

# Who Trades With Whom?

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## Abstract

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## **Abstract**

This paper examines empirically how market participants meet on the NYSE to form trades. Pure floor trades, involving only specialists and floor brokers, account for less than 6% of trading volume in the average stock, while pure system trades, involving only orders submitted electronically, account for 49% and floor and system interaction trades account for 45% of trading volume in the average stock. Market quality analysis reveals that pure system trades are generally more informative than other trades and that trades involving automatic execution are the most informative. This study offers insight into the rich web of liquidity supply and demand on the NYSE and provides a benchmark for analyzing market structure changes.

## **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), traders include system participants, who enter orders electronically, and floor participants, who are physically present on the trading floor (specialists and floor brokers). 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?

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 trade mostly with other floor participants or with system participants, remain unresolved. These questions are increasingly important now, as the NYSE prepares to expand electronic trading and convert many floor activities from manual to electronic. Understanding the current interactions between floor and system participants should provide insight into how liquidity supply and demand may evolve on a more electronic NYSE.

This paper considers two sets of empirical questions using non-public audit trail data from the NYSE. First, how do floor and system participants interact on the NYSE? Specifically, under what conditions do trades occur between floor participants, between system participants, and between floor and system participants? Are floor participants primarily liquidity suppliers or demanders in trades involving both types of 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.<sup>1</sup> For example, consider a stock in which there are two trades of 1000 shares each and, in total, floor participants 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 participants 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 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, less than 6% of the average stock's trading volume occurs in pure floor trades, 45% occurs in floor and system interaction trades, and 49% occurs in pure system trades. 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

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<sup>1</sup> See, for example, Madhavan and Sofianos (1998) on specialist trading and Sofianos and Werner (2000) on floor broker trading.

result of floor participants' physically meeting on the trading floor.<sup>2</sup> 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 one or both 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 appear to 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 other trade characteristics. Within floor and system interaction trades, floor-initiated trades generally have lower effective spreads than system-initiated trades, likely reflecting floor participants' last-mover and informational advantages.

Finally, the information content is lower for pure floor trades and floor and system interaction trades than for pure system trades in the same stock, all else equal. Trades involving automatic execution have the highest information content, despite the

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<sup>2</sup> 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.

current restrictions limiting automatic execution to fewer than 1100 shares and one trade per 30-second period. There are several possible explanations for these results. Floor participants may avoid representing informed order flow for reputational reasons, as in Benveniste, Marcus, and Wilhelm (1992), forcing informed traders to submit system orders. Floor participants may also use their last-mover and floor-based informational advantages to avoid interacting with informed orders that come through the system, leaving informed system orders to be executed in pure system trades. Further, informed traders may prefer the speed and pre-trade anonymity offered by automatic execution.<sup>3</sup>

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.<sup>4</sup> In the analysis most closely related to this paper, 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.<sup>5</sup> The present paper builds on this intuition by examining 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

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<sup>3</sup> 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.

<sup>4</sup> See, for example, Harris and Hasbrouck (1996) on market versus limit orders, and Keim and Madhavan (1996) on upstairs versus downstairs trades.

<sup>5</sup> Werner (2003) identifies trades according to whether they include particular order types (system market, system marketable limit, system limit, ITS, floor broker, CAP, or specialist) on the buy-side, sell-side, both, or neither, to examine how the net presence of each order type affects a trade's execution.

concludes and outlines future work.

## **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.<sup>6</sup> The CAUD file matches buyers and sellers for each trade, providing information

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<sup>6</sup> 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

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 (specialist, floor broker, and system) and dividing by twice total volume, since the numerator double-counts volume. The AAI trade described above has a who-trades breakdown of 58% system, 21% floor brokers, and 21% specialist.

Who trades with whom is determined by identifying all of the types of market participants involved in each trade and then categorizing the trade as follows:<sup>7</sup>

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

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information, and trades with unequal total purchase and sale quantities. Such records represent approximately 6% of the original trades.

<sup>7</sup> Percentage (CAP) executions, which floor brokers leave with the specialist to execute based on a preset strategy, are included as floor broker executions. Incoming Intermarket Trading System (ITS) executions are included as system participant executions.

participants.

