The Economic Value of a Trading Floor:
Evidence from the American Stock Exchange

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Abstract

This paper provides evidence that floor brokers add value that helps offset the higher cost of accessing the trading floor, making it a desirable venue for orders requiring more careful handling. We compare execution costs of non-block trades handled by Amex floor brokers with trades entered through its automated Post Execution Reporting (PER) system. Essentially, because floor traders can opportunistically seize liquidity without showing their hands too quickly, using a floor broker is equivalent to placing a "smart" limit order." Overall, floor trades have a lower realized half-spread than PER trades (-3.06 bps versus 4.43 bps). This finding holds for other measures of execution costs as well and is consistent across all order-size categories. The light our findings shed on the value of intermediation in security markets also has implications for automated trading systems.

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I. Introduction

In recent years, the trend in equity market structure has been away from floor based trading to automated floor-less trading systems.[1] But the two national U.S. stock exchanges, the New York Stock Exchange and the American Stock Exchange, still have trading floors. Is this the result of technological inertia and vested interests, or does the floor have economic value? Our objective in this paper is to assess the economic *raision d'être* of a trading floor. To this end, we examine trades on the floor of the American Stock Exchange (Amex) and contrast them with trades on Amex's automated Post Execution Reporting (PER) system. We find evidence of intelligent order handling by floor traders which results in reduced execution costs that may offset the higher handling costs of floor trades.[2]

Microstructure economists have in the past paid scant attention to the economic value of a trading floor. [3] Some have simply thought the floor archaic in an electronic environment where participants can work with a bank of computer screens far more easily on the upstairs

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[1] The Toronto Stock Exchange closed its trading floor in May 1997. The London Stock Exchange, which has been floor-less since Big Bang in 1996, introduced an electronic limit order book into its quote driven market in 1997. Nasdaq is currently planning to do the same. Floorless, electronic continuous trading now characterizes the equity markets of Toronto, Paris, Tokyo, Stockholm, Sidney, Switzerland, Madrid, Frankfurt and elsewhere. In the U.S., new alternative trading systems (commonly referred to as ATSs) and Electronic Communications Networks (ECNs) are also electronic, order driven systems.

[2] It is important to assess liquidity impact costs in light of studies such as Amihud and Mendelson (1986), Brennan and Subrahmanyam (1996), and Amihud, Mendelson and Lauterbach (1997), among others, that have provided evidence of a liquidity premium in asset pricing.

[3] Past research has largely focused on comparing execution costs across various market structures such as auction versus dealer markets. See, for example, Huang and Stoll (1996), Bessembinder and Kaufman (1997) and Venkatraman (2001).

desks than on the trading floor where space is at a premium.[4] Presumably, the computerization of information dissemination would give electronic trading a strong informational advantage vis-à-vis a floor. Nevertheless, Sofianos and Werner (1997), in their analysis of floor broker participation on the NYSE, find that floor brokers do contribute additional liquidity. Pagano and Röell (1992) point out a further advantage of a floor-based trading system: it gives participants "the opportunity to observe who trades what with whom, how urgently they seem to want to trade, etc." (p. 619). There are a number of other ways in which a floor trader may add value: (a) the trader might obtain knowledge of the presence of a contra party, mitigating price impact, (b) the trader could "round up" multiple counter parties, again cushioning the impact by trading in what may be viewed as a spontaneous call auction, (c) the trader could anticipate periods when liquidity is high and trade more often and in larger sizes during such periods, (d) the trader could avoid trading in periods when trading is low, and (e) the trader may possess superior ability to read momentum in the market and to time trades accordingly.

A potential drawback of trading via the floor is that handling costs are higher for orders worked on the floor than for orders delivered electronically through PER, and the fixed cost component may be appreciable.[5] Consequently, the floor may be an attractive venue for large, predominantly institutional participants who are concerned with controlling market impact. PER, on the other hand, may be attractive to small, predominantly retail participants whose orders are not large enough to have market impact or to justify the higher fixed cost component of floor-based order handling.

In this paper, we focus on comparing execution costs across the two venues (PER and the floor) for orders in the same stock matched by stock and trade characteristics such as execution price, order size and trade direction. We restrict ourselves to measuring implicit costs of

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[4] Saul Hansell in the *New York Times*, March 16, 1998 wrote, "To compete with electronic markets, the New York Stock Exchange is giving traders on its floors all manner of hand-held computer and communication devices. 'The typical broker on the floor is starting to look like a space cadet,' said Greg Kipness..." (page D5).

[5] Explicit commission costs are typically higher for orders that are harder to handle. The fixed cost component is implicit in the fact that a customer must maintain a higher trading volume over time in order for the services of a floor broker to be readily available.

execution such as realized spreads, quoted spreads and effective spreads.[6]   We employ a matched pair technique to control for the self-selection of trades submitted to the floor or to PER by investors, thereby allowing for a more meaningful comparison of execution costs across the two venues.

In our data set (October, 2001 Trade and Quote Data for 973 Amex stocks), 23.40% of the trading volume was initiated by floor brokers. Using the matched pair technique, we find that floor broker timed order handling generally results in lower execution costs. Overall, trades handled by floor brokers have a significantly smaller realized half-spread than do PER trades (-3.06 basis points versus 4.43 basis points). It is interesting to note that the realized half-spread for floor trades is actually negative. The contrast holds for all trade size categories in our sample. In addition, floor trades have a lower effective half-spread compared to PER trades (8.11 basis points versus 10.27 basis points). Finally, the quoted half-spread is also lower when floor orders initiate trades than when PER orders initiate trades (16.23 basis points versus 17.47 basis points). These differences are all statistically significant at the 1% level of significance and are economically meaningful.

Our finding of a lower realized spread for floor trades is robust to controls for the information content of a trade. In specific, we extend the matched pair technique to control for permanent price effects, and continue to find that execution costs are lower on the trading floor. We also examine execution costs for SPDRs (Standard and Poors Depository Receipts), a security that is not subject to information asymmetries. Our findings on SPDRs provide strong confirmation that the execution cost differentials are driven by the relative efficiency of order handling on the floor, rather than by information asymmetries.

We examine the determinants of trade initiation on the floor vs. PER using a probit analysis. Our findings are that the floor trading mechanism is preferred for larger sized trades, on occasions when the order flow is in the direction of the initiating trade (but not following a

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[6] There may be other implicit costs of order handling such as the cost of delayed execution or non-execution that are beyond the scope of this study. In that sense our analysis may be viewed as comparing execution costs across

recent large price change) during morning and late afternoon hours, and for less liquid stocks. We further examine the determinants of execution costs on the trading floor by modeling a floor trader's decision to trade that accounts for the potential selectivity bias in the data.[7] Our major findings are that the execution costs are lower for trades initiated in the direction of the order flow, but are higher for trades following large price changes. Together, these findings suggest that floor traders exhibit strategic behavior, becoming more aggressive in response to a thickening of the book on their own side, and becoming more patient following large pre-trade price changes. It thus appears that floor traders can opportunistically seize liquidity without showing their hands too quickly and that, consequently, using a floor broker is equivalent to placing a "smart" limit order." This implies a standard that electronic trading must meet in order to provide an environment that, from the point of view of institutional investors, is competitive with the trading floor. Currently, an increasing number of institutional investors have their own DOT machines and smart order handling systems, and are thereby able, to a limited extent, to handle their orders strategically from their upstairs desks, as they would be worked on the trading floor.[8]

In the next section of this paper, we consider order handling mechanisms and price determination in an electronic continuous trading system vs. a floor based continuous market. In Section III, we describe the data and methodology used for the study. In Section IV, we present our empirical results. Section V contains our conclusions.

