The Information Contained in Stock Exchange Seat Prices

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Abstract

Exchange seats are capital assets that confer access to the trading floor. As such, their prices reflect expectations about future activity and returns for the market as a whole. For this reason, the process by which seat prices are determined provides valuable information about beliefs of market participants who have the most intimate contact with the trading process. This paper examines the market for New York Stock Exchange (NYSE) seats using the complete *intra-daily* record of trades, bids and offers for the seat market for the 1973-1994 period. Our analysis yields several new results on the evolution of beliefs and their relation to asset prices. In contrast to traditional theories of bid-ask spreads that emphasize inventory costs or asymmetric information, we show that seat spreads reflect the heterogeneity of beliefs about future market performance. Our tests confirm that seat transactions and quotes do contain information about these beliefs, and our measure of divergence in opinion has predictive power regarding future stock market returns.

1. Introduction

Exchange seats are capital assets whose prices reflect expectations about future stock market returns and activity. Seats are traded by market participants with the most intimate knowledge of the trading process. Consequently, there is considerable interest in seat price returns and levels, and in what we can learn from these indicators of market health. From a practitioner viewpoint, seat prices are often viewed as measures of market sentiment (see, e.g., McGee (1998)) and indicators of long-run exchange profitability (see, e.g., Ip and Lohse (1998) regarding the proposed merger between the American Stock Exchange (AMEX) and the Nasdaq Stock Market). From an academic viewpoint, there is interest in exchange seats as capital assets, as in Schwert (1977b), and in using their prices to draw inferences about the impact of competitive and regulatory factors on security markets, as in Doede (1967), Schwert (1977a), Stoll (1979), Jarrell (1984), Chiang, Gay, and Kolb (1987), and Bagnoli and Battalio (1996). This paper examines the information content of New York Stock Exchange (NYSE) seat quotes and prices using unique, new data.

Our analysis is motivated by the idea that the bids, offers, and transaction prices of exchange seats contain information about the beliefs of market participants regarding the aggregate stock market. We test these hypotheses using the complete *intra-daily* record of trades, bids and offers for the seat market for the 1973-1994 period. Our analysis yields several new results on the relation between seat prices and underlying asset prices. Further, by jointly modeling the motivations for trade and the resulting seat price movements, we can address several interesting issues, including the observed price variability-volume relation and the extent to which differences in opinion (see, e.g., Harris and Raviv (1993)) explain trading activity.

The results provide added perspective on the risk and return of exchange seats. With the notable exception of Schwert (1977b), there have been few detailed analyses of the risks and returns of seat ownership. We extend Schwert's original analysis (which covered the period 1926 to 1972) to include the entire history of seat prices from 1869 to the present. These results provide added confirmation for Schwert's view of seats as assets whose returns are determined like those of other capital assets. Interestingly, although in nominal terms seat prices today are at all-time highs, in real terms they are roughly at the same level now that they were at the beginning of the century.

Using transactions-level data, we find that exchange seat transactions and quotes do indeed contain information about beliefs regarding aggregate stock market activity. This is reflected in several findings. First, spreads in the seat market are wide (22 percent) by any measure. Such large spreads are difficult to explain solely in terms of traditional theories such as inventory control or asymmetric information. We provide an alternative interpretation of the existence of wide bid-ask spreads in limit order book markets, i.e., that they reflect heterogeneity in beliefs regarding fundamental value. Second, we find that price changes associated with seat transactions contain a significant permanent (information) component of about 2.5 percent, as measured by the change in the prevailing midquotes over the period surrounding the trade. This suggests that seat transactions are viewed as informative. Third, we show that trading activity increases with greater dispersion in beliefs, a result that is consistent with our interpretation of the spread. This result also helps explain the observed positive relation between price variability and volume in other asset markets.

Consistent with these results, we find that lagged changes in the quoted seat spread significantly predict the monthly excess returns of the S&P500. This is consistent with Merton (1980), where an increase in the expected market risk premium follows an increase in the dispersion in beliefs (i.e., market variance), as proxied by wider pre-trade seat spreads. Additional tests show that the predictive ability of our seat spread variable is not proxying for other variables that have been found to display predictive power, such as the dividend yield and book-to-market ratio for the entire market, the low-grade bond default spread, and the slope of the term structure.

The paper proceeds as follows. Section 2 describes the market for NYSE seats and provides some historical perspective on their return and risk characteristics from 1869 to the present. Section 3 describes our transaction-level data for the 1973-94 period and reports summary statistics. Section 4 develops a model of seat trading that motivates our subsequent empirical tests. Section 5 investigates the information contained in seat price transactions and quoted spreads by analyzing the relation between traders' beliefs and seat prices, future market activity, and volume. Section 6 concludes the paper.

2. The Market for NYSE Seats

The New York Stock Exchange (NYSE) is a New York State not-for-profit organization whose net assets are owned by its seatholders. There are 1,366 regular members who own seats.[1] Ownership of a NYSE seat confers full distributive rights in the NYSE's net assets. Should the NYSE go private or be dissolved, the seat holders would be the recipients of the residual claims to the organization's assets.

Seatholders are individuals who personally own seats or the nominees of firms that own a seat. Seats are bought and sold in a public market, as described below, and there are relatively few restrictions on entry. Although the NYSE was founded in 1792, it was not until 1869 that seat transactions (purchase, sale, or transfers) were first allowed. Originally, there were 1,060 seats but this number was increased to 1,375 in 1932 and finally to their present number of 1,366 in 1953. Seats are indivisible, implying that the supply of seats in the last four decades has been fixed. A seat represents a residual claim to the exchange's net assets, both physical and intangible, and allows a member access to the NYSE's trading floor.

Members can participate in trading in several different roles, including: (1) Specialists, who are exchange-designated market makers, responsible for providing liquidity and maintaining price continuity in their assigned NYSE-listed stocks, (2) Commission (house) brokers, who help execute orders for brokerage firms, (3) Independent (Two-dollar) brokers who handle the trades of other members, (4) Floor traders, who trade for their personal accounts, and (5) Registered Competitive Market Makers, who are independent

[1] In addition, there are a small number of "partial" memberships which convey limited physical or electronic access to the floor for a basic fee supplemented by annual fees.

floor traders with additional affirmative obligations to provide liquidity.[2] The member determines how the seat will be used and in this sense, seats are undifferentiated products.[3] For example, although every specialist must own a seat, there is no such thing as a "specialist seat."

Seats are traded in an auction market maintained by the Secretary of the NYSE. Current bid and ask quotes are posted in prominent locations on the floor of the exchange, and there are no transaction costs to purchasing or selling a seat. In theory, the market for NYSE seats is a continuous market because transactions or quote changes can be made at any time during the day. In practice, however, seats are thinly traded and quotes may remain in effect for several days. The seat market is a particularly simple example of a limit order book system, a trading design that is increasingly common in financial markets.

Not all transactions take place in the auction market. Private sales or transfers between individuals within the same member institution could potentially involve consideration other than cash and for this reason need not occur at or within the quoted bid and offer prices. For this reason, we focus only on public seat transactions in cash.

2.1. Some Historical Perspective: 1869-1996

We obtained from the NYSE an annual series of seat prices covering the period from 1869, when trading in seats commenced, to 1997. The long-horizon data provide a useful historical perspective that helps place our more detailed transaction-level analyses in context. However, the annual series includes high and low seat prices in each year, and the non-synchronous nature of the data warrant some caution when interpreting the results. As noted by Working (1960) and Schwert (1990), averaging high and low prices within the year produces time series characteristics that are similar to those that result when time-

[2]Specialists and brokers (house and independent) represent the largest categories on the floor, accounting for 35% and 61% of total members, respectively.

[3]Before 1978 seats could not be leased to others, but this is now relatively common. This change implies that seats can provide a return even to members who do not themselves participate in trading or brokerage activities on the exchange floor.

averaging data that come from a random walk. The returns from such a series resemble a first-order moving average with correspondingly high first-order autocorrelation and understated standard deviations. Schwert (1990) employs a procedure to correct for this effect when he constructs a market return series (that we use below) based on the Cowles Index (which averages high and low prices). The summary statistics that we report below reflect this correction.

Figure 1 plots the series of averages of the annual high and low nominal prices for the entire period.[4] The series exhibits three significant price run-ups – with peaks in 1929, 1969, and 1987 – that were quickly followed by declines of comparable magnitudes. A significant run-up in prices also occurred in the first years of this century, although prices remained at this higher plateau for a number of years. Recent prices include the highest price, in nominal terms, ever paid for a seat – $2 million in March 1998.