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+) and upstairs-arranged trades. 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).<sup>8</sup>

### ***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.<sup>9</sup> The effective spread is defined as:  $\text{Effective Spread}_t = 2I(P_t - M_t)$ , where  $t$  denotes the trade,  $I$  is an indicator variable that equals one 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 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)

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<sup>8</sup> An upstairs-arranged trade can involve other parties in addition to the arranging broker, who is on both sides of the trade, because the trade must be exposed to the public on the NYSE, offering the opportunity for other participants to trade and for either side of the cross to receive price improvement.

<sup>9</sup> 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.

algorithm. The effective spread captures the immediate price impact of a trade.

The realized spread is defined as:  $\text{Realized Spread}_t = 2I(P_t - M_{t+5})$ , 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 in detail to determine which floor participants are involved and to what extent the trades are floor-initiated or system-initiated. Third, it examines pure floor trades to explore which floor participants are involved and the incidence of upstairs-arranged trades versus trades arranged on the floor. The section concludes by analyzing the prevalence of Direct+ (automatic) executions in pure system trades and floor and system interaction trades.

#### ***3.1. Who trades versus who trades with whom***

Panel A of **Table 2** analyzes who trades for the average stock in the full 200-stock sample and in each market capitalization decile. Specialists account for about 11%, floor brokers account for about 18%, and system participants account for about 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.

Panel B of Table 2 analyzes how market participants come together to form trades, or who trades with whom. Each trade is categorized as pure floor, floor and system interaction, or pure system, and trade-type volumes are divided by total volume to determine trade-type percentages. Pure floor trades are the least common trades on the NYSE, ranging from 7.5% of volume in the average decile 3 stock to only 4.1% in decile 10, the smallest stocks.<sup>10</sup> Pure system trades and floor and system interaction trades roughly split the remaining trading volume overall, but their cross-sectional patterns diverge significantly. 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.

A natural question is how these trade-type results compare to expectations. While there is no established theory for what percentage of trading should occur between different participant types in a market where both floor and electronic order submission are possible, there are two potentially useful benchmarks: complete segmentation and

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<sup>10</sup> 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.

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 (45% 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.

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? Are pure floor trades dominated by upstairs-arranged trades, or do floor participants also trade significantly with each other on the floor? What role do automatic executions play in pure system trades and floor and system interaction trades?

### ***3.2. Floor and system interaction trade analysis***

**Table 4** breaks down floor and system interaction trades along two dimensions. Panel A divides floor and system interaction trades into those involving only specialist and system participants, those involving only floor brokers and system participants, and those involving all three types of participants. Panel A shows that 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.

Panel B of 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.<sup>11</sup> 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 one or both sides, such as the AAI example in Section 2.2, are categorized as mixed-initiator.

Panel B shows that there is more system-initiated than floor-initiated trading

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<sup>11</sup> 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.

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. Pure floor trade analysis***

**Table 5** breaks down pure floor trades along two dimensions: by whether they involve floor brokers only or floor brokers and the specialist, and by whether or not they are upstairs-arranged. Panel A shows that the specialist is involved in slightly more than half of pure floor trading volume for the average stock. 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.

Panel B shows that most pure floor trading volume in the average stock is not upstairs-arranged but rather arises from the interaction of traders on the floor of the NYSE. At 1.4% of trading volume for the average stock, upstairs-arranged trading has shrunk substantially over recent years as other venues have facilitated the printing of upstairs-arranged trades without requiring them to be exposed to the market. For example, Hasbrouck, Sofianos, and Sosebee (1993) find that upstairs-arranged trades represent about 14% of share volume on the NYSE in 1993.

### ***3.4. Direct+ analysis***

**Table 6** analyzes the composition of trades involving Direct+, or automatic

execution, which is restricted to fewer than 1100 shares and can occur at the inside quote only. Trades involving Direct+ constitute about 14.5% of the average stock's volume in this sample (12.8% in pure system trades plus 1.7% in floor and system interaction trades). 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. Trades involving Direct+ are relatively more common in the middle market-capitalization deciles, although the largest stock deciles have more Direct+ shares traded on an absolute basis, 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:

$$\begin{aligned} \text{WTWW}\%_t = & \alpha + \beta_1 \text{LogPrice}_t + \beta_2 \text{LogVolume}_t + \beta_3 \text{Volatility}_t \\ & + \beta_4 \text{LogMktVolume}_t + \beta_5 \text{MktVolatility}_t + \varepsilon_t, \end{aligned} \quad (1)$$

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.<sup>12</sup>

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<sup>12</sup> Robustness checks using the VIX options volatility index as a proxy for market volatility yield qualitatively similar results.