II. Order handling and price formation

Standard limit and market orders are delivered to the Amex specialists through the Amex's Post Execution Reporting (PER) system. Market orders sent in electronically over PER typically trigger trades immediately. They are directly routed to the specialist who may execute them at

two venues conditional on trade execution.

[7] For further discussion of this approach, see Maddala (1996).

the prevailing quote or at an improved price within the quote. Some large institutional investors have DOT machines on their trading desks and send in system orders that are market timed. Predominantly, however, this is not the case.

In contrast, an order may be given to a floor broker to be worked on a "not held" (NH) basis. The order is called "NH" because the broker is "not held" to the price existing at the time of the order's arrival if he or she eventually fills the order at a worse price. Price limits are commonly placed on NH orders. Within these limits, a floor broker has the discretion to market time an NH order. Large floor orders are commonly broken up and presented to the market in smaller tranches in the hope of obtaining more favorable market conditions and in an attempt to minimize price impact.

Having an NH order worked on the floor of an exchange may have important benefits for the investor. By responding to market events as they occur, a floor broker can better control two polar opposite implicit execution costs: (i) the market impact cost of trading a large order too aggressively, and (ii) the opportunity cost of trading it too patiently. One might also use a floor broker to gain access to, and to profit from, the agent's superior information about latent order flow.

Comprehensively viewed, the key service provided by floor traders is the timing, sizing, and pricing of the tranches of an order. We expect floor brokers to time NH orders according to current market conditions. This may, in fact, be an important reason why investors submit orders to the floor. In other words, it may be more difficult to work such orders away from the floor.

The time an order is actually submitted is not observable from our data. Floor traders disclose neither the time an order is received nor the full size of the order. Our tests focus on the liquidity impact cost at the time when part or all of an order triggers a trade. It would be of some

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[8] DOT (the NYSE's Designated Order Turnaround system) routes orders directly to specialists' posts on the NYSE trading floor and to the Amex's PER system which brings the orders for Amex stocks to the Amex specialists' posts.

interest to examine the spreads prevailing in the market at the time an order is placed but, unfortunately, we are not able to do so. Because floor orders are commonly broken up and presented to the market in smaller tranches, the "full order" that was initially submitted is generally larger than the "tranche" that triggers a trade at any point in time. This is of no serious consequence for our analysis; we consider the initial order a package of smaller orders, and focus on the timing of the tranches as they are revealed to the market and turned into trades.

III. The Data and Test Design

A. Data

Our analysis uses October, 2001 non-block trade and quote data for 973 Amex stocks. For each stock (ticker symbol), for each day, we have: (i) *the quote file* (for each posted quote, the time of the posting, the posting exchange, the bid price posted, the size of the bid, the ask price posted, and the size of the ask); and (ii) *the trade file* (for each trade, the time the trade was reported executed, identification code for the buy account, the quantity purchased, identification code for the sell account and the quantity sold).

In order to classify trades, we first re-construct the National Best Bid and Offer (*NBBO*)[9] from the quote file, which is updated each time a new quote is posted by an exchange. In re-constructing the *NBBO*, we adhere strictly to the Consolidated Tape Association's price, size and time priority rules. We follow tradition by using the Lee-Ready algorithm to infer the initiating party.[10] Hence, our master data file contains trades arranged in chronological order and

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[9] The NBBO consists of the best prevailing bid, the size of the best bid and the exchange posting best bid, and similarly the best prevailing ask, the size of the best ask and the exchange posting the best ask.

[10] The Lee-Ready rule is that if the trade execution price is below the average of the prevailing NBBO bid and ask (the mid-quote), we classify it as buyer-initiated, and if the trade execution price is above the mid-quote we classify it as seller-initiated. If a trade occurs at the mid-quote, we use the tick test: if the execution price occurs on a plus tick or a zero-plus tick (i.e., it is higher than the last non-identical execution price), the trade is classified as buyer initiated, and if the execution price occurs on a minus tick or a zero-minus tick, the trade is classified as seller initiated.

identified as buyer or seller initiated, the source of the initiating order (floor versus PER), and the *NBBO* at the time of trade execution.

We are concerned about strategic order splitting by traders and its affect on our measure of execution cost. We measure market impact by the price adjustment that occurs after a trade. Because order splitting can impact prices after a floor trade *t*, it can bias our measure of the market impact of the order that triggered trade *t*. We have information on broker identification. Thus, we eliminate possibly split trades by using the following heuristic rule: for each trade *t*, we examine the fifteen trades immediately following it. If a trade during this fifteen-trade interval has the same clearing firm on the same side of the trade as trade *t*, it is identified as a "split" trade. If trade *t* has more than three "split" trades during the following fifteen-trade interval, we eliminate it from the sample. Our analysis is based on this reduced sample of trade observations.

B. Measuring Execution Costs

Consistent with previous studies [for example, Bessembinder and Kauffman (1997); Huang and Stoll (1996)], we measure the quoted half-spread and the effective half-spread for floor trades and PER trades. Consistent with standard practice, the quoted half-spread is defined as one-half of the ratio of the bid-ask spread to the prevailing midquote. The quoted half-spread is an appropriate measure of execution cost only if trades are assumed to occur at the posted quotes. However, it is not appropriate if trades occur away from the quotes.

The relevant measure in the latter case is the effective half-spread which is usually defined as the ratio of the difference between the execution price and the prevailing midquote, to the midquote. The effective half-spread is an accurate measure of the revenue realized by the liquidity provider (and hence, the cost incurred by the liquidity demander) if the value of the asset is unchanged following the trade. However, there is evidence in the literature that the asset value moves in the direction of the trade following the trade [Hasbrouck (1988), Huang and Stoll (1994)]. In other words, the price increases following a market buy and declines following a market sell. Accordingly, a more accurate measure of the execution cost is the realized half-spread, which is sometimes referred to as the temporary price impact.

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Following Huang and Stoll (1996) and Bessembinder and Kaufman (1997), we define the realized half-spread for trade t for stock i as the negative of the logarithmic return from the transaction to the mid-quote at the time of the fifteenth trade after the transaction. [11]

C. Matched Pair Sampling Technique

Our objective is to compare execution costs across the two trading venues, floor and PER. There are, of course, exogenous factors such as stock specific characteristics, order size, trade direction (buy or sell), among others, that impact execution costs. To control for these factors we use a matched pair sampling technique. For each floor trade, we try to locate a matching PER trade. The matching criteria are: (1) trades must be in the same stock, (2) trades must be in the same direction (buy or sell), (3) the execution price of the PER trade must be within 20% of the price of the floor trade, and (4) the size of the PER trade must be within 20% of the size of the floor trade.[12] We present our empirical results by categorizing trades into four groups: trades less than 500 shares, trades between 500 and 999 shares, trades between 1000 and 1499 shares and trades between 1500 and 9999 shares.