In real terms, however, the recent highs pale in comparison to past seat prices. Figure 2 reports an inflation-adjusted seat price index series. This series is constructed using the nominal series from Figure 1, deflated by a price level series and rescaled to $1 in 1869.[5] Figure 2 is dominated by the 1929 observation, which is on the order of three times the magnitude of the next highest observation in 1969. In comparison, the 1987 and 1997 observations appear small, lower even than the observations at the beginning of the century. In real terms, the capitalized value of the floor trading franchise is at approximately the same level that prevailed at the beginning of the century.

It is also instructive to compare the behavior of seat prices to the underlying behavior of stock prices. We use a value-weighted index of NYSE stocks constructed by Schwert (1990) for the 1870-1925 period and by CRSP for the 1926-1996 period. In nominal terms, the annual mean return (standard deviation) for the 1869-1996 period is 7.99 percent (33.36 percent) for exchange seats and 10.56 percent (18.44 percent) for the S&P 500. The

[4]We do not "split-adjust" the seat prices for the increase in the number of seats in 1932 and 1952 because we view these events as analogous to a secondary equity issue rather than a straight dilution of existing equity. Since the magnitude of the increases are relatively small, however, our conclusions are unaffected by such an adjustment.

[5]We thank Jeremy Siegel for providing us with the price level data. See Siegel (1992) for a detailed description of the underlying data sources and construction of the index.

mean seat return ranged from 4.0 percent in the 1934-65 period to 10.3 percent in the 1966-96 period. Following Schwert (1977b), we estimate a market model for annual seat returns that includes lagged market returns. The estimated coefficient on the contemporaneous market return (i.e., beta) is 0.95 for the entire period, and ranges from a low of 0.89 in 1901-1933 to 1.13 in 1966-1996. The coefficient on the lagged market returns is significant for the overall period (0.62) and in each subperiod except the most recent. These results are consistent with a view of seats as capital assets that are related to general market movements, but are limited by the low frequency nature of the data. We revisit this topic below using more refined transaction-level data.

3. Data

Our analysis is based on a complete chronological record of all bids, offers, and transactions in the NYSE seat market from January 1973 to July 1994. These data are unique in several important respects. First, although transactions are infrequent, quotations are available on a daily (and occasionally intradaily) basis. Quotation data are interesting because they can be used to measure the range of estimates by market participants of seat value. To our knowledge, these data have not been examined before. Second, the data identify the date and time (to the nearest minute) of all quotes and transactions, allowing us to investigate in more detail the relation between seat prices and future stock market returns and activity. Previous studies use prices for transactions that occurred closest to the end of the month. Such prices present potential problems because the exact dates of the transactions (or the changes in bids or offers that led to a transaction) are not observed.

Third, the data identify the trader behind the quoted bid and ask and the parties to a transaction. This information, together with quotation data, and descriptors such as "X sells to Y" aid in the identification of trade initiation. Fourth, the data also provide information on the nature of the sale. Most importantly, they identify whether the seat price includes option trading rights and whether the sale was public or was a private sale or transfer. This information helps us identify trades (e.g., private sales or transfers) taking place at non-market prices. Finally, the period 1973-94 is of particular interest as it covers several events that pertain to the competitive position of the NYSE and the profitability of the brokerage industry. These events include the elimination of fixed commissions in May 1975, the introduction of the DOT electronic trading system in March 1976, the introduction of the Intermarket Trading System (ITS) in April 1978, and the Crash of October 1987.

The data were obtained from the NYSE in the form of a hand-written ledger and were then transcribed by hand to electronic form.[6] Several filters were used to ensure the accuracy of the data. First, we screened the data for obvious outliers and other keypunch errors such as dropped digits. Second, we cross-checked the transaction prices against reported prices available through other sources (e.g., the NYSE *Fact Book*). Finally, we took care to ensure that sequences of transaction prices were comparable by excluding private sales and transfers, and by correcting for the effect of option trading rights which can be traded separately.

To illustrate the nature of the data, consider Table 1. The table shows the quotation record from Monday, July 21 to Wednesday, July 23, 1986, with only the first initial of the participants' last names used to preserve anonymity. At the open of the auction market at 9:00 on Monday, the bid and ask prices were $505,000 and $600,000 (based on quotes by S and W), respectively. These quotes remained in effect through the open on Tuesday. At 11:15, an outside investor, T who was not previously represented on either the bid or ask side, sold to S at the prevailing bid of $505,000. With S out of the market, the best bid was represented by G for $410,000. This bidder then improved the bid to $430,000 at 13:00, and at 13:30 on Tuesday, a new player L entered the market and posted an ask price of $550,000. At 14:20, a new bidder (B) entered with a bid of $435,000. These quotes remained in effect until 10:40 on Wednesday, when yet another new player A improved the bid further to $450,000. This offer was soon countered by B who improved the bid to $460,000. These quotes remained in effect for the rest of the week.

[6]Due to omissions in the data obtained from the NYSE, we are missing quote and price information for two blocks of time: January 1980-December 1980 and May 1983-October 1983.

This example serves to illustrate several aspects of the data. First, the trade shown here is clearly seller-initiated, but it is also clear that traders adjust their quotes to signal their willingness to trade. This is illustrated by the quote record for 13:00 on Tuesday, July 22, when G voluntarily raises his bid price from \$410,000 to \$430,000, possibly to indicate an active interest in trading. Second, there is a tendency for the percentage spread to widen following a trade. In this example, the spread widens from 17 percent before the trade to 38 percent after the trade. This occurs because a transaction removes the parties most eager to trade. Third, quotes narrow in response to competition and the entry of new players, as shown by the quote records for Wednesday, July 23.

However, the example is not representative in that most days feature less activity. Overall, there are 686 trades in the sample period, implying a trading frequency of just 0.20 per business day. In contrast, the quotation frequency is much higher with an average of two quotations per business day over the entire period. Both trading and quotation frequencies are higher in the 1973-1980 period which included events such as the elimination of fixed commissions, the oil crisis, and a major recession. Of particular interest, the mean percentage bid-ask spread is large, 22.54 percent, and is remarkably constant over time.[7]

3.1. Seat Price Behavior: 1973-1994

The more refined data from 1973-1994 allow us to revisit the relation between risk and return for exchange seats and extend Schwert's monthly results to the post-1972 period. We compute monthly seat returns using end-of-month midquotes. Monthly stock market returns are the total returns for the S&P 500. Figure 3 plots the value of constructed wealth indices (normalized to \$1 in January 1973) for NYSE seat prices and the S&P 500

[7]Although the seat bid-ask spread is large relative to quoted spreads for stocks (see Keim and Madhavan (1998) for a recent survey of the evidence), it is not unusual in the context of a spread amortized over the expected holding period. For example, in our sample we observe, on average, one seat transaction per week, or about 52 per year. Given the fixed number of seats (1366), this implies an annual turnover of about 4 percent, or a holding period of about 25 years. This implies a one percent spread, stated on an annual basis. The recent paper by Chalmers and Kadlec (1998) provides an analysis of amortized spreads for common stocks.

based on the monthly returns and illustrates several interesting findings regarding the evolution of seat prices over the last two decades. First, in the early period of the sample, exchange seat prices fell in anticipation of the elimination of fixed commissions in May, 1975, reaching a low of $35,000 in October, 1977. Seat prices remained at depressed levels until 1978 when leasing was permitted, giving seat owners the ability to obtain income from these assets without maintaining a physical presence on the floor.

Second, as financial assets, seats underperformed the market portfolio. By July 1994, the value of the $1 seat investment was $4.36 versus $9.55 for the S&P 500 index.[8] Despite this underperformance, seats exhibited considerably more volatility – the standard deviation of monthly seat returns over the 1973-1994 period of 12.41 percent is considerably higher than the 4.59 percent standard deviation for the S&P 500 return.

Finally, it is apparent that until the market break of October 19, 1987, the value of a seat was closely tied to the value of the total market portfolio. Similar to the 1929 and 1969 episodes, there is a divergence after the October 1987 crash which persisted until the end of 1990 with seat prices falling and the stock index rising. The apparent delinking of the relation between market and seat returns in the three years following the October 1987 crash is puzzling and warrants further analysis.