**Table 7** 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) 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. 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 (excluding

upstairs-arranged trades) in the 40-day sub-period:

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

where  $n$  denotes the trade; WTWW is the trade type (pure floor, floor and system interaction, or pure system); QuotedSpread is the best ask minus the best bid quote at the time of the trade, normalized by the quote midpoint; QuotedDepth is the average number of shares at the best bid and best ask quotes at the time of the trade; TradeSize is the size of the trade; Volume15 is the 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.<sup>13</sup>

**Table 8** 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

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<sup>13</sup> Robustness checks show that including the trade price and more lags of the trade-type indicators does not affect the coefficients of interest.

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 7 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 (excluding upstairs-arranged trades) in the 40-day sub-period, using GMM with Newey-West standard errors:

$$\begin{aligned}
 \text{MQstat}_n = & \alpha + \beta_1 \text{LogTradePrice}_n + \beta_2 \text{LogTradeSize}_n + \beta_3 \text{PureFloor}_n \\
 & + \beta_4 \text{Interaction}_n + \beta_5 \text{Int\_FBSys}_n + \beta_6 \text{Int\_SpSys}_n + \beta_7 \text{Int\_FlrInit}_n \\
 & + \beta_8 \text{Int\_SysInit}_n + \beta_9 \text{Direct}_n + \sum_{i=1}^{10} \gamma_i \text{VolumeDecile}_n \\
 & + \sum_{j=1}^{13} \delta_j \text{HalfHourInterval}_n + \varepsilon_n
 \end{aligned} \tag{3}$$

where  $n$  denotes the trade, MQStat is the market quality statistic (effective spread, realized spread, or information content), LogTradePrice is the natural logarithm of the trade price, and 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: 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\_FBSys indicates that the trade is an interaction trade involving only floor brokers and system participants; Int\_SpSys indicates that the trade is an interaction trade involving

only the specialist 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; and Direct+ indicates that the trade involves automatic execution.

**Table 9** presents the results for regression Eq. (3) of effective spread in Panel A, realized spread in Panel B, and information content in Panel C.<sup>14</sup> Mean coefficient estimates 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. The first two right-side variables reflect basic trade characteristics other than who trades with whom. Trades at higher prices generally have lower effective and realized spreads and information content, even though all three are normalized by trade price. Larger trades generally have higher effective spreads and information content but lower realized spreads, suggesting that all else equal larger trades are more informed, reducing liquidity provider profits despite their higher effective spreads.

Several results linked to who trades with whom are apparent from Table 9. 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 overall, but the effect is less uniform in large stocks, where some stocks have a significantly positive coefficient estimate, than in small stocks, where all of the significant coefficient estimates are negative. Realized spreads, in contrast, are higher overall for pure floor trades, with the

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<sup>14</sup> Results reported in Table 9 are based on five-minute realized spread and information content measures; results using 30-minute measures are qualitatively similar and are available on request.

strongest results arising in the largest stocks and pure floor trades in small stocks exhibiting less uniform results.

Second, floor and system interaction trades have significantly higher realized spreads and lower information content, and these results hold across large and small stocks. These effects are strongest in interaction trades involving all three types of participants (specialist, floor brokers, and system), as shown by the opposite-sign coefficients on the indicators for interaction trades involving only two participant types. Thus the higher realized spreads and lower information content of interaction trades are driven by the interaction trades that represent the biggest consolidation of trading interest. Looking at interaction trades by initiator type, floor-initiated trades have significantly lower effective and realized spreads and higher information content. 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.

Third, taken together, the pure floor trade and floor and system interaction trade results show that trades involving the floor have lower information content than pure system trades. Even floor-initiated interaction trades, which are more informative than system-initiated interaction trades, are on balance less informative than pure system trades. These findings suggest a change from the 1990s. Using TORQ data from 1990-1991, Cooney and Sias (2004) find that most informed trading occurs through orders executed by floor brokers. Similarly, using CAUD data from 1997 Werner (2003) finds that liquidity-demanding floor broker orders are the most informative order type. The lower information content found in Table 9 for trades involving the floor suggests that as

the use of system orders has grown, traders have increasingly chosen to submit system orders rather than use a floor broker for their informed trades. This trend may have been boosted by the introduction of automatic execution (Direct+) in 2001.