D. Determinants of Trade Initiation on Floor vs. PER

Our hypothesis is that trades executed on the floor are strategically timed to account for order characteristics and to coincide with market conditions that reduce execution costs. We first focus on understanding the determinants of trade initiation on the two venues. Theoretical research on order submission strategies suggests two variables that may be of particular relevance to our study. The first explanatory variable, *order size*, is suggested by theoretical models such as Easley and O'Hara (1987). The second explanatory variable, *order imbalance*, is suggested by market microstructure models such as Kyle (1985) and Admati and Pfleiderer

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[11] Our definition of temporary price impact incorporates one-half of the spread prevailing at the time of trade execution, a component that we refer to as the spread-related component of price impact. As a test of robustness, we also measured temporary price impact using the mid-quote for trade t to assess the component that is not spread related. The results were generally consistent with the findings reported here.

[12] A similar matched pair technique is also used by Venkatraman (2001) and Conrad et al. (2001).

(1988). Glosten and Harris (1988), Madhavan, Richardson and Roomans (1997) and Huang and Stoll (1997) provide evidence that trade indicator variables (buyer-initiated and seller-initiated trades) also explain intra-day price movements.

To obtain a measure of order imbalance for a trade t, we begin by dividing each day into 15-minute intervals. Order imbalance for trade t is the aggregate trading volume triggered by orders on the same side of the market (as the order that triggered trade t) relative to total trading volume in the stock over the contemporaneous 15-minute interval.[13] To ensure that the measure is not contaminated by a trader's own trading volume in that 15-minute interval, in computing the imbalance we eliminate all trades that the same trader participates in during that period. Hence, we define the order imbalance for trade t as

$$Imb_t = \frac{Own\text{-}side\ 15\text{-}minute\ trading\ volume}{Total\ 15\text{-}minute\ trading\ volume}$$

For trading intervals during which no trades are recorded for a stock we set Imb_t equal to 0.50.

It is possible to identify other variables that may affect the order submission strategy. For example, implementing a momentum strategy requires that one react more aggressively to price changes compared to a value strategy. [14] Hence, recent price changes may be a relevant factor in our analysis. We capture this by incorporating the pre-trade price change as an explanatory variable in our model. Additionally, the time of day may influence order placement. In particular, as the afternoon progresses, we expect to see participants stepping forward to trade because they do not want to risk carrying unfilled orders into the overnight period. We control for the time of the day effect by dividing the trading day into three periods; an opening period

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[13] Our results are robust to several alternative measures of *order imbalance*. For example, we also examine the ratio of the depth on own side of the book to the total depth at the both prevailing inside quotes. Our concern with the latter measure is that it could be corrupted by the possibility of the floor trader's own order being reflected in the quotes. Nevertheless, the two measures gave very similar results. We also found that changing the length of the window over which imbalance is measured to 5 minutes does not materially alter our results.

[14] We thank the referee for this suggestion.

(9:30 AM to 10:00 AM), a mid-day period (10:00 AM to 3:30 PM), and a closing period (3:30 PM to 4:00 PM).

We formally model the probability of a trade occurring on PER as follows:

$$\Pr(y_t = 0) = \Phi(\theta' z_t)$$

(1)

where $\theta' z_t = \theta_0 + \theta_1 q_{1t} + \theta_2 q_{2t} + \theta_3 q_{3t} + \theta_4 Imb_t + \theta_5 Preret_t + \theta_6 D_{1t} + \theta_7 D_{2t} + \theta_8 Vol_t$

The variable q_{1t} is a binary indicator variable that takes a value of 1 if the order size is between 500 and 999 shares and zero otherwise, q_{2t} takes a value of 1 if the order size is between 1000 and 1499 shares, and q_{3t} takes a value of 1 if the order size is between 1500 and 9999 shares. The variable Imb_t captures the trading imbalance in the market, taking a value closer to zero (one) when there is less (more) trading interest on the side of the initiating trade. The variable $Preret_t$ is defined as the absolute value of the return from the mid-quote prevailing fifteen trades prior to trade t, to trade t. The variable D_{1t} is a binary indicator variable that takes a value of 1 if the trade occurs between 9:30 AM and 10 AM and zero otherwise, and D_{2t} takes a value of 1 if the trade occurs between 3:30 PM and 4 PM and zero otherwise. The variable Vol_t is the logarithm of the average daily trading volume during October 2001 for the stock being traded.

E. Determinants of Execution Costs with Endogenous Trade Initiation by Floor Traders

We now turn to an analysis of the determinants of execution costs for floor trades when floor traders may time orders to minimize realized costs. To handle the potential selection bias in the data, we model the traders' decision to initiate trades, i.e., the decision to submit or withhold an order given the order characteristics and market conditions. Our model follows the standard treatment of cases involving selection bias with an endogenous event.[15] It is similar in spirit to Madhavan and Cheng (1997) who use an endogenous switching regression model to study the price impact of block trades across two venues, namely, the upstairs market and the

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[15] See Maddala (1996) for examples of such applications in Finance.

downstairs market. Both models represent the treatment of cases where data are generated by the self-selection of traders, i.e., by the endogenous choices made by the traders. However, there are important differences. Madhavan and Cheng model the choice of the appropriate venue by an agent and use a two-stage procedure to estimate the model by using data on block trades executed on both venues. In contrast, we analyze the determinants of the realized half-spread for floor trades by modeling a floor trader's decision to execute trades selectively. Since we use data on executed floor trades, two-stage estimation methods are not appropriate in our context. Accordingly, we use the maximum likelihood method to estimate our model.

In our model, the floor trader's decision to initiate trades is dependent on the expected realized half-spread of a trade. Consider a trader who initiates trade t (for simplicity, let t also denote that trader) and who faces a realized half-spread r_t^f. We express the realized half-spread as:

$$r_t^f = \beta_0^f + \beta_{11}^f q_{1t} + \beta_{12}^f q_{2t} + \beta_{13}^f q_{3t} + \beta_2^f Imb_t + \beta_3^f Preret_t + \beta_{41}^f D_{1t} + \beta_{42}^f D_{2t} + \beta_5^f Vol_t + \varepsilon_t^f$$

(2)

where ε_t^f is a stochastic error term with variance σ^2. The explanatory variables are as defined under equation 1. The order size indicator variables q_{it} control for the variations in realized half-spread related to the size of the order that the market has to absorb. The order imbalance variable Imb_t controls for variations in execution costs relative to the costs of waiting. The variable $Preret_t$ controls for the impact of recent price changes on order placement. The time-of-day indicator variables D_{1t} and D_{2t} account for intra-day effects. The variable Vol_t is a proxy measure of the general level of liquidity of the stock and is expected to be an important determinant of the execution cost.[16]

Note that equation (2) could not be estimated using standard OLS procedures if floor traders endogenously time their trades. In this case, the data would be subject to a selectivity

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[16] There are other possible proxies of a stock's liquidity such as price level, value of shares outstanding, etc. In our tests we found these variables to be highly correlated with a stock's trading volume.

bias. Hence, the OLS procedure would yield inconsistent parameter estimates since the conditional means of the observed error terms in equation (2) would be non-zero.

