Ownership structure, liquidity, and trade informativeness

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ABSTRACT

In this paper, we examine the relationship between ownership structure (or number of financial analysts following) and liquidity and trade informativeness. We find that insider ownership is negatively correlated with liquidity after controlling for price, volatility, trading volume, and market capitalization. In addition, stocks with higher institutional ownership or larger number of financial analysts following have better liquidity. Furthermore, we find a stock with higher insider and institutional ownership has higher informativeness of trades. These results imply that there is more informed trading for stocks with higher insider and institutional ownership, and market makers believe that insiders and institutional investors are informed traders.

Keywords: insiders, financial institutions, financial analyst, liquidity, trade informativeness

1. INTRODUCTION

For the last couple of decades, financial researchers have debated over who is informed and who can access better information. Literature documents that insiders, financial institutions, and financial analysts could access or have better information than individual investors. The insiders could have better information that is not fully reflected in the stock price at that point. Supporting the argument, Seyhun (1986) finds that insiders make abnormal returns in trading their company's stock, and that their trading has a significant influence on their company's stock price. In addition, Demsetz and Lehn (1985) and Denis and Denis (1994) find that firm managers with high insider ownership have information advantages.

Also, institutional investors may have better information than individual investors even though they may not be able to access as much information as rapidly as insiders. The institutional investors may use their resources to access the information that individual investors are not able to access. Chiang and Venkatesh (1988) assume that insiders and institutional investors create information asymmetry because they know more than individual investors. The authors show that the bid-ask spread is not related to institutional ownership but is significantly positively related to insider ownership. In addition, Grullon and Wang (2001) assume that institutional investors are informed traders and individual investors are uninformed traders because institutional investors have an advantage by exploiting economies of scale in information acquisition and processing.

Chung et al. (1995), Brennan and Subrahmanyam (1995) and Easley et al. (1998) performed studies on financial analysts following in the microstructure area. Chung et al. (1995) find that financial analysts tend to follow stocks with greater bid-ask spreads. Van Ness, Van Ness, and Warr (2001) also show that the adverse selection component of the bid-ask spread is positively related to the number of analysts following a firm. Womack (1996) use the number of financial analysts following as a proxy for the amount of information available on a firm. However, Brennan and Subrahmanyam (1995) find that firms with more analysts following exhibit better liquidity such as smaller bid-ask spread and larger depth. In addition, Easley et al. (1998) document that the number of analysts following a firm is not a good proxy for informational asymmetry. Therefore, the relationship between financial analysts following and stock market liquidity and information asymmetry remains a research question.

Moreover, because insiders may be able to access better information than institutional investors or financial analysts, there is a clear relationship between insider ownership and information asymmetry. If insiders do have better information, a market maker's trading strategy for a stock with high insider ownership would be different from one with low insider ownership. Also, as mentioned, institutional investors and financial analysts may have an informational advantage because they can exploit economies of scale in information acquisition and processing. Thus, a market maker's trading strategy for a stock with high institutional ownership and/or a large number of analysts following would be different from that of companies with low institutional ownership and/or a small number of analysts following.

Higher information asymmetry may drive a stock with high insider ownership to have wider spreads than those with low insider ownership. Kyle (1985), Copeland and Galai (1983), and Glosten and Milgram (1985) predict that greater information asymmetry between informed and liquidity traders will lead to wider spreads. Insiders could be either informed traders or liquidity providers, but both sell their stocks when they believe the stocks are overvalued and buy stocks when they believe the stocks are undervalued. They could assess the intrinsic value

of stocks with better information. Market makers, therefore, increase their spreads to protect their profits or loss from informed traders who have superior information over market makers or liquidity traders. In addition, Lee et al. (1993) and Kavajecz (1999) find that market makers both widen the spreads and decrease the depths at times of high informational asymmetry or trade with possible informed traders in order to manage their information asymmetry risk.