Table 9 shows that Direct+ trades have lower effective spreads than non-Direct+ trades. Direct+ trades also have higher information content than non-Direct+ trades. This suggests that despite the size and frequency restrictions on automatic execution trades on the NYSE, they are regularly used by informed traders. Informed traders' use of Direct+ likely reflects their desire for execution speed as well as pre-trade anonymity.

## **6. Conclusions and future work**

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 from many sources. 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, and pure system trades are generally more informative than pure floor trades and floor and system interaction trades. These results are consistent with predictions that floor brokers avoid representing informed orders to preserve their reputations on the floor. Collectively, these findings offer insight into the rich web of liquidity supply and

demand on the NYSE.

This study also provides a benchmark for analyzing the proposed market structure changes at the NYSE, which include removing most of the restrictions on automatic execution and allowing floor participants to place reserve (undisplayed) liquidity on the limit order book. Given how little trading currently results from the interaction of floor participants with each other, whether they will interact more or less in a more automated environment is an open question. Equally interesting are questions of where the greatest information will be revealed under the new structure. Will automatic execution trades become even more informative relative to other trade types, or will the potential increase in non-face-to-face floor trades (through floor brokers' placing undisplayed liquidity on the limit order book) increase floor brokers' involvement in informative trades?

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

Floor indicates shares traded by floor brokers or specialist; System indicates shares traded by system participants. Pure Floor trades have only floor participants 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
<b>Scenario A</b>			
Floor buys 1000 shares Floor sells 1000 shares	System buys 1000 shares System sells 1000 shares	50% Floor 50% System	50% Pure Floor 50% Pure System
Trade type: Pure Floor	Trade type: Pure System		
<b>Scenario B</b>			
Floor buys 1000 shares System sells 1000 shares	System buys 1000 shares Floor sells 1000 shares	50% Floor 50% System	100% Floor and System Interaction
Trade type: Floor and System Interaction	Trade type: Floor and System Interaction		

**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 and Who Trades with Whom**

Panel A: Who Trades depicts the percentage of twice daily volume accounted for by the purchases and sales of specialist, floor broker, and system participants, respectively. Panel B: Who Trades with Whom depicts the percentage of daily volume accounted for by trades involving floor participants (specialist and floor brokers) only, both 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.

**Panel A: Who Trades**

	<u>Specialist</u>	<u>Floor Broker</u>	<u>System</u>
Full Sample	11.1%	17.6%	71.3%
By decile:			
Largest stocks = 1	10.3%	21.3%	68.4%
2	9.8%	22.1%	68.1%
3	9.4%	23.3%	67.3%
4	9.8%	18.0%	72.2%
5	10.0%	19.0%	71.0%
6	10.7%	15.6%	73.7%
7	10.7%	14.8%	74.5%
8	10.9%	15.6%	73.5%
9	13.0%	14.0%	73.0%
Smallest stocks = 10	16.3%	12.4%	71.3%

**Panel B: Who Trades with Whom**

	<u>Pure Floor</u>	<u>Floor &amp; System Interaction</u>	<u>Pure System</u>
Full Sample	5.6%	45.2%	49.2%
By decile:			
Largest stocks = 1	6.1%	48.9%	45.0%
2	6.8%	47.2%	46.1%
3	7.5%	46.4%	46.1%
4	5.8%	42.9%	51.3%
5	6.1%	44.2%	49.7%
6	4.7%	43.3%	52.1%
7	4.7%	41.5%	53.8%
8	5.4%	42.0%	52.6%
9	5.0%	44.9%	50.2%
Smallest stocks = 10	4.1%	51.0%	44.9%