Empirical models of seat value (e.g., Schwert (1977b)) suggest that seat values depend on expectations of future cash flows from floor trading. Thus, one possibility is that the post-crash price behavior of exchange seats is related to a change in the expectations of trading activity (as opposed to the market returns) during this period. Figure 4 plots nominal seat prices against NYSE trading volume and shows that seat prices closely track monthly aggregate trading volume over the sample period. Annual NYSE share volume grew by 29 percent from 1986-1987, and by 34 percent from 1987-1988, but fell by 15 percent in 1988 and continued to stagnate until 1991, when volume grew by 14.2 percent. Indeed, it was not until 1992 that share volume recovered to the level of 1987. Consistent

[8] Of course, this computation ignores the implicit dividends obtained from seat ownership in the form of the additional brokerage revenues accruing to the holder from a presence on the floor. For comparison, the value of a $1 investment in the value-weighted CRSP index without dividends grew to $3.70 over the same period.

with the pattern of trade volume over this period is the pattern of the profitability of NYSE member firms. The average annual after-tax return on equity for NYSE member firms from 1975-1995 was 8.35 percent, but in the years 1988-1991, this figure was only 4.21 percent. From 1992-1995, the period of recovery of seat prices, the return on equity averaged over 7 percent.

The evidence for the 1973-94 period suggests a relation between seat price changes and both stock returns and trade volume. To estimate this relation, we extend the model estimated by Schwert. We include the contemporaneous and lagged market returns as independent variables to mitigate possible non-trading biases associated with infrequent revisions of quotes. To capture the influence of trade activity, we include the log monthly change in composite NYSE volume. Finally, Fama and French (1993) argue that two additional factors are ueseful to capture the nondiversifiable risk of an asset. They find that a size-related and a value/growth-related factor are helpful in describing asset return variation. We therefore include those two factors in our model.

We estimate the following model:

$$r_t = \alpha + b_1 r_{m,t} + b_2 r_{m,t-1} + b_3 r_{m,t-2} + c_1 SMB_t + c_2 HML_t + c_3 Vol_t + c_4 Vol_{t-1} + \epsilon_t, \quad (1)$$

where in month t, r_t is the percentage seat price change in excess of the risk-free rate, $r_{m,t}$ is the excess market return, SMB_t is a monthly size premium (small stock return less large stock return), HML_t is a monthly book/market premium (high B/M return less low B/M return), Vol_t is defined as the (logarithmic) growth in aggregate NYSE share volume, and ϵ_t is an error term.[9]

The results, summarized in Table 2, show that for the entire period the contemporaneous and lagged excess market returns are positive and significant, indicating that seat prices respond to market information, albeit slowly. The sum of the three market coefficients is 1.19, consistent with Schwert's finding for the pre-1973 period. The coefficient on the size premium is significant in the overall period indicating that this "factor" that has been shown to have a significant effect on stock returns also affects seat returns,

[9] We thank Gene Fama and Ken French for providing data on the market, size and value factor returns.

perhaps a reflection of the illiquid nature of both the market for seats and for small-cap stocks. However, the coefficient on the price/book variable is insignificant, indicating the value-growth factor is not important for seat values. Finally, and in contrast to the visual relation that appears in Figure 4 between seat value and volume, we find little evidence of a relation between monthly seat price changes and monthly NYSE volume changes. The coefficients on both the contemporaneous and lagged volume growth variables are insignificant for the 1974-94 period.

As for the pre- and post-crash subperiods, we find that the results are different. The explanatory variables that are significant in the overall period are also significant in the pre-crash subperiod. However, we find little evidence of significant explanatory power in the post-crash period for the model. Note that the mean seat and S&P 500 returns exhibit similar variability across the subperiods. The seat return in the pre-crash period is 1.85 percent per month, nearly twice the return on the S&P 500. In the post-crash period, the average monthly seat return (0.41 percent) is half the return of the S&P 500. These findings are interesting in that they indicate that there may have been a structural change in the risk-return relation in the post-crash period.

4. A Model of Seat Trading

In this section we develop a simple model to analyze the information content of NYSE seat quotes and prices. The model is motivated by the idea that bid, offer and transaction prices of exchange seats contain information about the beliefs of market participants regarding aggregate stock market activity. By jointly modeling the motivations for trade and the resulting seat price movements, the analysis allows us to make predictions about the price variability-volume relation and the extent to which differences of opinion explain trading activity.

4.1. *Reservation Prices*

Seats have value because they provide their owners with revenue from direct access to the trading floor provided by exchange membership or from leasing the seat to another individual. Let N denote the total number of seats, and let S denote the set of potential sellers, i.e., the N existing seatholders. Similarly, let B denote the set of potential buyers, i.e., the set of all possible purchasers of a seat. The expected present value of a seat's cash flows to agent i (who may be an existing seatholder or a potential purchaser of a seat) at time t is given by

$$v_{i,t} = E\left[\sum_{k=0}^{\infty} \rho^k \pi_{i,t+k} | \Phi_{i,t}\right] \tag{2}$$

where $\pi_{i,t}$ denotes the profits accruing to agent i from a physical presence on the floor at time t, $0 < \rho < 1$ is the discount factor, and $\Phi_{i,t}$ represents the agent's information at time t.[10]

The reservation price of a potential seller $i \in S$, is $r_{i,t} = v_{i,t}$, where $v_{i,t}$ is the present value in equation (2). However, for a potential buyer (or entrant), the reservation price is the present value of cash flows (given by equation (2)) less the entry costs to floor trading. Entry costs consist of the explicit costs of entry (including, for example, the costs of establishing a physical presence on the floor) and, perhaps more importantly, implicit costs (including the costs of building reputational capital with other floor participants) associated with floor trading.[11] Let $r_{h,t}$ denote the reservation price (as opposed to present value) of an exchange seat for potential entrant $h \in B$ at time t. Then, $r_{h,t} = v_{h,t} - \psi$, where ψ denotes the entry costs.

4.2. *Information Events*

Denote by r^b_{t-1} the highest reservation value among potential buyers, and similarly define r^s_{t-1} as the lowest reservation price among the set of potential sellers at time $t-1$. We

[10] Observe that in equation (2), the role of the exchange member is subsumed in the profits from seat ownership. Thus, a member who is a specialist may place a high value on owning a seat whereas a floor broker whose extra-marginal rents may be small may place a low value on a seat.

[11] Any exit costs are implicitly assumed to equal zero; this assumption is made purely for convenience and can be easily relaxed.

assume that at time $t-1$, buyers and sellers have homogenous beliefs, and since $\psi > 0$, $r^b_{t-1} < r^s_{t-1}$ and trade is not mutually beneficial.[12]

At time t, an information event occurs which alters the valuations of buyers and sellers. The event date can be a thought of as a random variable drawn from a Poisson distribution. Let $\xi_{i,t}$ denote the change in agent i's valuation. The shock $\xi_{i,t}$ can take values of $-d_t$, 0, and $+d_t$ according to a discrete distribution F_t.

Immediately after the event at time t, the reservation prices of the most eager buyer and seller, (r^b_t, r^s_t), correspond to one of the following pairs: (i) $(r^b_{t-1}+d_t, r^s_{t-1}+d_t)$, (ii) $(r^b_{t-1}+d_t, r^s_{t-1}-d_t)$, (iii) $(r^b_{t-1}-d_t, r^s_{t-1}+d_t)$, or (iv) $(r^b_{t-1}-d_t, r^s_{t-1}-d_t)$. Whether trade occurs or not depends on the magnitude of the information event, as measured by the dispersion shock d_t. A trade is mutually beneficial only if $r^b_t > r^s_t$. It is clear that cases (i) and (iv) correspond to mean preserving shifts in the distribution of values. Since reservation prices change in the same direction in these cases, no trade occurs. Similarly, there is no trade in case (iii) because $r^b_{t-1} < r^s_{t-1}$. Case (ii), however, admits the possibility of mutually beneficial trade if $r^b_{t-1}+d_t > r^s_{t-1}-d_t$. Since $r^b_{t-1} = r^s_{t-1}-\psi$, this corresponds to $d_t > \frac{\psi}{2}$, i.e., that the shock be sufficiently large.

4.3. Quotes and Prices

To abstract from the details of the bargaining process, we assume that a trade takes place if the most eager buyer and seller find it mutually beneficial to trade. Without loss of generality, we can express the ultimate transaction price, denoted by p_t, as a weighted average of the reservation prices of the two traders, i.e.,

$$p_t = (1-\alpha_t)r^s_t + \alpha_t r^b_t, \tag{3}$$

where $\alpha_t \in [0,1]$ represents the seller's bargaining power (which in turn depends on competition from other potential sellers as well as idiosyncratic negotiation skills) and r^s_t

[12] This assumption is made for simplicity. The model could be extended straightforwardly to the case where prior beliefs are heterogeneous.

and r_t^b denote the reservation prices of the seller and buyer. High values of α_t represent better prices for the seller and worse prices for the buyer.