On the other hand, relationships between spreads and the institutional ownership or analysts following are not clear because higher institutional ownerships are concentrated on larger firms and more analysts follow larger firms. This means that the percentage of institutional ownership and the number of analysts following are positively correlated with firm size and trading volume. As other researchers have noted, the firm size and spreads are negatively related. This indicates that a firm with higher institutional ownership or with more analysts following may have smaller spreads than a firm with lower institutional ownership or a smaller number of analysts following. Therefore, in this evidence, the spreads may not be a good proxy for information symmetry if we do not control other variables such as price, volume, market capitalization, and volatility.

There are two empirical studies investigating the issue of ownership structure and information asymmetry. Sarin et al. (2000) find that higher insider and institutional ownership are both associated with wider spreads and smaller depth. Dennis and Weston (2001), however, document that institutional ownership and spreads are negatively related. Both studies show that adverse selection costs and insider ownership have a positive relationship. However, the information asymmetry proposed by Copeland and Galai (1983) and Glosten and Milgram (1985) predict that greater information asymmetry leads to wider spreads.

In this paper, we investigate the relationship between ownership structure (i.e., the percentage of shares held by financial institutions or insiders) or financial analysts following a firm and liquidity and trade informativeness.

Although this study is related to that of Sarin et al. (2000) and Dennis and Weston (2001), it is different in several ways. First, the most recent insider ownership data from Compact Disclosure is used. Anderson and Lee (1997) found that the Compact Disclosure has the most reliable ownership data as compared to other sources of ownership structure data. The study by Sarin et al. (2000) used outdated insider ownership data from 1984 Value Line. Second, we construct comparable low and high insider ownership stocks and directly compare the relationship between insider ownership and information asymmetry. Our sample shows that smaller firms have a higher tendency toward insider ownership. Chung and Charoenwong (1998) show that the percentage of insider trading in small firm groups is significantly higher than that in large firm groups. Therefore, without a one to one matching for low and high insider ownership stocks, we would have a biased result for the relationship between insider ownership and information asymmetry. To eliminate this problem, following Huang and Stoll (1996), we construct matching pairs for low and high insider ownership stocks. Third, we use Hasbrouck's price impact model to investigate this relationship

Our findings are as follows: A stock with higher insider ownership tends to have lower liquidity (wider spread and smaller depth) after controlling for price, volume, market capitalization, and volatility. Also, a stock with higher institutional ownership or larger number of financial analysts has better liquidity. Lastly, our empirical results indicate that insider ownership and institutional ownership are positively correlated with informativeness of trades. However, we do not find a similar relationship for financial analysts following.

In section II and III of this paper, we discuss data and methodology, in section IV, we analyze the empirical results, and in the final section, we summarize the results.

2. DATA

For this study, the Compact Disclosure 2000 is used to determine the number of shares owned by directors and officers and the percentage of institutional ownership. Anderson and Lee (1997) documented that the Compact Disclosure has the best ownership data compared to other sources. To normalize the size of firms, the number of shares owned by officers and directors is divided by the total number of shares outstanding, which gives the percentage of insider ownership for each firm. In addition, the number of financial analysts following used in this study is taken from the Institutional Brokers Estimation System (I/B/E/S) database.

After retrieving data from the Compact Disclosure and I/B/E/S, the original samples are matched with CRSP by CUSIP. The stocks with average annual share price of less than $5.00 or greater than $100 are excluded. In addition to this price filtering, the stocks that split their shares in the sample period and the stocks that announced splits without actual splitting are also eliminated. This follows the work of Muscarella and Vetsuypens (1996), Lipson (1999) and Schultz (2000). They find that the stock splits and split announcements affect a stock's volatility and transaction costs due to the change in information asymmetry. They also find that, after stock splits, the liquidity significantly improves. The non-U.S. stocks are also deleted because Bacidore and Sofianos (2001) find that the bid-ask spreads for the non-U.S. stocks are higher than those of a matched sample of domestic stocks.