**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 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 -				Actual -				Actual -	
	Actual	Baseline	Baseline	p-value	Actual	Baseline	Baseline	p-value	Actual	Baseline	Baseline	p-value
Full Sample	5.6%	8.8%	-3.2%	<.0001	45.2%	37.6%	7.5%	<.0001	49.2%	53.6%	-4.4%	<.0001
By decile:												
Largest stocks = 1	6.1%	10.3%	-4.1%	<.0001	48.9%	41.2%	7.6%	<.0001	45.0%	48.5%	-3.5%	<.0001
2	6.8%	10.8%	-4.1%	<.0001	47.2%	40.7%	6.5%	<.0001	46.1%	48.5%	-2.4%	<.0001
3	7.5%	12.0%	-4.5%	<.0001	46.4%	40.1%	6.3%	<.0001	46.1%	47.9%	-1.9%	0.0001
4	5.8%	8.6%	-2.8%	<.0001	42.9%	36.8%	6.0%	<.0001	51.3%	54.5%	-3.2%	<.0001
5	6.1%	9.1%	-2.9%	<.0001	44.2%	38.3%	5.9%	<.0001	49.7%	52.7%	-2.9%	0.0014
6	4.7%	7.3%	-2.6%	<.0001	43.3%	36.1%	7.2%	<.0001	52.1%	56.6%	-4.6%	<.0001
7	4.7%	7.3%	-2.6%	<.0001	41.5%	34.4%	7.1%	<.0001	53.8%	58.3%	-4.5%	<.0001
8	5.4%	7.9%	-2.5%	<.0001	42.0%	35.1%	6.9%	<.0001	52.6%	57.0%	-4.4%	<.0001
9	5.0%	7.3%	-2.3%	<.0001	44.9%	36.4%	8.4%	<.0001	50.2%	56.3%	-6.1%	<.0001
Smallest stocks = 10	4.1%	7.2%	-3.1%	<.0001	51.0%	37.4%	13.6%	<.0001	44.9%	55.4%	-10.4%	<.0001

**Table 4: Who Trades with Whom in Floor & System Interaction Trades**

Panel A reports the percentage of daily volume accounted for by floor and system interaction trades analyzed by the combination of market participants involved: specialist and system only; floor brokers and system only; and specialist, floor brokers, and system. Panel B 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.

**Panel A: Floor & System Interaction Trades by Participant Type**

	<b>Specialist &amp; System</b>	<b>Floor Brokers &amp; System</b>	<b>Specialist, Floor Brokers, &amp; System</b>	<b>Total Floor &amp; System Interaction</b>
Full Sample	17.3%	12.2%	15.7%	45.2%
By decile:				
Largest stocks = 1	13.9%	12.0%	22.9%	48.9%
2	13.2%	13.4%	20.5%	47.2%
3	11.9%	14.7%	19.8%	46.4%
4	14.4%	13.0%	15.5%	42.9%
5	14.6%	13.3%	16.2%	44.2%
6	16.9%	11.7%	14.6%	43.3%
7	17.4%	11.0%	13.0%	41.5%
8	17.3%	12.3%	12.4%	42.0%
9	22.4%	11.3%	11.1%	44.9%
Smallest stocks = 10	31.0%	9.2%	10.8%	51.0%

**Panel B: Floor & System Interaction Trades by Initiator Type**

	<b>Floor- Initiated</b>	<b>System- Initiated</b>	<b>Mixed- Initiator</b>	<b>Total Floor &amp; System Interaction</b>
Full Sample	9.8%	12.1%	23.3%	45.2%
By decile:				
Largest stocks = 1	8.1%	5.9%	34.9%	48.9%
2	8.9%	7.5%	30.8%	47.2%
3	9.4%	8.4%	28.5%	46.4%
4	9.7%	10.5%	22.6%	42.9%
5	10.2%	10.7%	23.3%	44.2%
6	10.0%	11.8%	21.4%	43.3%
7	10.2%	12.4%	18.9%	41.5%
8	9.9%	15.2%	17.0%	42.0%
9	10.8%	16.0%	18.1%	44.9%
Smallest stocks = 10	10.9%	22.3%	17.8%	51.0%

**Table 5: Who Trades with Whom in Pure Floor Trades**

The table reports the percentage of daily volume accounted for by pure floor trades analyzed by the combination of market participants involved: trades involving floor brokers only versus trades involving floor brokers and the specialist in Panel A; upstairs-arranged versus non-upstairs-arranged trades in Panel B. 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.