Define $z_t \equiv 2\alpha_t - 1 \in [-1, 1]$, $\mu_t \equiv (r_t^b + r_t^s)/2$, and $\sigma_t \equiv (r_t^b - r_t^s)/2$. The term μ_t is the average of the buyers' and sellers' reservation prices. The term z_t captures trade initiation; for a buyer-initiated trade where the seller extracts all rents, $\alpha_t = 1$, and z_t takes the value +1. Similarly, $z_t = -1$ for a seller-initiated trade, and 0 for a trade where both parties are equally keen to trade. Finally, σ_t captures the range between the high and low reservation prices among the sets of potential buyers and sellers, respectively. Using our definitions, we see that $\sigma_t = d_t - \psi/2$. Observe that $\sigma_t > 0$ if a trade is mutually beneficial. Thus, the term σ_t is positively related to the dispersion in seat valuations resulting from the information signal observed by market participants at time t.

Then, the transaction price can be written as

$$p_t = \mu_t + \sigma_t z_t. \tag{4}$$

Equation (4) shows that the price at time t is the mean conditional expectation (net of the mean costs of entry, which are split by the buyer and seller) plus a premium paid by the initiator. The premium is proportional to the dispersion in beliefs regarding the present value of cash flows from exchange membership. In our empirical analyses, we use equation (4) to test hypotheses about trading activity and beliefs.

The actual transaction price at the time of the trade reflects bargaining between the buyer and seller but the bid and offer prices immediately prior to trade may be different from this price. Prior to a trade, the seller and buyer quote prices that form the basis for their negotiation. In our model, reservation prices are common knowledge, but a traders' negotiating ability is not known at the start of the bargaining process. We assume there is a positive probability, following an information event, that an "urgent" trader will immediately hit either the posted bid or offer, as in the example discussed in table 1.

Since negotiations are costless in our model, a potential seller will set an ask price that extracts the maximum possible surplus, i.e., will demand the buyer's reservation price. Similarly, a potential buyer will begin the negotiations by offering a bid price equal to the seller's reservation price. Such prices are "regret-free" conditional upon being hit immediately, and serve as reference points for the subsequent negotiations. Formally, the ask and bid prices prior to trade are $A_t = \mu_t + \sigma_t$ and $B_t = \mu_t - \sigma_t$ respectively. The spread prior to a trade is $S_t = A_t - B_t = 2\sigma_t$, i.e., an increasing function of the dispersion in beliefs as measured by σ_t. The actual bid-ask spread at the time of a trade is definitionally zero. It follows then that the change in pre-trade bid-ask spread, i.e., $\Delta S_t = 2(\sigma_t - \sigma_{t-1})$. We use this metric later when we assess the information content of seat transactions. For now, it is sufficient to note that the change in the pre-trade bid-ask spreads reflects the change in the dispersion of beliefs.

5. Empirical Tests of the Information Content of Seat Prices

We turn now to an exploration of the determinants of seat price movements and trading activity using transaction-level data. The theory developed above suggests that the dispersion in beliefs regarding future brokerage revenue is reflected in price changes associated with seat transactions, in quoted bid-ask spreads, and in seat trading activity. The following sections test these hypotheses.

5.1. An Econometric Model of Price Changes

From equation (4), the change in prices from transaction $t-1$ to t is given by

$$\Delta p_t = \Delta\mu_t + \sigma_t z_t - \sigma_{t-1} z_{t-1}, \tag{5}$$

where the discrete variable $z_t = +1$ for a buyer-initiated trade, -1 for a seller-initiated trade, and 0 for a cross, $\Delta\mu_t$ is the change in the mean reservation prices, and σ_t measures the range of the distribution of reservation values.

To the extent that a trade may be information motivated, a trader may revise his or her reservation price in the direction of trade initiation. In addition, reservation prices are likely to move with market returns. Accordingly, we model

$$\Delta\mu_t = \beta r_{m,t} + \xi z_t + \epsilon_t, \tag{6}$$

where β is a constant, $r_{m,t}$ is the return on the market portfolio from trade $t-1$ to trade t, ξ is interpreted as the information effect on prices caused by the trade, and ϵ is white noise. Finally, for empirical implementation we model the dispersion of beliefs at time t as a function of a vector of state variables, W_t. Since σ_t is non-negative we model the dispersion as

$$\ln(\sigma_t) = \gamma' W_t, \tag{7}$$

where γ is a vector of coefficients.

Using equations (5)–(7) we obtain an empirical model

$$\Delta p_t = \beta r_{m,t} + \left[\xi + e^{\gamma' W_t}\right] z_t - e^{\gamma' W_{t-1}} z_{t-1} + \epsilon_t. \tag{8}$$

We propose a vector of state variables W_t consisting of a constant, the absolute return on the market portfolio from the time of the previous trade, $|r_{m,t}|$, (as a proxy for volatility in fundamentals), and the log of the midquote, $\ln(m_t)$, (since the dispersion of reservation prices is likely to be positively related to the price level). Then, writing $\gamma' W_t = \gamma_0 + \gamma_1 |r_{m,t}| + \gamma_2 \ln(m_t)$ in equation (8) yields the final model. Since the right-hand side variables are all likely to be proportional to seat values, we estimate this model using logarithmic returns rather than changes in price levels as the dependent variable. Thus, the coefficients have interpretations as the percentage effects, which is useful given the substantial variation in seat prices over the sample period.

Economic theory suggests natural signs for the parameters of interest. We expect $\beta > 0$, $\xi > 0$ (as the information motivating trade initiation is likely to be positively correlated with trade direction), $\gamma_1 > 0$ (since large market movements are likely to be associated with greater dispersion in beliefs). The sign of γ_2 reflects the extent to which the range in reservation values varies with the price level.

Equation (8) can be estimated in transaction time provided we have observations on the indicator variable z_t. In most cases, it is straightforward to define z_t using quotation data, as described in the example of Table 1 above. However, as a check of the robustness of the results to the classification of trade initiation, we also estimated the model using a different method. In this alternative approach, we compare the transaction price to the bid and ask quotations three quotes prior to the trade. We selected this number because this is the median number of quote revisions on days when trades occur, as evidenced by the sequence number in our data. In this alternative scheme, trades are classified as buyer-initiated if the transaction price is closer to the pre-trade ask than the pre-trade bid, and seller-initiated if the opposite is the case. In the event that the trade price is at the pre-trade midquote, the trade is classified as neither buyer- nor seller-initiated.

Table 3 contains non-linear least squares estimates of equation (8) (with asymptotic standard errors in parentheses) using all trading data for the period 1973-1994, excluding the day of the crash of 10/19/1987 and all subsequent trading days in October 1987. The model performs well, and all parameter estimates are of the predicted sign and are statistically significant. Of particular interest, the permanent component, ξ, is 2.4 percent of the price, which is consistent with the hypothesis that initiators possess private information about future stock market activity. This result shows that information effects alone are unlikely to account for the magnitude of quoted spreads. Further, the coefficient on the absolute market return, γ_1, is positive and significant, indicating that larger stock market movements imply greater dispersion. The coefficient on the log price variable is significantly negative. Since σ is expressed as a percentage of price, the fact that $(1 + \gamma_2) > 0$, implies that the dollar amount of dispersion decreases with the price level, although at a decreasing rate.

We explored several alternative specifications of the model, but our conclusions are unaffected. The specifications include models where σ_t is constant. We also checked the stability of the parameter estimates across different time periods. Although there is some evidence that dispersion widened in the post-crash period, it is not strong. The qualitative results are also robust to alternative signing schemes for the initiation variables.

5.2. Direct Estimates of Price Impacts

As a check on the estimation of the permanent component in (8), we compute the permanent and temporary price movements associated with seat transactions. These definitions are common in the block trading literature.[13] The permanent (information-based) impact is defined as $\ln(m^{pre}/m^{post})$, where m^{pre} is the midquote prevailing immediately before the trade and m^{post} is the midquote prevailing just before the subsequent trade. The permanent impact captures the long-run change in asset values as a result of a trade. The temporary (liquidity-based) component is measured as $\ln(m^{post}/Pri)$, where Pri is the trade price. The temporary impact is interpreted as the price movement necessary to compensate the liquidity provider for accommodating the initiator's desire for immediacy. The percentage price impact of the trade is the sum of the permanent and temporary impacts.