After the filtering, the final samples are reduced to 838, 1,491, and 1,532 firms for insider ownership, institutional ownership and number of financial analysts following, respectively. The quote and trade data are retrieved from the NYSE's Trade and Quote (TAQ) database during the period of July to September in 2000. Each quote observation in the data file includes ticker symbol, quote date, time-stamp, bid price, ask price, bid-depth, ask-depth, and exchange code.

To clean the data for errors, the following trades and quotes are deleted: a) trades and quotes if they were out of time sequence or involved an error; b) quotes if either the ask price or the bid price were equal to or less than zero; if either the bid or ask depth were equal to or less than zero; c) trades if either the price or volume were equal to or less than zero; d) quotes with a spread less than zero or wider than $4; e) quotes and trades related to trading halts, before the open and after the close; e) trades and quotes with the trade price, ask, or bid change greater than 10% comparing to the last observation.

Table 1 shows the descriptive statistics in the sample period of July to September 2000. Share price is the average of daily mid quotes. Return volatility is the standard deviation of daily returns computed using mid-quote to mid-quote prices. Daily trading volume is the average daily trading volume over our sample period. We obtain the Market Capitalization from CRSP. Panel A of Table 1 shows that the mean percentage insider ownership for the sample is 12.82% and, for 75% of firms, the insider percentage ownership is less than 20%. For institutional ownership, Panel B of Table 1 shows that the average percentage institutional ownership is about 47.56%. In addition, the number of financial analysts following a firm ranges from 1 to 40 and the average is 9 analysts following a firm.

Using these samples, we investigate the relationship between ownership structure or the number of financial analysts following a firm and other variables such as share price, daily trading volume, return volatility and market capitalization. Table 2 shows that insider ownership

is negatively correlated with market capitalization and trading volume. However, the percentage of institutional ownership and number of analysts are positively correlated with those variables. More importantly, the table shows that, consistent with Bhushan (1989), the percentage of insider ownership is negatively correlated with institutional ownership and the number of analysts following a firm. Overall, this result implies that smaller firms have greater tendency toward higher insider ownership, and institutions prefer a large firm to a small firms. In addition, more analysts follow large firms.

3. METHODOLOGY

3.1. Liquidity: spreads and depth

There are two types of traders in the market, informed and uninformed traders (liquidity traders). To minimize their risk and reduce their loss to informed traders, market makers make spreads wider in the presence of informed trading. Especially, Lee et al. (1993) and Kavajecz (1999) find that market makers both widen the spread and decrease depth in times of high informational asymmetry.

Denote $A_{i,t}$, $B_{i,t}$, and $P_{i,t}$ as the ask, bid, and trade prices of stock *i* at time *t*, and $M_{i,t} = (A_{i,t} + B_{i,t})/2$ as quote midpoint. The computing procedures for the quote and percentage quote spreads are as following:

- Quoted Spread = $A_{i,t} - B_{i,t}$.
- Percentage Quote Spread = $(A_{i,t} - B_{i,t})/M_{i,t}$.

In addition to the quote and percentage quote spreads, we compute effective spreads and percentage effective spreads using evidence from the work of Lee and Ready (1991) that many transactions take place inside the bid-ask spread[1]. Christie and Huang (1994) and Lee et al. (1993) suggest that the effective spread could be a better measure for transaction costs than the quote spread. To compute the effective spread we used the following equations. The procedure of Lee and Ready (1991) for time disparity between quotes and trades is followed.

- Effective Spreads = $2 \mid P_{i,t} - M_{i,t} \mid$
- Percentage Effective Spread = $2 \mid P_{i,t} - M_{i,t} \mid / M_{i,t}$

Depth is calculated as the sum of number of shares at ask and bid price per quotation.