**Panel A: Pure Floor trades by Participant Type**

	<b>Floor Brokers Only</b>	<b>Specialist &amp; Floor Brokers</b>	<b>Total Pure Floor</b>
Full Sample	2.7%	2.9%	5.6%
By decile:			
Largest stocks = 1	3.6%	2.6%	6.1%
2	3.9%	2.8%	6.8%
3	4.0%	3.5%	7.5%
4	2.8%	2.9%	5.8%
5	3.0%	3.1%	6.1%
6	2.1%	2.6%	4.7%
7	1.9%	2.8%	4.7%
8	2.3%	3.1%	5.4%
9	1.9%	3.1%	5.0%
Smallest stocks = 10	1.4%	2.8%	4.2%

**Panel B: Pure Floor trades by Upstairs-arranged versus Non-upstairs-arranged**

	<b>Upstairs- Arranged</b>	<b>Not Upstairs- Arranged</b>	<b>Total Pure Floor</b>
Full Sample	1.4%	4.2%	5.6%
By decile:			
Largest stocks = 1	1.7%	4.4%	6.1%
2	2.3%	4.5%	6.8%
3	2.2%	5.3%	7.5%
4	1.6%	4.2%	5.8%
5	1.8%	4.3%	6.1%
6	1.1%	3.6%	4.7%
7	0.8%	3.9%	4.7%
8	1.1%	4.3%	5.4%
9	0.8%	4.2%	5.0%
Smallest stocks = 10	0.3%	3.9%	4.2%

**Table 6: Who Trades with Whom in Direct+ Trades**

The table reports the percentage of daily volume accounted for by trades involving and not involving Direct+, for the two categories in which Direct+ executions occur: pure system trades and floor and system interaction trades. 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.

	<u>Pure System with Direct+</u>	<u>Pure System no Direct+</u>	<u>Floor &amp; System Interaction with Direct+</u>	<u>Floor &amp; System Interaction no Direct+</u>	<u>Total Pure System + Floor &amp; System Interaction</u>
Full Sample	12.8%	36.3%	1.7%	43.5%	94.4%
By decile:					
Largest stocks = 1	11.9%	33.1%	1.2%	47.7%	93.9%
2	12.2%	33.9%	1.5%	45.6%	93.2%
3	12.0%	34.1%	1.4%	45.0%	92.5%
4	13.6%	37.8%	1.8%	41.1%	94.2%
5	13.9%	35.8%	1.8%	42.3%	93.9%
6	15.3%	36.8%	1.9%	41.4%	95.3%
7	16.3%	37.5%	1.8%	39.7%	95.3%
8	15.1%	37.5%	2.6%	39.4%	94.6%
9	13.0%	37.2%	2.0%	42.8%	95.0%
Smallest stocks = 10	5.3%	39.6%	0.9%	50.1%	95.9%

**Table 7: Who-Trades-With-Whom Time Series Regressions**

GMM regressions with Newey-West standard errors (using 5 lags) are run for each symbol over the 252 trading days in 2004. Mean coefficient estimates, adjusted R-squareds, 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 = 200 stocks					Deciles 1&2 = 40 Large stocks			Deciles 9&10 = 40 Small stocks		
	Mean	%	%	% Sig	% Sig	Mean	% Sig	% Sig	Mean	% Sig	% Sig
	Estimate	Positive	Negative	Positive	Negative	Estimate	Positive	Negative	Estimate	Positive	Negative
<b>Panel A: Dependent Variable = %PureFloor</b>											
Constant	-0.156	43%	57%	5%	13%	-0.128	8%	18%	-0.115	0%	8%
LogPrice	-0.033	40%	61%	14%	25%	-0.020	18%	23%	-0.035	5%	20%
LogVolume	0.057	99.0%	1.0%	98%	0%	0.070	100%	0%	0.045	93%	0%
Volatility	-0.128	13%	88%	1%	40%	-0.245	0%	40%	-0.047	0%	30%
LogMktVolume	-0.021	26%	75%	2%	24%	-0.037	0%	43%	-0.013	3%	5%
MktVolatility	0.031	51%	49%	2%	2%	0.146	3%	0%	-0.181	3%	3%
<b>Panel B: Dependent Variable = %Interaction</b>											
Constant	-0.695	29%	72%	5%	21%	-1.093	0%	28%	-0.117	5%	5%
LogPrice	-0.048	46%	55%	17%	24%	0.015	23%	13%	-0.037	20%	18%
LogVolume	0.082	96%	5%	84%	2%	0.102	100%	0%	0.045	63%	10%
Volatility	-0.167	20%	80%	5%	32%	-0.410	0%	50%	0.124	20%	5%
LogMktVolume	-0.009	47%	54%	4%	9%	-0.019	3%	10%	-0.015	5%	5%
MktVolatility	0.137	58%	43%	4%	3%	-0.076	5%	5%	-0.140	3%	3%
<b>Panel C: Dependent Variable = %Pure System</b>											
Constant	0.850	70%	30%	21%	5%	1.221	30%	0%	0.232	5%	3%
LogPrice	0.081	57%	44%	31%	18%	0.005	18%	25%	0.072	23%	20%
LogVolume	-0.138	3%	98%	1%	93%	-0.172	0%	100%	-0.089	3%	78%
Volatility	0.295	86%	14%	48%	2%	0.655	70%	0%	-0.077	10%	8%
LogMktVolume	0.030	61.5%	38.5%	14%	2%	0.056	20%	0%	0.029	8%	0%
MktVolatility	-0.169	46%	55%	2%	5%	-0.070	0%	8%	0.322	3%	5%