We expect a floor trader to initiate a trade if and only if the expected realized half-spread is below a threshold level.[17] We define the latent variable y_t^* as the expected difference between the realized half-spread for trader t and the threshold value c_t:

$$y_t^* = E\left[\left(r_t^f - c_t\right)\middle|\Omega_t\right] + \xi_t \tag{3}$$

where Ω_t is the information set for trader t and ξ_t denotes an error term with variance normalized to 1. We can write the above equation in compact form as:

$$y_t^* = \gamma' z_t + \xi_t \tag{4}$$

where z_t is the vector of explanatory variables outlined in equation (1), and γ is the vector of coefficients.[18] Floor trader t chooses to step forward with an order if $y_t^* \leq 0$, otherwise the trader withholds the order. Let y_t represent a variable that takes the value 1 if the trader chooses to trade and takes the value 0 otherwise. Hence, the observable variable is:

$$y_t = \begin{cases} \mathbf{1} & \text{if } y_t^* \leq 0 \\ \mathbf{0} & \text{if } y_t^* > 0 \end{cases} \tag{5}$$

We assume that $\left(\varepsilon_t^f, \xi_t\right)$ are jointly normally distributed with means zero and covariance matrix Σ, where:

$$\Sigma = \begin{bmatrix} \sigma^2 & \rho\sigma \\ \rho\sigma & 1 \end{bmatrix} \tag{6}$$

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[17] The threshold value can be viewed as a constant. A more general interpretation is possible, however. It can be viewed as the cost of waiting to trade later and hence, as a function of the order characteristics and market conditions at the time of the decision. The model estimates are unaffected by the interpretation.

Using the properties of the normal distribution, we can write the expected realized half-spread conditional on observing a floor trade as:[19]

$$E\left(r_t^f \middle| y^* \le 0\right) = \beta_0^f + \beta_{11}^f q_{1t} + \beta_{12}^f q_{2t} + \beta_{13}^f q_{3t} + \beta_2^f Imb_t + + \beta_3^f Preret_t +$$
$$\beta_{41}^f D_{1t} + \beta_{42}^f D_{2t} + \beta_5^f Vol_t + \rho\sigma\left[\frac{-\phi(\gamma' z_t)}{1 - \Phi(\gamma' z_t)}\right]$$
(7)

Re-writing equation (7) in compact notation, we get:

$$E\left(r_t^f \middle| y^* \le 0\right) = X_i\beta + \rho\sigma\left[\frac{-\phi(\gamma' z_t)}{1 - \Phi(\gamma' z_t)}\right]$$
(8)

where ϕ and Φ are, respectively, the density function and the cumulative distribution function of the standard normal (evaluated at $\gamma' z_t$) and ρ is the correlation between ε_t^f and ξ_t. Note that in the absence of self-selection of orders by the traders, ρ would be equal to zero. This allows us to test the null hypothesis that traders do not time their orders.

We use data on executed floor trades for our analysis. Equation (8) is estimated by maximizing the following likelihood function that takes into account the truncated nature of the data:[20]

$$L = \prod_i \left[\Phi(-Z_i\gamma)\right]^{-1} \frac{1}{\sigma} \exp\left[-\frac{1}{2\sigma^2}(y_i - X_i\beta)^2\right] \times \Phi\left(\frac{-[Z_i\gamma - \rho(y_i - X_i\beta)/\sigma]}{(1 - \rho^2)^{1/2}}\right)$$
(9)

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[18] In other words, $\gamma' z_t = \gamma_0 + \gamma_1 q_{1t} + \gamma_2 q_{2t} + \gamma_3 q_{3t} + \gamma_4 Imb_t + \gamma_5 Preret_t + \gamma_6 D_{1t} + \gamma_7 D_{2t} + \gamma_8 Vol_t$

[19] See Maddala (1983)

[20] For details, please see pages 266-267, Maddala (1983).

IV. Results

A. Characteristics of Trades Executed on the Amex

Table 1 presents descriptive statistics for the trades in the sample we have analyzed. Overall, the volume of trades initiated on the floor is 110,489,600, accounting for 23.40% of the total volume. Trading volume initiated on PER accounts for 361,739,540 shares traded, or 76.60% of total volume. In addition to the 23.40% trading volume reported in Table 1 that is initiated on the floor, there is an additional 10.39% trading volume in which the trading floor is a passive participant. It is clear that the trading floor is an attractive venue for many non-block trades. Henceforth, we refer to trades initiated on the floor as floor trades and those initiated on PER as PER trades. We classify trades into four categories according to the number of shares transacted at the trade: (i) less than 500 shares, (ii) between 500 and 999 shares, (iii) between 1000 and 1499 shares, and (iv) between 1500 and 9,999 shares.

For trades less than 500 shares, floor trades account for only 3.96 million shares (0.84% of total trading volume) and PER trades account for 58.54 million shares (12.40% of total trading volume). The average size of floor trades in this category is 283.76 shares. For PER trades, the average size is slightly smaller at 250.54 shares. As may be seen from the last panel of Table 1, the average time spanned by the thirty trades surrounding a typical trade of less than 500 shares is 30.54 minutes. For floor trades, this time span is marginally more than the time span for PER trades.

There are 73.47 million shares traded in the 500-999 trade size category. Floor trades account for 8.50 million shares (1.80% of the total trading volume) while PER trades account for the remainder 64.97 million shares (13.76% of total trading volume). The average size of floor trades is 905.19 shares. For PER trades, the average size is again slightly smaller at 882.46 shares. The average time spanned by the thirty trades surrounding a typical trade of between 500 shares and 999 shares is 26.07 minutes.

There are only 27.48 million shares traded in the 1000-1500 trade size category. Of these, floor trades account for 4.72 million shares (1.00% of total trading volume) while PER trades account for 22.77 million shares (4.82% of total trading volume). As in the other

categories, PER trades are smaller-sized with an average of 1346.59 shares compared to floor trades (1358.08 shares). The average time spanned by the thirty trades surrounding a typical trade in this category is 27.74 minutes.

Finally, for the trades between 1500 and 9999 shares, floor trades account for 93.31 million shares (19.76% of total trading volume) and PER trades account for 215.46 million shares (45.63% of trading volume). The average size of floor trades of between 1500 shares and 9999 shares is 4038.46 shares. For PER trades, the average size is considerably smaller at 3366.31 shares. The average time spanned by the thirty trades surrounding a typical trade in this category is only 21.34 minutes.