These measures presume that the pre-trade reference price is an accurate assessment of the asset's underlying value or "unperturbed" price prior to the transaction. For a thinly traded asset such as an exchange seat, the pre-trade price may be a biased measure of this value if bid and offer quotes are stale. For example, consider a sell trade following a decline in the overall stock market. If the quotes are stale, the reference (pre-trade) price will be too high, and the permanent impact will be overstated. Although stale quotes represent a potentially serious problem, note that most transactions occur on days where there have been several quote revisions. Indeed, there are approximately *three quote revisions* just prior to a trade. Nevertheless, as a robustness check, we computed the percentage movement in the S&P 500 from the time of the previous trade to the current trade for buys and sells.

We estimated the two components of trade impact separately for the 344 buys (i.e., those transactions that take place at the ask quote that prevailed before the trade) and 286 sells (i.e., those transactions that take place at the bid) in our sample, excluding the

[13] See, e.g., Kraus and Stoll (1972), Scholes (1972), Holthausen, Leftwich, and Mayers (1987), Keim and Madhavan (1996), among others.

55 uncategorized transactions. The permanent impacts are economically and statistically significant. The average permanent impact for buys is 2.55 percent and for sells is -2.43 percent, and these magnitudes are very close to the estimates in equation (8). Interestingly, buy (sell) trades are associated with positive (negative) market movements, but these movements (0.82 percent for buys and -0.38 percent for sells) are not large compared to the impacts. Thus, even though there is a tendency for trade-initiation to be correlated with market movements, the transaction price is still permanently revised in the direction of trade initiation. This is consistent with there being an information content to trade initiation, possibly because some brokers have information about their own order flows and hence private signals regarding future trading activity. The estimates of the temporary component are also economically significant, but are smaller in magnitude. Temporary impacts are higher for sells (-2.24 percent) than buys (1.47 percent). The reason for this asymmetry is unclear. It is possible that sells occur more often in downward markets when the brokerage sector is distressed and potential buyers can extract greater rents from sellers. There are no systematic patterns in the permanent or temporary impacts for unclassified trades.

In summary, the results here confirm our general findings from the statistical model discussed above. Even net of market movements, the price impacts are large when compared with the corresponding figures for large-block trades in equity markets. The fact that seat price movements contain a permanent price component indicates that market participants revise their beliefs in response to trades, i.e., trades are perceived to contain information about future asset values.

5.3. Evidence on Spreads

We find strong evidence that quoted spreads are narrower prior to a transaction and are wider after a trade. The percentage bid-ask spread two quotations before a transaction is 12.68 percent, while the corresponding spread two quotations after the trade is 21.56 percent, close to the overall sample average. A paired t-test for the equality of two sample means strongly rejects (with a t-statistic of 18.79) the null hypothesis that the difference in pre- and post-trade spreads are zero. This behavior is predicted by our model and is consistent with the actual trade represented in table 1. Specifically, a transaction occurs when the distribution of beliefs of buyers and sellers overlap, so that the most pessimistic seat owner trades with the most optimistic potential buyer. Following a trade, the gap in reservation values between the next most pessimistic potential seller and the next most optimistic potential buyer must be larger. If quotes are determined competitively between potential buyers and sellers, it follows that the spread following a trade must be wider than that prevailing before the trade.

5.4. Using Seat Bid-Ask Spreads to Predict Stock Returns

In this section we test the ability of changes in seat bid-ask spreads to predict market excess returns. Recall that the implicit bid-ask spread for exchange seats is an increasing function of the magnitude of divergence in opinion of market participants. Thus, changes in the spread reflect changes in the divergence in expectations about future market returns. Merton (1980) makes the point that the equilibrium expected return for the market is an increasing function of the risk of the market, and argues that models of the market risk premium must account for changes in the level of market risk. He goes on to suggest that the model can be improved by inclusion of additional non-market instruments for market risk, such as surveys of investor expectations. Our seat spread variable represents a market-determined observation on such expectations. If changes in the heterogeneity of expectations ($\Delta\sigma_t$) have predictive power, we expect changes in lagged seat spreads to, likewise, have predictive power.

Accordingly, we estimate the following regression

$$r_{m,t} = a_0 + a_1\, r_{m,t-1} + a_2\, \text{dspread}_{t-1} + a_3\, \text{dspread}_{t-2} + a_4\, \text{dspread}_{t-3} + e_t \qquad (9)$$

where: $r_{m,t}$ is the excess return on the S&P 500 Index for month t; and $\text{dspread}_t = \text{spread}_t - \text{spread}_{t-1}$, where spread_t is defined as $(\text{Ask}_t/\text{Bid}_t) - 1$, and Ask_t and Bid_t are the last quotes prevailing before the last trade of month t. Our model suggests a positive relation between market excess returns and lagged spread changes – wider spreads signify greater dispersion in beliefs. We employ several lagged values of spread changes because we have no strong priors on the intensity of the forward-looking expectations implied in seat quotes.

Panel A of Table 4 reports estimates of the coefficients for the 1973-1994 period.[14] We find evidence that lagged changes in the bid-ask spread have predictive power for future excess market returns. The coefficients a_3 and a_4 are positive and significant. The observed relation is consistent with an increase in the expected risk premium following an increase in the dispersion in beliefs, manifested by a wider pre-trade spread (Merton (1980)).

Recent research finds similar patterns of predictability in stock returns. For example, Campbell (1987) and Keim and Stambaugh (1986) use ex ante observable stock and bond market variables that capture the level of asset prices, default premium, and term structure slope to predict monthly stock and bond returns; Fama and French (1988) and Harvey (1991) use the dividend yield for the U.S. equity market to predict stock returns domestically and internationally, respectively; and Kothari and Shanken (1997) and Pontiff and Schall (1998) use the book-to-market ratio for the overall market to predict stock returns. To assess the possibility that our spread variable is proxying for these previously-examined variables, we estimate an expanded version of eq. (9) that includes the following ex ante observable variables used in Pontiff and Schall (1998).[15] BM is the Dow-Jones book-to-market ratio. DEF is the low-grade bond default premium. $TERM$ is the average yield of Treasury bonds with more than ten years to maturity minus the yield of T-bill that mature in three months. $TBYLD$ is the yield of a T-bill that matures in three months. DIV is the annual dividend yield of the CRSP value-weighted index measured monthly, as described in Fama and French (1988). We find that our lagged seat spread variables are individually uncorrelated with these five additional variables. The estimation of the expanded version of eq. (9), shown in Panel B of Table 4, shows that

[14] We also estimated eq. (9) excluding October 1987 and the results are the same.

[15] We thank Jeff Pontiff and Larry Schall for generously providing these data.

the inclusion of the additional ex ante observable variables does not materially impact the estimated coefficients, or the significance, of the seat spread variables. Further, the coefficient estimates and significance levels for the five additional variables are comparable to those reported by Pontiff and Schall (1998) for the 1959-1994 period (see their Table 3, Panel B).

5.5. Trading Activity and Dispersion in Beliefs

Public trades in exchange seats reflect decisions of traders to enter and exit from brokerage, and as such are of considerable interest. As noted above, we expect trades to occur when the distribution of reservation prices exhibits greater variation. Indeed, it is the differences in opinion among existing brokers and potential entrants which makes trade mutually beneficial.

Recall that the number of trades reflects the underlying heterogeneity in the distribution of beliefs regarding the future cash flows from exchange membership. A trade is mutually beneficial only if the time-varying dispersion in beliefs exceeds the entry costs at time t, i.e., if $d_t > \frac{\Psi}{2}$. Let n_t denote the number of trades in seats in a given time period t, where n_t takes on integer values. The discrete nature of the dependent variable (including the large number of observations for which there is no trade) suggest that standard regression models are inappropriate. Rather, we use a count data model, where n_t is assumed to be drawn from a Poisson distribution with mean parameter λ_t.

The model is:

$$\Pr[N_t = n_t] = \frac{e^{-\lambda_t}\lambda_t^{n_t}}{n_t!} \tag{10}$$

for $n_t = 0, 1, \ldots$. The expected number of trades in a given period is $E[Q_t] = \lambda_t$. In many count data models, the time-varying mean is modeled as a log-linear function of a vector of explanatory regressors, x_t, i.e.,

$$\ln(\lambda_t) = \beta' x_t. \tag{11}$$

There is a direct analogy between this formulation and the classical regression model. In the classical regression model, the error term is usually modeled as normal and the link function (relation between the mean of the dependent variable and the regressors) is the identity function. By contrast, in this formulation, the error process is Poisson and the link function is logarithmic.