**Table 8: Probit Who-Trades-With-Whom Trade Regressions**

Probit regressions are run for all non-upstairs-arranged 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. 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-minute Volatility is the absolute stock return in the 15 minutes preceding the trade. 15-minute Volume is the dollar volume traded in the stock 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.

	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
<b>Panel A: Dependent Variable = Probability of Pure Floor Trade</b>												
Quoted Spread	0.0173	0.9653	98%	2%	85%	0%	0.088	100%	0%	4.419	51%	0%
Quoted Depth	-0.0169	-0.1128	17%	83%	6%	45%	-0.033	5%	67%	-0.423	3%	26%
Trade Size	-0.0001	0.0399	98%	2%	94%	0%	0.042	100%	0%	0.339	85%	0%
15-min Volume	0.0001	0.2798	85%	15%	56%	3%	0.048	62%	3%	1.174	38%	0%
15-min Volatility	77.2274	0.2751	23%	77%	7%	44%	-0.030	5%	54%	1.550	13%	26%
<b>Panel B: Dependent Variable = Probability of Interaction Trade</b>												
Quoted Spread	0.024	0.222	99%	1%	98%	0%	0.248	100%	0%	0.220	95%	0%
Quoted Depth	-0.002	-0.015	31%	69%	16%	55%	-0.015	10%	77%	-0.028	8%	50%
Trade Size	0.000	0.087	98%	2%	97%	1%	0.116	100%	0%	0.057	85%	3%
15-min Volume	0.000	0.040	80%	20%	66%	8%	0.021	54%	21%	0.044	65%	0%
15-min Volatility	-10.080	-0.022	22%	78%	9%	59%	-0.037	0%	87%	-0.008	23%	23%
<b>Panel C: Dependent Variable = Probability of Pure System Trade</b>												
Quoted Spread	-0.024	-0.232	1%	99%	0%	98%	-0.252	0%	100%	-0.227	0%	95%
Quoted Depth	0.003	0.022	75%	25%	61%	11%	0.023	79%	8%	0.038	55%	5%
Trade Size	0.000	-0.180	1%	99%	0%	98%	-0.245	0%	100%	-0.114	0%	90%
15-min Volume	0.000	-0.039	24%	76%	15%	62%	-0.006	36%	46%	-0.057	3%	65%
15-min Volatility	12.881	0.028	81%	19%	66%	9%	0.045	95%	0%	0.009	23%	18%

**Table 9: Market Quality Regressions on Who-Trades-with-Whom Trade Types**

GMM regressions with Newey-West standard errors (using 5 lags) are run across all non-upstairs-arranged trades for each symbol. 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. 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; Int: FB & System indicates that the trade is an interaction trade involving only floor brokers and system participants; Int: Spec & System indicates that the trade is an interaction trade involving only specialist and system participants; Int: Floor-initiated indicates that the trade is an interaction trade initiated by floor participants; Int: System-initiated indicates that the trade is an interaction trade initiated by system participants; Direct+ indicates that the trade involves automatic execution; Upstairs indicates that the trade is upstairs-arranged. 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.