B. Evidence on execution costs

Table 2 presents our measures of execution costs for a matched sample of floor and PER trades. Using the matching criteria discussed in Section III C, we were able to find a matching PER trade for 48,471 floor trades out of a total of 49,940 floor trades (i.e., 97.06%). The matching procedure led to a close match between the trade pairs. Namely, the mean difference in trade execution price between the pairs was 7.04% with a median difference of 5.26%, and the mean difference in trade size between the pairs was 7.09% with a median difference of 2.44%. We present evidence on the following measures of execution cost: the quoted half-spread, the effective half-spread and the realized half-spread. The trades are classified into four trade size categories: less than 500 shares, 500 - 999 shares, 1000 – 1499 shares and 1500 - 9999 shares.

Panel 1 of the table presents evidence on the quoted half-spread. Overall, the floor trade sample has an average quoted half-spread of 16.23 basis points as compared to 17.49 basis points for the matched PER trade sample. The difference of -1.24 basis points is significant at the 1% level of significance. In terms of trade size categories, the quoted half-spread is significantly lower for floor trades in all of the categories. The difference varies from -0.84 basis points for large trades to -2.56 basis points for the 1000-1499 shares category.

As stated earlier, the quoted half-spread reflects the true execution cost only if trades occur at the quotes. In panel 2, we present evidence on the effective half-spread. The effective

half-spread is consistently lower for floor trades across all categories, and averages 8.11 basis points as compared to 10.27 basis points for a matched sample of PER trades. The difference of negative 2.16 basis points is significant at the 1% level of significance. It varies from -1.57 basis points for large trades to -2.89 basis points for the 500-999 shares category. It is significant at the 1% level for all cases.

In panel 3, we present evidence on the realized half-spread. As discussed previously, the realized half-spread is the most appropriate measure of the compensation realized by a liquidity provider, and hence, the cost to a liquidity seeker. The realized half-spread is consistently lower for floor trades, averaging -3.06 basis points compared to 4.43 basis points for the matched sample of PER trades. The difference of -7.49 basis points is significant at the 1% level. This difference is negative and significant for each of the trade-size categories. It is interesting to note that the realized spread on floor orders is consistently negative for all trade categories. This suggests that, with effective order handling, trading gains may be realized instead of market impact costs being incurred.

At this stage it is worthwhile to ask whether the differences in execution costs across the two venues are economically meaningful. To assess this issue we can compare the difference in execution costs to the mean quoted half-spread of 16.85 bps in our matched sample. The differences in realized half-spreads reported in Panel 3 translate to between 36.38 percent and 57.63 percent of the mean quoted half-spread. This suggests that differential execution costs are appreciable, and that trading on the more expensive venue can aggregate into major dollar costs for investors. Alternatively stated, bringing orders to the floor can generate savings that justify the higher fees that floor access involves.

The evidence on realized half-spreads is consistent with the hypothesis that floor traders time their orders to minimize execution costs, by buying (selling) at times of rising (falling) stock prices. This would explain why, in equilibrium, some trades would be submitted to the trading floor in spite of higher access costs (that are not measured in this study). An alternative interpretation of these findings is that floor trades have higher information content. In the next section, we seek to distinguish between these two hypotheses.

C. Evidence on Execution Costs of Trades with Similar Information Content

We refine our matching technique to control for the information content of trades. Specifically, we expand the matching criteria to include a control for the Permanent Price Impact of a trade defined as:

$$Permanent\ Price\ Impact = D_{it} \cdot \left[\ln \left(\frac{M_{+15}}{M_{-15}} \right) \right]$$

where D_{it} is an indicator variable that is equal to +1 for buyer-initiated trades and is equal to –1 for seller-initiated trades, and M_{+15} (M_{-15}) refers to the mid-quote prevailing at the time of the fifteenth trade after (before) trade *t*. The permanent price impact is a measure of the information content of a trade (see, for example, Kraus and Stoll (1972), and Madhavan and Cheng (1997)).

In addition to the previous matching criteria, we now require the permanent price impact of PER trades to be within 20% of the permanent price impact of floor trades. With this constraint we obtain matching PER trades for 45,536 floor trades (i.e., 91.18% of all floor trades). The mean difference in the trade execution price between the pairs is 6.79% with a median difference of 5.69%. The mean difference in trade size between the pairs is 6.70% with a median difference of 0. Finally, the mean difference in permanent price impact between the pairs is 9.66% with a median difference of 9.64%.

We present measures of the execution cost for this reduced sample of matched trades in Table 3. The first panel in the table presents the quoted half-spreads for the matched sample of floor trades and PER trades classified by four trade size categories. The average quoted half-spread for floor trades is 14.53 basis points as compared to 15.38 basis points for PER trades. The difference of –0.85 basis points is significant at the 1% level. Additionally, floor trades have significantly lower quoted half-spreads for each of the four trade-size categories.

Results on effective half-spreads are presented in the second panel of the table. Similar to the results for the full sample in Section 3.2, effective half-spreads for floor trades average

7.13 basis points as compared to 8.94 basis points for the matched sample of PER trades. The difference of -1.81 basis points is significant at the 1% level of significance. Also, it is significantly negative for all the trade size categories, varying from -1.15 basis points for the large trade category to -2.64 basis points for the 500-999 share category.

In the third panel of the table, we present results on the realized half-spreads. Overall, realized half-spreads for floor trades average -4.21 basis points as compared to -0.09 basis points for PER trades. The difference of –4.12 basis points is significant at the 1% level of significance. The difference is significantly negative for individual trade size categories. Once again, realized spreads are negative for floor trades in all trade size categories, varying from -2.88 basis points for large trades to -6.68 basis points for the 1000-1499 share category. Also, the realized spread is negative for the PER small trades at -2.55 basis points.

Overall, the results for the sample where we control for the permanent price impact are similar to the results for the full sample. We note, however, that, with just one exception, for all three half-spread measures and four size categories for both floor and PER orders, the half-spread values are somewhat smaller when we control for the permanent price impact. A higher information content of floor trades could account for this. Nevertheless, all measures of execution costs shown in Table 3, including the quoted half-spread, the effective half-spread and the realized half-spread, are significantly lower for the floor trades. This suggests that we can rule out information differences as the main reason for the lower realized half-spreads for floor trades. We further test the information content hypothesis by focusing on SPDRs, a security for which we expect no meaningful informational asymmetries.

D. Evidence on Execution Costs of Trades for SPDRS

The Amex's SPDRs (Standard and Poors Depository Receipts) are an exchange traded fund (ETF), that is potentially subject to little or no information asymmetry.[21] A SPDR represents an ownership interest in the SPDR trust that holds all of the S&P 500 composite stocks, and is a highly liquid alternative to the S&P index mutual funds. SPDRs offer us an opportunity to compare execution costs across the floor and PER in a setting that is largely devoid of private information. A finding that execution costs are different across the two venues for SPDR trades would further confirm the hypothesis that these cost differentials are driven by the relative efficiency of order handling in the two venues, rather than by informational asymmetries.

Table 4 presents the evidence on execution costs for SPDRS. The first panel in the table presents the quoted half-spreads for the matched sample of floor trades and PER trades classified by four trade size categories. The average quoted half-spread for floor trades is 3.93 basis points as compared to 4.01 basis points for PER trades. The difference of –0.08 basis points is not significant. Floor trades have lower quoted half-spreads for the larger trade size categories but a higher quoted spread for the less than 500 share trade size category. Even though the differences in these two categories are statistically significant, they do not appear to be economically meaningful.