It is straightforward to show that the log-likelihood function is

$$\ln(L) = \sum_t [-\lambda_t + n_t \beta' x_t - \ln(n_t!)]. \tag{12}$$

The first derivative of the likelihood function yields

$$\frac{\partial \ln(L)}{\partial \beta} = \sum_t (n_t - \lambda_t) x_t. \tag{13}$$

Similarly, the Hessian is

$$\frac{\partial^2 \ln(L)}{\partial \beta \partial \beta'} = -\sum_t \lambda_t x_t x_t'. \tag{14}$$

Using the expression for the derivative of the log-likelihood function, the maximum likelihood estimates for this model are easily computed. The asymptotic variance-covariance matrix of β is then computed as the inverse of the estimated Hessian matrix.

We estimate the model using monthly trading data on NYSE seats. In particular, we use an extension of the Poisson model suggested by McCullagh and Nelder (1983) to correct for possible overdispersion.[16] Our discussion above suggests that the probability of trading is directly related to the dispersion in prior beliefs regarding future stock market activity. Consequently, we include as regressors proxies for the prior distribution in beliefs. The variables included in the vector x_t are the contemporaneous absolute market return, the lagged absolute market return, and the difference between the high and low transaction price as a percentage of the average midquote price. The range variable captures the dispersion in beliefs, and is also correlated with trading activity in the previous period. We expect these measures of volatility and dispersion to enter positively.

Table 5 presents the maximum likelihood estimates of the Poisson model with asymptotic standard errors in parentheses using monthly data. The model performs well and

[16] The Poisson model imposes the restriction that the variance of n_t equals its mean, whereas in practice, count data often exhibit overdispersion in that the variance exceeds the mean.

the null hypothesis that the independent variables have no explanatory power is rejected. As expected, the contemporaneous market volatility is positive and is close to being statistically significant at the 5 percent level. Lagged volatility is relatively insignificant, while the lagged range variable is positive and highly significant. This variable captures much of the uncertainty in seat values, especially during the 1970s, when many important exogenous events affected seat values.[17] The significance of the range variable may also reflect its correlation with lagged trading activity. Indeed, our results can be interpreted as evidence that trading provides the impetus for further trading activity. For example, trading may induce current seat holders to re-evaluate their desire to retain their seats or may stimulate interest by non-members.

We experimented with alternative specifications, including robustness checks using ordinary least-squares, and obtained similar results. Our findings support our conjecture that differences in beliefs are associated with trading activity and volumes in the exchange seat market. These findings are also consistent with our earlier estimates of the determinants of seat price movements at the transaction level.

6. Conclusions

Stock exchange seats are capital assets whose prices reflect the expectations of market professionals regarding future activity in the equity market as a whole, and for this reason are of particular interest to financial economists. In addition, the seat market resembles the canonical example of a limit order book system, and as such is of interest from a microstructure perspective. This paper examines the determinants of seat price movements and trading activity using unique data from the auction market for New York Stock Exchange (NYSE) seats.

Our analysis shows that the bids, offers, and transaction prices for exchange seats contain information about the dispersion in beliefs regarding aggregate stock market trading

[17] These include the recession of 1973-74 and associated stock market declines, the elimination of fixed commissions in 1975, the introduction of the DOT electronic trading system in 1976, changes in bylaws to allow leasing of seats in 1978, the introduction of the Intermarket Trading System and the entry of foreign brokers in 1978. These events were associated with large numbers of trades.

activity. We find that price changes associated with seat transactions contain a significant permanent (information) component of about 2.5 percent, suggesting that market participants revise their beliefs about future market activity in response to trades. Further, we find that trading activity in the seat market increases with greater dispersion in beliefs about future market activity, which is consistent with the observed positive relation between price variability and volume in other asset markets. Finally, we find that spread changes in the seat market predict future stock market returns. This relation may reflect an increase in the expected risk premium following an increase in the dispersion in beliefs, as manifested by a wider pre-trade spread. Alternatively, the observed predictability may reflect a liquidity premium. Specifically, changes in seat spreads may be inversely related to a time-varying *market* liquidity factor which in turn affects expected stock returns. Finally, our model provides new insights into the determinants of bid-ask spreads in limit order book markets, i.e., that they may reflect heterogeneity in beliefs rather than asymmetric information or dealer inventory costs.

The prices of exchange seats are widely reported and are closely watched by many investors and market professionals. Our analysis suggests that there are sound reasons for this interest – seat prices contain important information about the beliefs of traders regarding future stock market activity.

References

Bagnoli, M., and R. Battalio, 1996, "CBOT Membership Prices and the Value of Specialization: Theory and Evidence, 1982-86," Working paper, Indiana University.

Campbell, J. Y., 1987, "Stock Returns and the Term Structure," *Journal of Financial Economics*, 18, 373–400.

Chalmers, J. M. R., and G. B. Kadlec, 1998, "An Empirical Examination of the Amortized Spread," *Journal of Financial Economics*, 48, 159–188.

Chiang, R., G. Gay, and R. Kolb, 1987, "Commodity Exchange Seat Prices," *Review of Futures Markets*, 6, 1–10.

Doede, R., 1967, "The Monopoly Power of the New York Stock Exchange," Working paper, University of Chicago; Unpublished Dissertation.

Fama, E., and K. R. French, 1988, "Dividend Yields and Expected Stock Returns," *Journal of Financial Economics*, 22, 3–25.

Fama, E., and K. R. French, 1993, "Common Risk Factors in the Returns on Stocks and Bonds," *Journal of Financial Economics*, 33, 3–56.

Harris, M., and A. Raviv, 1993, "Differences of Opinion Make A Horse Race," *Review of Financial Studies*, 6, 473–506.

Harvey, C., 1991, "The World Price of Covariance Risk," *Journal of Finance*, 46, 111–157.

Holthausen, R., R. Leftwich, and D. Mayers, 1987, "The Effect of Large Block Transactions on Security Prices: A Cross-Sectional Analysis," *Journal of Financial Economics*, 19, 237–267.

Ip, G., and D. Lohse, 1998, "Nasdaq Plan with AMEX set for Vote," *The Wall Street Journal*, March 18, C1.

Jarrell, G. A., 1984, "Change at the Exchange: The Causes and Effects of Deregulation," *Journal of Law and Economics*, 27, 273–312.

Keim, D. B., and A. Madhavan, 1996, "The Upstairs Market for Large-Block Transactions: Analysis and Measurement of Price Effects," *Review of Financial Studies*, 9, 1–36.

Keim, D. B., and A. Madhavan, 1998, "The Cost of Institutional Equity Trades," *Financial Analysts Journal*, 54, 50–69.

Keim, D. B., and R. F. Stambaugh, 1986, "Predicting Returns in the Stock and Bond Markets," *Journal of Financial Economics*, 17, 357–390.

Kothari, S. P., and J. Shanken, 1997, "Book-to-Market, Dividend Yield, and Expected Market Returns: a Time Series Analysis," *Journal of Financial Economics*, 44, 169–203.

Kraus, A., and H. Stoll, 1972, "Price Impacts of Block Trading on the New York Stock Exchange," *Journal of Finance*, 27, 569–588.

McCullagh, P., and J. Nelder, 1983, *Generalized Linear Models*, Chapman and Hall, New York.

McGee, S., 1998, "Stocks are in Stratosphere, by Some Measures," *The Wall Street Journal*, March 4, C1.

Merton, R. C., 1980, "On Estimating the Expected Return on the Market: An Exploratory Investigation," *Journal of Financial Economics*, 8, 323–361.

Pontiff, J., and L. D. Schall, 1998, "Book-to-Market Ratios as Predictors of Stock Returns," *Journal of Financial Economics*, 49, 141–160.

Scholes, M., 1972, "The Market for Securities: Substitution versus Price Pressure and the Effects of Information on Share Price," *Journal of Business*, 45, 179–211.

Schwert, G. W., 1977a, "Public Regulation of National Securities Exchanges: A Test of the Capture Hypothesis," *Bell Journal Of Economics*, 8, 128–150.

Schwert, G. W., 1977b, "Stock Exchange Seats as Capital Assets," *Journal of Financial Economics*, 4, 51–78.

Schwert, G. W., 1990, "Indexes of U.S. Stock Prices from 1802 to 1987," *Journal of Business*, 63, 399–426.

Siegel, J., 1992, "The Equity Premium: Stock and Bond Returns Since 1802," *Financial Analysts Journal*, 48, 28–38.

Stoll, H., 1979, "Regulation of Securities Markets: An Examination of the Effects of Increased Competition," Working paper, Monograph Series in Finance and Economics; New York University, Graduate School of Business Administration.

Working, H., 1960, "Note on the Correlation of First Differences of Averages in a Random Chain," *Econometrica*, 28, 916–918.