	Full Sample = 200 stocks					Deciles 1&2 = 40 Large stocks			Deciles 9&10 = 40 Small stocks		
	Mean	%	%	% Sig	% Sig	Mean	% Sig	% Sig	Mean	% Sig	% Sig
	Estimate	Positive	Negative	Positive	Negative	Estimate	Positive	Negative	Estimate	Positive	Negative
<b>Panel A: Dependent Variable = Effective Spread (bp)</b>											
LogTradePrice	-10.5636	12%	88%	6%	75%	-2.5360	8%	82%	-25.3193	5%	70%
LogTradeSize	1.1975	99%	1%	96%	0%	0.2427	100%	0%	2.9280	85%	0%
Pure Floor	-1.5789	23%	77%	6%	43%	0.1685	15%	33%	-5.5176	0%	38%
Interaction	-0.6446	23%	77%	8%	43%	-0.1917	13%	44%	-0.1246	10%	35%
Int: FB & System	0.0873	49%	51%	16%	18%	-0.0634	28%	33%	0.2179	5%	8%
Int: Spec & System	2.0524	93%	7%	76%	2%	0.3661	74%	3%	3.2383	48%	0%
Int: Floor-initiated	-2.5332	8%	92%	2%	68%	-0.3023	3%	87%	-8.9230	0%	63%
Int: System-initiated	-0.6782	14%	86%	2%	43%	-0.2411	3%	67%	-1.5485	3%	18%
Direct+	-2.2298	8%	92%	6%	88%	-0.3264	10%	79%	-5.3848	5%	75%

	Full Sample = 200 stocks					Deciles 1&2 = 40 Large stocks			Deciles 9&10 = 40 Small stocks		
	Mean	%	%	% Sig	% Sig	Mean	% Sig	% Sig	Mean	% Sig	% Sig
	Estimate	Positive	Negative	Positive	Negative	Estimate	Positive	Negative	Estimate	Positive	Negative
<b>Panel B: Dependent Variable = Realized Spread (bp)</b>											
LogTradePrice	-7.4588	36%	64%	5%	22%	-1.2177	5%	18%	-29.7974	5%	55%
LogTradeSize	-0.6685	15%	85%	2%	47%	-0.5121	0%	87%	-0.7012	3%	23%
Pure Floor	0.1241	68%	32%	15%	3%	1.1775	28%	3%	-3.1751	5%	5%
Interaction	3.0195	90%	10%	46%	1%	1.9192	72%	0%	2.4877	20%	3%
Int: FB & System	-1.6145	14%	86%	2%	35%	-1.1111	0%	49%	0.4637	5%	15%
Int: Spec & System	-0.5765	28%	72%	4%	20%	-0.7213	0%	23%	1.4972	5%	8%
Int: Floor-initiated	-4.0105	14%	86%	3%	61%	-4.0448	0%	97%	-4.5958	5%	25%
Int: System-initiated	-0.7264	61%	39%	18%	8%	1.3321	54%	0%	-4.1307	3%	10%
Direct+	-6.3853	2%	98%	1%	94%	-2.2984	0%	100%	-13.9620	3%	75%
<b>Panel C: Dependent Variable = Information Content (bp)</b>											
LogTradePrice	-2.9563	26%	74%	7%	30%	-1.3354	13%	26%	5.1118	13%	23%
LogTradeSize	1.8918	99%	1%	82%	0%	0.7549	100%	0%	3.7287	63%	0%
Pure Floor	-1.7765	26%	74%	2%	22%	-1.0291	5%	31%	-2.6665	3%	8%
Interaction	-3.6564	7%	93%	1%	59%	-2.1096	0%	79%	-2.6856	3%	30%
Int: FB & System	1.6793	85%	15%	36%	2%	1.0450	49%	3%	-0.3621	18%	5%
Int: Spec & System	2.6115	88%	12%	42%	1%	1.0941	36%	0%	1.6588	33%	3%
Int: Floor-initiated	1.5100	78%	22%	53%	6%	3.7448	97%	0%	-4.1073	10%	18%
Int: System-initiated	0.0580	31%	69%	4%	22%	-1.5735	0%	64%	2.7269	8%	8%
Direct+	4.1850	92%	8%	77%	1%	1.9728	97%	0%	8.6777	50%	3%