Results on effective half-spreads are presented in the second panel of the table. Effective half-spreads for floor trades average 0.95 basis points as compared to 2.23 basis points for the matched sample of PER trades. The difference of –1.27 basis points is significant at the 1% level. Also, it is significantly negative for each of the individual trade size categories.

In the third panel of the table, we present results on the realized half-spreads. Overall, realized half-spreads for floor trades average -0.09 basis points as compared to 2.06 basis points

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[21] SPDRs are now also traded on the NYSE.

for PER trades. The difference of –2.16 basis points is negative and significant at the 1% level. Also, the difference is consistently negative and significant at the 1% level across all trade size categories. To benchmark these results, note that the mean quoted half-spread in our matched sample is 3.97 bps. Hence, the differences in realized half-spread that we report in Panel 3, range from 47.36 % to 70.03% of the mean quoted half-spread.

In contrast to our full sample of stocks, the quoted half-spreads and effective half-spreads for SPDRS are substantially smaller across the board. This is also true for the realized half-spread for SPDR PER trades (though not for floor trades). This finding is consistent with the absence of any meaningful informational asymmetries for SPDRs. Despite absence of information asymmetries, we observe differences between the execution costs of floor and PER trades reported in Table 4 that are consistent with our earlier findings. This strongly suggests that the trading floor offers the advantage of lower execution costs through improved order handling.

E. Evidence on Determinants of Order Arrival on Floor vs. PER

We present below the probit estimates based on equation (1) (chi-square statistics are in parenthesis):

$$
\begin{aligned}
\theta'z_t = &\ 0.9031 \ - \ 0.4037 \ q_{1t} \ - \ 0.6578 \ q_{2t} \ - \ 1.0240 \ q_{3t} \ - \ 0.2094 \ Imb_t \\
&\ (3106.60) \ \ (3220.58) \ \ \ \ (3420.17) \ \ \ \ \ (26378.8) \ \ \ \ \ \ (662.25) \\
&+ \ 6.0362 \ Preret_t \ -0.0093\,D_{1t} \ -0.0207\,D_{2t} \ + \ 0.0864 \ Vol_t \\
&\ \ (280.20) \ \ \ \ \ \ \ \ \ \ \ (1.14) \ \ \ \ \ \ (5.39) \ \ \ \ \ \ (2795.18)
\end{aligned}
\tag{10}
$$

Log Likelihood = -140988.0619

The coefficients on the three order size indicator variables are all significantly negative, indicating that larger sized orders have a lower probability of being executed on PER and, therefore, a greater probability of execution on the floor. The coefficient on the variable Imb_t is significantly negative, suggesting that, as own-side order imbalance increases, there is a lower probability of a PER trade and, correspondingly, a higher probability of a floor-based trade. The co-efficient on the variable $Preret_t$ is significantly positive, indicating that a PER trade is more

likely following a large pre-trade price change. The findings on Imb_t and $Preret_t$ imply that floor traders observe and react to order imbalance and that floor trades are more likely when there is more interest on the side of the initiating trade. At the same time, floor traders appear to be relatively patient and to avoid trading after large pre-trade price changes. Later on we show that this behavior is consistent with minimizing execution costs. Conversely, PER traders appear more apt to chase price changes (i.e., to engage in momentum trading), which may explain our earlier findings of higher realized half-spreads for PER trades.[22]

The morning time-of-day indicator variable (D_{1t}) has a negative but insignificant co-efficient, and the late afternoon time-of-day indicator variable (D_{2t}) has a significantly negative co-efficient. This indicates that, relative to mid-day, floor trades are more likely in the morning and afternoon. There are two factors at play here: (1) there is evidence that the markets are more liquid during the morning and afternoon hours than during mid-day [see, for example, Jain and Joh (1988)], and (2) floor traders who may be willing to be patient earlier in the trading day, are more apt to step forth and trade as the closing bell approaches so as to avoid carrying an open position into the overnight period.

Finally, the coefficient on average trading volume is significantly positive, implying that the probability of a PER trade increases with the average trading volume of the stock (that is a measure of the stock's liquidity). Conversely, for a given order size, a less liquid stock that requires more special order handling is more likely to be traded via the floor.

In sum, the probit estimates suggest that the floor trading mechanism is preferred for larger sized trades, on occasions when the book is thicker on the side of the trade initiating order (but not following a recent large price change), during the late afternoon hours and for less liquid stocks.

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[22] Keim and Madhavan (1995) show that traders following momentum-based strategies trade more aggressively and incur higher trading costs relative to value traders.

G. Evidence on Determinants of Execution Costs

The estimates of the trade initiation model given by equation (8) are presented below:

$$E\left(r_t^f \,\middle|\, y^* \le 0\right) = 0.00003^* + 0.00042^{***} q_{1t} + 0.00037^{**} q_{2t} + 0.00063^{***} q_{3t} - 0.00399^{***} Imb_t$$

$$+ .06184^{**} Preret_t - 0.00046^{***} D_{1t} + 0.00011 D_{2t} + 0.00014^{***} Vol_t + 0.08683 \left[\frac{-\hat{\phi}(\gamma' Z_t)}{1 - \hat{\Phi}(\gamma' Z_t)} \right]$$

(11)

where

$$\gamma' Z_t = 0.60402 - 0.18755 q_{1t} + 0.50145^{***} q_{2t} + 0.79156^{***} q_{3t} + 0.72311^* Imb_t$$

$$+ 0.13271 Preret_t + 0.26139^{***} D_{1t} + 0.15004 D_{2t} + 1.48472^{**} Vol_t$$

(12)

***	indicates significance at the 1% level ;
**	indicates significance at the 5% level;
*	indicates significance at the 10% level.

In equation (11), the co-efficients corresponding to the second through the fourth terms (corresponding to the order-size indicator variables q_{1t}, q_{2t} and q_{3t}) are significantly positive, which indicates that the expected realized half-spread increases with order size. In contrast, the co-efficient of Imb_t in equation (11) is significantly negative, implying that the expected realized half-spread decreases with order imbalance. The co-efficient for $Preret_t$ in equation (11) is significantly positive, implying that the expected realized half-spread increases following recent price changes. The results on Imb_t and $Preret_t$ in conjunction with our earlier Probit results, suggest strategic behavior on the part of floor traders who become more aggressive in response to a thickening of the book on their own side, and who become patient following large pre-trade price changes.