Table 1

Sample Chronological Record of Bids, Offers and Trades

The table reports sample quotation records for the NYSE seat market (obtained from the NYSE) for Monday, July 21, to Wednesday, July 23, 1986. Each record shows the prevailing bid, offer or trade price (with the identities of the traders) at the time of the transaction or change in quotes. All prices are in thousands of dollars.

Date	Time	Bid		Ask		Transaction	
		Price	Identity	Price	Identity	Price	Direction
Monday, 7/21	Open	$505	S	$600	W		
Tuesday, 7/22	Open	505	S	600	W		
	11:15					$505	Sell ($T \rightarrow$ S)
	12:00	410	G	600	W		
	13:00	430	G	600	W		
	13:30	430	G	550	L		
	14:25	435	B	550	L		
Wednesday, 7/23	Open	435	B	550	L		
	10:40	450	A	550	L		
	12:19	460	B	550	L		

Table 2

Return and Risk of NYSE Seats: 1973-1994

The regression model is:

$$R_t - R_{Ft} = a + b_1\, r_{m,t} + b_2\, r_{m,t-1} + b_3\, r_{m,t-2} + c_1\, SMB_t + c_2\, HML_t + c_3\, vol_t + c_4\, vol_{t-1} + e_t$$

where $r_{m,t} = R_{mt} - R_{Ft}$, SMB_t is a monthly size premium (small stock return - large stock return), HML_t is a monthly book/market premium (high B/M return - low B/M return), and vol_t is $ln(v_t/v_{t-1})$ where v_t is the aggregate NYSE share volume. SMB_t, HML_t and $r_{m,t}$ are the three factors used in Fama and French (1993). Standard errors are in parenthesis.

	Mean Return (Standard Deviation)		Estimated Regression Parameters (Standard Error)								
	NYSE Seat	S&P 500	Intercept	$r_{m,t}$	$r_{m,t-1}$	$r_{m,t-2}$	SMB_t	HML_t	vol_t	vol_{t-1}	Adjusted R^2
1/73–7/94	0.0134	0.0093	0.0027	0.4136	0.3894	0.3245	0.8464	0.0122	0.0943	0.0538	0.141
($n = 230$)	(0.1241)	(0.0459)	(0.0080)	(0.1971)	(0.1754)	(0.1630)	(0.3019)	(0.3379)	(0.0516)	(0.0524)	
1/73–9/87	0.0185	0.0099	0.0075	0.4225	0.3035	0.5198	0.9337	−0.2685	0.0873	0.0653	0.153
($n = 148$)	(0.1297)	(0.0466)	(0.0106)	(0.2678)	(0.2309)	(0.2074)	(0.3851)	(0.4245)	(0.0675)	(0.0673)	
10/87–7/94	0.0041	0.0080	−0.0050	0.3418	0.5396	−0.2004	0.8523	0.7428	0.0845	0.0639	0.100
($n = 81$)	(0.1134)	(0.0446)	(0.0122)	(0.3113)	(0.3063)	(0.2842)	(0.5305)	(0.5857)	(0.0956)	(0.1002)	

Table 3

Determinants of NYSE Seat Price Movements

This table contains estimates of a model of transaction prices in NYSE seats, estimated over the period 1/73–7/94 using non-linear least squares. The model is

$$p_t - p_{t-1} = \beta r_{m,t} + (\xi + \sigma(X_t))z_t - \sigma(X_{t-1})z_{t-1} + e_t$$

where p_t is the natural log of the seat price at time t and z_t is a trade initiation variable taking the value +1 for buys, −1 for sells, and 0 for crossed trades. We model σ_t as a log-linear function, $\ln(\sigma(X_t)) = \gamma_0 + \gamma_1|r_{m,t}| + \gamma_2 \ln(m_t)$, where $r_{m,t}$ is the market return and m_t is the pre-trade midquote.

Estimated Parameters (Standard Error)						
β	ξ	γ_0	γ_1	γ_2	Adjusted R^2	N
0.3775	0.0240	−0.5037	13.8736	−0.8627	0.2445	684
(0.1087)	(0.0037)	(1.3051)	(3.3777)	(0.3244)		

Table 4

Using Quoted Bid-Ask Spreads on Stock Exchange Seats to Predict Stock Market Returns

We use the following model to test whether changes in the divergence of opinion, as reflected in quoted NYSE seat spreads, can predict future market returns

$$r_{m,t} = a_0 + a_1\, r_{m,t-1} + a_2\, \text{dspread}_{t-1} + a_3\, \text{dspread}_{t-2} + a_4\, \text{dspread}_{t-3} + a_5\, BM_{t-1} + a_6\, DEF_{t-1} + a_7\, TERM_{t-1} + a_8\, TBYLD_{t-1} + a_9\, DIV_{t-1} + e_t$$

where: $r_{m,t}$ is the excess return on the S&P 500 Index for month t; $\text{dspread}_t = \text{spread}_t - \text{spread}_{t-1}$, where spread_t is defined as $(\text{Ask}_t/\text{Bid}_t) - 1$, and Ask_t and Bid_t are the last quotes prevailing before the last trade of month t; *BM* is the Dow Jones book-to-market ratio; *DEF* is the low-grade bond default yield premium; *TERM* is the average yield of Treasury bonds with more than ten years to maturity minus the yield of T-bills that mature in three months; *TBYLD* is the yield of a T-bill that matures in three months; and *DIV* is the annual dividend yield of the CRSP value-weighted index measured monthly, as described in Fama and French (1988). The last five variables are from Pontiff and Schall (1998) who describe their construction in more detail. Estimates below are for the January 1973–June 1994 period. Heteroskedasticity-consistent t-values are in parentheses.

a_0	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	Adjusted R^2
A.										
0.0045	−0.0285	0.0278	0.1053	0.1508						0.065
(1.52)	(−0.44)	(0.79)	(2.68)	(4.37)						
B.										
−0.0700	−0.0584	0.0139	0.0974	0.1453	−9.1592	2.6540	−0.1016	−0.6501	4.0907	0.158
(−3.49)	(−0.76)	(0.49)	(2.03)	(3.78)	(−3.31)	(2.51)	(−0.31)	(−2.66)	(3.82)	

Table 5

A Poisson Model of Trades in NYSE Seats

The table contains Maximum likelihood estimates of a Poisson model with mean parameter λ_t where

$$\ln(\lambda_t) = \lambda_0 + \lambda_1 |R_{mt}| + \lambda_2 |R_{mt-1}| + \lambda_3 \, RNG_{t-1}$$

where R_{mt} is the market return and RNG_{t-1} is the ratio of the high less the low seat price relative to midquote in the previous month. Estimates correct for potential overdispersion as suggested by McCullagh and Nelder (1983). Figures in parentheses are asymptotic standard errors and values in the bottom row are the χ^2 values from the Wald tests.

	Estimated Parameters					
	λ_0	λ_1	λ_2	λ_3	Deviance	χ^2
Estimate	0.8770	0.0303	-0.0221	2.4709	422.05	195
Standard Error	(0.1115)	(0.0164)	(0.0174)	(0.4808)		
Wald χ^2		3.3953	1.6159	26.3057		

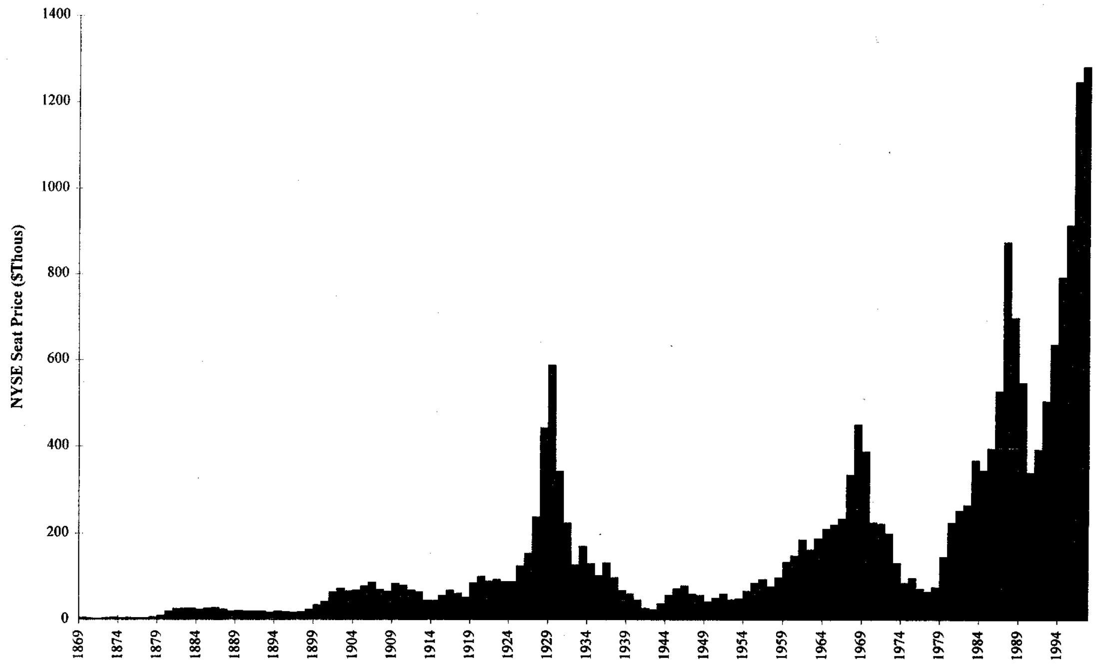

Figure 1. New York Stock Exchange Seat Prices, 1869-1997.

