure Floor	1.3302	25%	3%	1.5259	26%	3%	-2.4740	3%	12%
Interaction	1.2613	48%	4%	3.3732	67%	1%	0.3355	8%	4%
Interaction: Floor-initiated				-4.1067	2%	64%	-3.8536	2%	61%
Interaction: System-initiated				-1.0327	13%	10%	-0.5397	17%	9%
Specialist							1.9387	37%	2%
CAP							0.8780	19%	3%
Direct+							-6.3788	1%	94%
Panel C: Dependent Variable = Information Content (bp)									
LogTradePrice	-3.1034	7%	28%	-2.9185	7%	29%	-3.0473	7%	30%
LogTradeSize	1.9174	88%	0%	1.9263	87%	0%	1.8596	83%	0%
Pure Floor	-2.5652	2%	30%	-2.6266	2%	33%	3.0404	15%	3%
Interaction	-1.6402	2%	59%	-2.4514	0%	58%	0.8998	5%	3%
Interaction: Floor-initiated				1.4439	56%	6%	1.3385	53%	6%
Interaction: System-initiated				0.1580	7%	17%	-0.1493	4%	22%
Specialist							-1.7345	2%	32%
CAP							-2.7291	0%	43%
Direct+							4.1820	77%	1%