The co-efficient of the morning dummy variable D_{1t} in equation (11) is significantly negative, implying that the expected realized half-spread is low in the morning hours, at a time when we expect market liquidity to be higher. The co-efficient of the afternoon dummy variable D_{2t} is positive but insignificant. Given our earlier probit results that the probability of floor

initiated trades is higher in the afternoons, it appears that, as the day wears on, the traders' patience wears thin and the desire to complete their orders increases. Finally, the co-efficient of average trading volume is positive and significant, which would suggest that the expected cost of trading via the floor is higher for larger volume stocks, and that the floor is a relatively more attractive venue for less liquid stocks. The last term of equation (11) is commonly referred to as the Inverse Mills ratio. The co-efficient of this term is insignificant, which indicates that selectivity bias may be absent in the data.[23]

Similarly, the results in equation (12) are economically insightful. The equation presents the relationship between the probability of a floor trade occurring (as opposed to a trade being withheld) and order size, order imbalance, recent price change, time of day and average trading volume for the stock. This probability increases with order size except for the small share category, for which the co-efficient is insignificant. The probability of a floor trade increases with order imbalance as well. With respect to price changes, the results are insignificant. With respect to the time-of-day, floor trades are more likely in the morning hours. The results are insignificant with respect to the late afternoon. The results are consistent with more liquidity being available in the morning. Finally, the probability of a floor trade increases with average trading volume, indicating that floor traders are more inclined to trade a stock with higher average trading volume quickly than they are to trade a stock with lower average trading volume. As one would expect, more strategic behavior is required for stocks with lower average trading volume.

V. Conclusion

For an expanding array of equity markets, including Toronto, Paris, Tokyo, Australia, Madrid, Stockholm, Switzerland, Frankfurt and London, floorless electronic trading systems have been the wave of the future. In this paper, we have focused on the value of a trading floor. Our analysis of non-block trades on the Amex, a floor-based market, suggests that the floor

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[23] Following this finding, we estimated equation (2) using OLS, and the sign and significance of the explanatory variables was virtually identical to those in equation (11).

environment adds value through improved order handling.   Consistent with this, we find that 23.40% of the trading volume in our sample is initiated on the trading floor and that, on the passive side, the floor participates in an additional 10.39% of the trading volume.

Using a matched pair technique, we find that floor broker timed order handling generally results in lower execution costs. Overall, trades handled by floor brokers have a significantly smaller realized half-spread than do PER trades (-3.06 basis points versus 4.43 basis points). This difference of 7.49 basis points is equivalent to a savings of 3.94 cents per share for an average priced stock on the Amex.[24] Given the aggregate floor trading volume of 110,489,600 shares in October 2001, this translates to a total savings of $4.36 million for the month. In addition, floor trades have a lower effective half-spread compared to PER trades (8.11 basis points versus 10.27 basis points). The quoted half-spread is also lower when floor orders initiate trades than when PER orders initiate trades (16.23 basis points versus 17.47 basis points).

Our finding of a lower realized spread for floor trades is robust to controls for the information content of a trade. In specific, we examine execution costs for a restricted sample that further controls for the permanent price effect. We continue to find that execution costs are lower on the trading floor.

Our evidence on SPDRs, a security that is not subject to information asymmetries, further reinforces the above findings. We find that execution costs continue to be lower on the floor despite absence of information differentials for matched trades compared across the two venues. Our findings on SPDRs strongly suggest that the trading floor offers the advantage of reduced execution costs through improved order handling.

We have examined the determinants of trade initiation on the floor vs. PER. Our findings are that the floor trading mechanism is preferred for larger sized trades, on occasions when the order flow is in the direction of the initiating trade (but not following a recent large price change), during morning and late afternoon hours, and for less liquid stocks. Our findings on the

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[24] In this context we define the average price as the trade-weighted transaction price in our sample.

determinants of execution costs on the trading floor are that the execution costs are lower for trades initiated in the direction of the order flow, but higher for trades that are preceded by large price changes.

Together, these findings suggest that floor traders exhibit strategic behavior, becoming more aggressive in response to a thickening of the book on their own side, and becoming more patient following large pre-trade price changes. In contrast, PER traders are more apt to chase recent price changes. This helps explain why floor orders incur lower (and even negative) execution costs and sheds light on the role of floor brokers and the value of intermediation in an equity market.

It is important to point out, however, that, to some extent at least, the functions of a floor trader can be carried out in an electronic environment, and that the strategic timing of trades does not necessarily require verbal order entry by human intermediaries. A growing number of institutional investors now have DOT machines and smart order handling systems that give them some ability to work their orders strategically from their upstairs desks. The ECNs show orders away from the best bid and offer (as the New York Stock Exchange now does through its Open Book), and some of the ECNs have reserve book functionality. While this may not yet be enough for buyside traders working their own smart limit orders to compete with floor traders handling not held orders,[25] with improvements in the technology for order routing and handling and the development of superior market design, one might expect the future to lie with electronic trading.

Observing that trading costs can be controlled by proper trade initiation underscores the need to design an environment that best presents the relevant information on market conditions to participants. Our analysis suggests a standard that the electronic platforms must meet, especially with regard to institutional order flow.

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[25] For further discussion of this point, see Keim and Madhavan (1996).

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Table 1

Sample Statistics

Share volume, percent of volume, trade size and time between trades for the four trade size categories at the American Stock Exchange during October 2001

We classify both floor initiated and PER initiated trades into four categories: less than 500 shares, between 500 and 999 shares, between 1000 and 1499 shares, and between 1500 and 9999 shares. Number of trades, Percent of Trades (%), Trade size (shares), and Time between Trades –15 to +15 (in minutes) is reported in the four panels below.

Share Volume

	Less than 500	500 – 999	1000 – 1499	1500 - 9999	Total
Floor	3,964,700	8,499,700	4,716,600	93,308,600	110,489,600
PER	58,542,440	64,967,400	22,765,400	215,464,300	361,739,540
All Trades	62,507,140	73,467,100	27,482,000	308,772,900	472,229,140

Percent of Total Volume (%)

	Less than 500	500 – 999	1000 – 1499	1500 - 9999	Average
Floor	0.84	1.80	1.00	19.76	23.40
PER	12.40	13.76	4.82	45.63	76.60
All Trades	13.24	15.56	5.82	65.39	100.00

Trade Size (shares)

	Less than 500	500 – 999	1000 – 1499	1500 - 9999	Average
Floor	283.76	905.19	1358.08	4038.46	2212.45
PER	250.54	882.46	1346.59	3366.31	931.85
All Trades	252.42	885.03	1348.55	3544.59	1077.82

Time between trades -15 and +15 (in minutes)

	Less than 500	500 – 999	1000 – 1499	1500 - 9999	Average
Floor	32.19	27.04	26.28	23.17	26.64
PER	30.44	25.95	28.04	20.68	27.87
All Trades	30.54	26.07	27.74	21.34	27.73

Table 2

Matched Sample Results, All Trades: Quoted half-spread, effective half-spread and realized half-spread, reported in basis points, for matched pairs of floor and PER initiated trades classified by the four trade size categories at the American Stock Exchange during October 2001.

The quoted half-spread is defined as $Quoted\ Half - Spread = (Ask\ \text{-}\ Bid)/(Bid\ +\ Ask)$. The effective half-spread is

$Effective\ Half - Spread = D_{it} \cdot \{[P_0\ \text{-}\ (Bid\ +\ Ask)/2]/[(Bid\ +\ Ask)/2]\}$ where P_0 is the transaction price and D_{it} is an indicator variable that is equal to $+1$ for buyer-initiated trades and is equal to -1 for seller-initiated trades. The realized half-spread for trade t for stock i is the negative of the logarithmic return from the transaction (with the trade price denoted by P_0) to the mid-quote at the time of the fifteenth trade after the transaction denoted by M_{+15}, i.e., $Realized\ Half\text{-}Spread = D_{it} \cdot [\ln(P_0/M_{+15})]$.