3.2. Trade informativeness — Hasbrouck (1991b)

Research concerning the informed trading finds that information asymmetry can be captured not only by the adverse selection cost of bid-ask spread, but also by the price impact of the trade because trades convey the private information. In Hasbrouck (1991b), he assumes that trades are motivated by private information and/or exogenous liquidity needs. The trade impact on the security price reflects two types of effect, transient and permanent. The permanent impact is due to market maker's beliefs about the private information content of the trade. So the

[1] Lee and Ready (1991) found that 30% of the transactions in their sample occurs inside spread.

Hasbrouck's (1991b) measure of trade informativeness is actually a measure of permanent price impact of the trades.

The trade informativeness is derived as follows. Assuming q_t is the transaction price or the midpoint of the prevailing bid and ask quotes, $q_t = m_t + s_t$, where m_t is the efficient price (the expected end-of-trading security value conditional on all time-t public information) and s_t is a disturbance that impacts all the transient microstructure imperfections causing q_t to deviate from the efficient price. The efficient price is assumed to evolve as a random walk, $m_t = m_{t-1} + w_t$, where $Ew_t = 0$, $Ew_t^2 = \sigma_w^2$ and $Ew_t w_\tau = 0$ for $\tau \neq t$.

Assuming x_t is the signed trade volume, then the current trade innovation is $x_t - E[x_t \mid \Phi_{t-1}]$, which reflects the private information possessed by informed traders, where Φ_{t-1} is the public information set prior to the trade. The impact of the current trade innovation on the efficient price innovation, i.e. the trade related efficient price innovation, is $E[w_t \mid x_t - E[x_t \mid \Phi_{t-1}]]$. If the absolute measure of trade informativeness is defined as the variance of trade related efficient price innovation, it should be represented by $Var\left(E[w_t \mid x_t - E[x_t \mid \Phi_{t-1}]]\right) = \sigma_{w,x}^2$. And the relative measure is

$$\frac{Var\left(E[w_t \mid x_t - E[x_t \mid \Phi_{t-1}]]\right)}{Var(w_t)} = \frac{\sigma_{w,x}^2}{\sigma_w^2} = R_w^2.$$

Because the variables, such as efficient price innovations, are unobservable, the estimation adopts Hasbrouck's (1991a) vector autoregressive (VAR) model, which is:

$$r_t = a_1 r_{t-1} + a_2 r_{t-2} + \cdots + b_0 x_t + b_1 x_{t-1} + \cdots + \upsilon_{1,t}$$

$$x_t = c_1 r_{t-1} + c_2 r_{t-2} + \cdots + d_1 x_{t-1} + d_2 x_{t-2} + \cdots + \upsilon_{2,t}$$

where $r_t = q_t - q_{t-1}$. The innovations $\upsilon_{1,t}$ and $\upsilon_{2,t}$ are zero-mean, serially uncorrelated disturbances with $Var(\upsilon_{1,t}) = \sigma_1^2$, $Var(\upsilon_{2,t}) = \Omega$, and $E(\upsilon_{1,t}\upsilon_{2,t}) = 0$. Under the assumption of invertibility, the trades and quote revisions may be expressed as a linear function of current and past innovations, i.e. the vector moving average (VMA) corresponding to the above VAR model:

$$r_t = \upsilon_{1,t} + a_1^* \upsilon_{1,t-1} + a_2^* \upsilon_{1,t-2} + \cdots + b_0^* \upsilon_{2,t} + b_1^* \upsilon_{2,t-1} + \cdots$$

$$x_t = c_1^* \upsilon_{1,t-1} + c_2^* \upsilon_{1,t-2} + \cdots + \upsilon_{2,t} + d_1^* \upsilon_{2,t-1} + d_2^* \upsilon_{2,t-2} + \cdots$$