The figure plots the year-by-year average of the annual high and low (nominal) transaction prices for stock exchange seats.

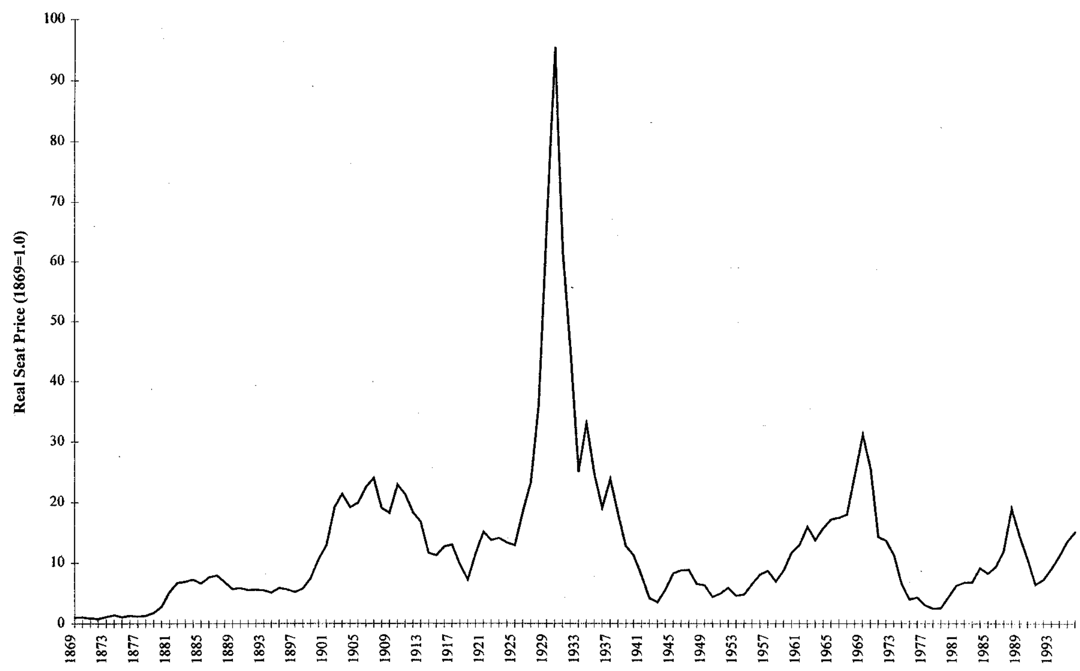

Figure 2. Real New York Stock Exchange Seat Index, 1869-1997.

The figure plots an inflation-adjusted seat price index. The series is constructed using the nominal series in figure 1, deflated by a price level series from Siegel (1992), and rescaled to $1 in 1869.

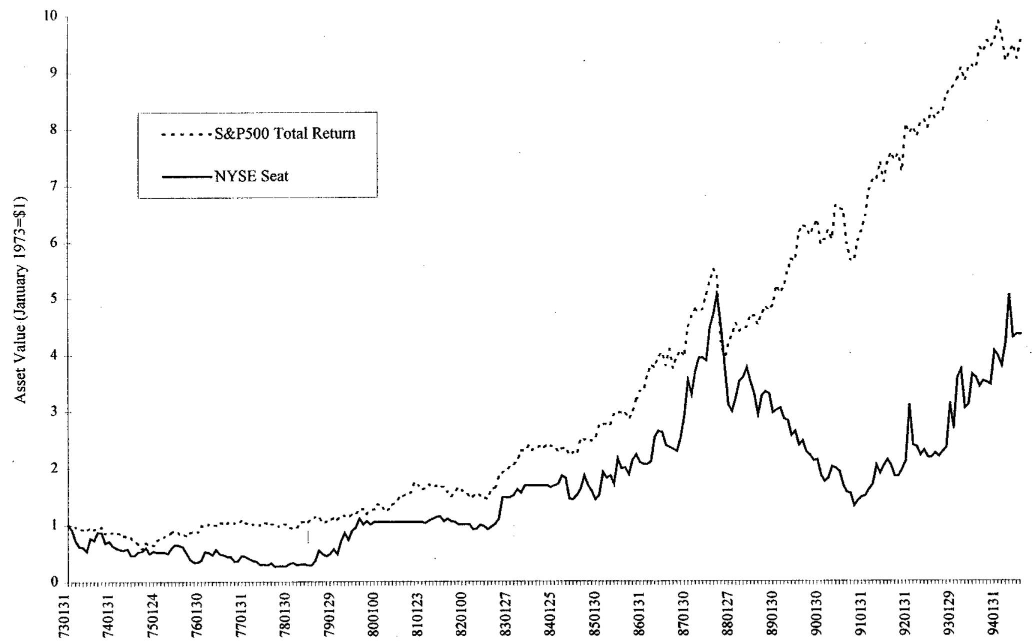

Figure 3. NYSE Seat Index vs. S&P 500 Stock Index, 1973-1994.

The figure plots the month-by-month value of nominal wealth indexes (normalized to $1 in January 1973) for NYSE seat prices and the S&P 500 Index, based on monthly returns.

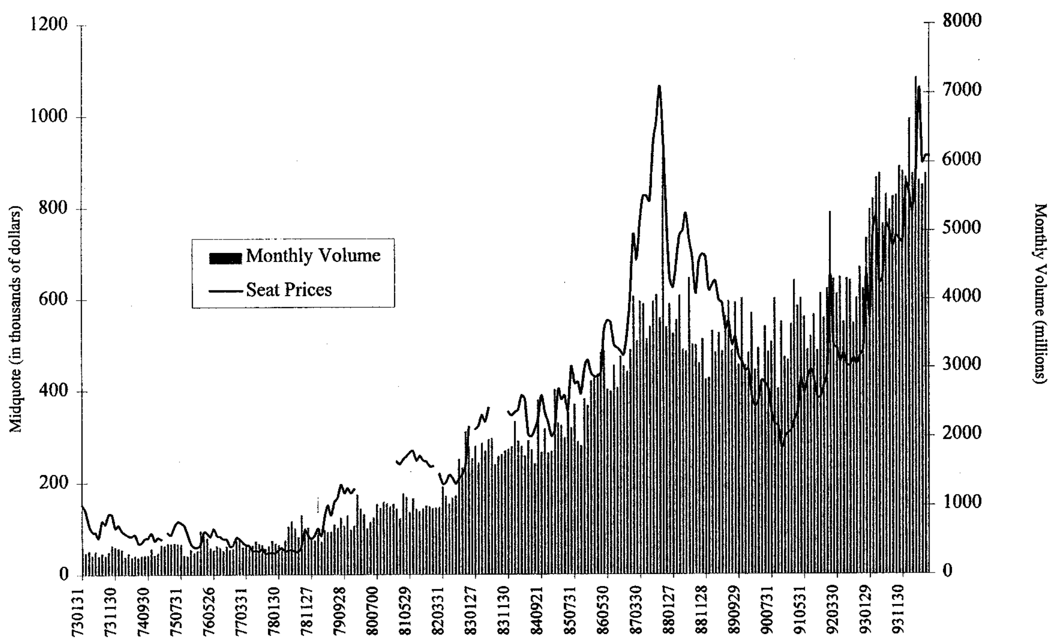

Figure 4. Monthly NYSE Seat Prices vs. NYSE Monthly Trading Volume, 1973-1994.

The figure plots the (nominal) NYSE seat price, corresponding to the transaction closest to the end of the month, and the monthly aggregate trade volume for the NYSE for the period January 1973 to July 1994.