The matching is achieved as follows. For each floor trade, we try to locate a matching PER trade. The matching criteria are: (1) trades must be in the same stock, (2) trades must be in the same direction, buy or sell, (3) the execution price of the PER trade must be within 20% of the price of the floor trade, and (4) the size of the PER trade must be within 20% of the size of the floor trade.

Quoted Half-Spread (in basis points)

	Less than 500 shares	500 - 999 shares	1000 – 1499 shares	1500 - 9999 shares	Average
Floor	17.02	16.78	16.77	15.39	16.23
PER	18.18	18.60	19.33	16.23	17.47
Difference	*-1.16***	*-1.82***	*-2.56***	*-0.84***	*-1.24***

Effective Half-Spread (in basis points)

	Less than 500 shares	500 - 999 shares	1000 – 1499 shares	1500 - 9999 shares	Average
Floor	7.26	8.08	9.38	8.47	8.11
PER	9.69	10.97	12.16	10.04	10.27
Difference	*-2.44***	*-2.89***	*-2.78***	*-1.57***	*-2.16***

Realized Half-Spread (in basis points)

	Less than 500 shares	500 - 999 shares	1000 – 1499 shares	1500 - 9999 shares	Average
Floor	-7.20	-3.03	-3.47	-0.33	-3.06
PER	2.51	3.10	3.94	6.33	4.43
Difference	*-9.71*[**]	*-6.13*[**]	*-7.41*[**]	*-6.67*[**]	*-7.49*[**]

[**] Denotes significance at the 1% level

Table 3

Matched Sample Results, Trades with Similar Information Content: Quoted half-spread, effective half-spread and realized half-spread, reported in basis points, for matched pairs of floor and PER initiated trades classified by the four trade size categories at the American Stock Exchange during October 2001.

The quoted half-spread is defined as $Quoted\ Half-Spread = (Ask - Bid)/(Bid + Ask)$. The effective half-spread is $Effective\ Half-Spread = D_{it} \cdot \{[P_0 - (Bid + Ask)/2]/[(Bid + Ask)/2]\}$ where P_0 is the transaction price and D_{it} is an indicator variable that is equal to $+1$ for buyer-initiated trades and is equal to -1 for seller-initiated trades. The realized half-spread for trade t for stock i is the negative of the logarithmic return from the transaction (with the trade price denoted by P_0) to the mid-quote at the time of the fifteenth trade after the transaction denoted by M_{+15}, i.e., $Realized\ Half\text{-}Spread = D_{it} \cdot [\ln(P_0/M_{+15})]$.

The matching is achieved as follows. For each floor trade, we try to locate a matching PER trade. The matching criteria are: (1) trades must be in the same stock, (2) trades must be in the same direction, buy or sell, (3) the execution price of the PER trade must be within 20% of the price of the floor trade, and (4) the size of the PER trade must be within 20% of the size of the floor trade. Additionally, the permanent price impact, defined as $Permanent\ Price\ Impact = D_{it} \cdot [\ln(M_{+15}/M_{-15})]$, of the PER trade must be within 20% of that of the floor trade.

Quoted Half-Spread (in basis points)

	Less than 500 shares	500 - 999 shares	1000 – 1499 shares	1500 - 9999 shares	Average
Floor	15.81	15.85	14.96	12.96	14.53
PER	16.66	16.95	16.76	13.54	15.38
Difference	*-0.85***	*-1.10***	*-1.80***	*-0.58***	*-0.85***

Effective Half-Spread (in basis points)

	Less than 500 shares	500 - 999 shares	1000 – 1499 shares	1500 - 9999 shares	Average
Floor	6.83	7.52	7.94	7.02	7.13
PER	8.89	10.16	10.34	8.17	8.94
Difference	*-2.06***	*-2.64***	*-2.40***	*-1.15***	*-1.81***

Realized Half-Spread (in basis points)

	Less than 500 shares	500 - 999 shares	1000 – 1499 shares	1500 - 9999 shares	Average
Floor	-7.14	-4.61	-5.81	-1.72	-4.21
PER	-2.55	0.53	0.87	1.17	-0.09
Difference	*-4.60*[**]	*-5.14*[**]	*-6.68*[**]	*-2.88*[**]	*-4.12*[**]

[*] Denotes significance at the 5% level

[**] Denotes significance at the 1% level

Table 4

Matched Sample Results for SPDRS: Quoted half-spread, effective half-spread and realized half-spread, reported in basis points, for matched pairs of floor and PER initiated trades classified by the four trade size categories at the American Stock Exchange during October 2001.

The quoted half-spread is defined as $Quoted\ Half-Spread = (Ask - Bid)/(Bid + Ask)$. The effective half-spread is $Effective\ Half-Spread = D_{it} \cdot \{[P_0 - (Bid + Ask)/2]/[(Bid + Ask)/2]\}$ where P_0 is the transaction price and D_{it} is an indicator variable that is equal to $+1$ for buyer-initiated trades and is equal to -1 for seller-initiated trades. The realized half-spread for trade t for stock i is the negative of the logarithmic return from the transaction (with the trade price denoted by P_0) to the mid-quote at the time of the fifteenth trade after the transaction denoted by M_{+15}, i.e., $Realized\ Half\text{-}Spread = D_{it} \cdot [\ln(P_0/M_{+15})]$.

The matching is achieved as follows. For each floor trade, we try to locate a matching PER trade. The matching criteria are: (1) trades must be in the same direction, buy or sell, (2) the execution price of the PER trade must be within 20% of the price of the floor trade, and (3) the size of the PER trade must be within 20% of the size of the floor trade.

Quoted Half-Spread (in basis points)

	Less than 500 shares	500 - 999 shares	1000 – 1499 shares	1500 - 9999 shares	Average
Floor	4.01	3.91	3.94	3.92	3.93
PER	3.90	4.00	4.04	4.04	4.01
Difference	*0.11*[**]	*-0.09*	*-0.11*	*-0.12*[**]	*-0.08*

Effective Half-Spread (in basis points)

	Less than 500 shares	500 - 999 shares	1000 – 1499 shares	1500 - 9999 shares	Average
Floor	0.13	0.91	0.70	1.23	0.95
PER	1.84	2.15	2.37	2.34	2.23
Difference	*-1.70*[**]	*-1.23*[**]	*-1.66*[**]	*-1.11*[**]	*-1.27*[**]

Realized Half-Spread (in basis points)

	Less than 500 shares	500 - 999 shares	1000 – 1499 shares	1500 - 9999 shares	Average
Floor	-0.43	-0.73	0.03	0.14	-0.09
PER	2.11	2.05	2.32	2.02	2.06
Difference	*-2.54*[**]	*-2.78*[**]	*-2.29*[**]	*-1.88*[**]	*-2.16*[**]

[**] Denotes significance at the 1% level