Then, the variance of efficient price innovation σ_w^2 and the absolute (relative) measure of trade informativeness $\sigma_{w,x}^2$ (R_w^2) can be estimated by:

$$\sigma_w^2 = \left(\sum_{t=0}^{\infty} b_i^*\right)\Omega\left(\sum_{t=0}^{\infty} b_i^{*'}\right) + \left(1 + \sum_{t=1}^{\infty} a_i^*\right)^2 \cdot \sigma_1^2$$

$$\sigma_{w,x}^2 = \left(\sum_{t=0}^{\infty} b_i^*\right)\Omega\left(\sum_{t=0}^{\infty} b_i^{*'}\right)$$

$$R_w^2 = \frac{\sigma_{w,x}^2}{\sigma_w^2}$$

In our estimation, we adopt a four-variable VAR model, i.e. the trade variable becomes a column vector of $\left[x_t^0 \quad x_t^1 \quad x_t^2\right]$ in this model. Assuming x_t is the signed trading volume we have $x_t^k = sign(x_t)|x_t|^k$. For the quote revision, we use $r_t = \log(q_t / q_{t-1})$ instead of $r_t = q_t - q_{t-1}$, where q_t is the quote midpoint. We followed the Lee and Ready (1991) procedure to classify the trade as a purchase or a sale.[2] Then the signed trade volume can be obtained by multiplying the trade volume with –1 (or +1) if the trade is a sale (or purchase). Following Hasbrouck (1991b), VAR is truncated at lag 5 and VMA is truncated at lag 10.

4. EMPIRICAL RESULTS

4.1. Descriptions of sample firms with spreads, depths and trade informativeness

We divide our sample for insider ownership, institutional ownership, and financial analysts following a firm into five groups to investigate the variation of spreads, depth and trade informativeness. Table 3 shows the results for each group.

Panel A of Table 3 shows that, except for the smallest insider ownership group, all spread measures (such as dollar quoted spreads, percentage quoted spreads, dollar effective spreads, and percentage effective spreads) monotonically increase with the percentage of insider ownership. These results are consistent with Chiang and Venkatesh (1988) and Sarin et al. (2000) who find that higher insider ownership is associated with wider spreads and inconsistent with Dennis and Weston (2001) who document that insider ownership and spreads are negatively related.

Following Lee et al. (1993) and Kavajecz (1999), we measure depths by different groups of insider ownership because the authors find that market makers both widen the spread and lower the depth at times of high informational asymmetry. Panel A of Table 3 shows that, the depths monotonically decrease with the percentage of insider ownership except for the smallest insider ownership group. Therefore, both spread and depth results are consistent with Lee et al. (1993) and Kavajecz (1999), who found that the market makers increase their spreads and decrease their depths when they have a high probability of trading with informed traders.

Our empirical model for trade informativeness shows that it increases with the percentage of insider ownership. This result implies that there is higher informational asymmetry for higher insider ownership firms. These results are consistent with Sarin et al. (2000) and Dennis and Weston (2001) who find a positive relationship between adverse selection costs and insider ownership.

Chiang and Venkatesh (1988) show that there is no relationship between spreads and institutional ownership. Dennis and Weston (2001) find that the spread is negatively related to the percentage of institutional ownership. However, Kothare and Laux (1995) and Sarin et al. (2000) find that there is a positive relationship between spread and institutional ownership, contrary to these studies. Therefore, there is no agreement in the literature as to the direction of the relationship.

[2] Classify the trades that occur in the middle of the spread using the tick test and other trades as buys (sells) if they are closer to the ask (bids).

In Panel B of Table 3, we present our empirical results for the relationship between spreads and institutional ownership. Like insider ownership, we equally divide the sample into 5 groups by percentage of institutional ownership. The Panel shows that all spread measures decrease with a higher percentage of institutional ownership. Therefore, our results are consistent with Dennis and Weston (2001) who show a negative relationship between spreads and institutional ownership.

However, we do not observe a clear pattern for depth and trade informativeness with institutional ownership. Sarin et al. (2000) documents a negative relationship between adverse selection costs and institutional ownership. However, Dennis and Weston (2001) find that there is a positive relationship between adverse selection costs and institutional ownership. We will investigate this issue with regression in a later section.

In addition to the ownership, we investigate the number of financial analysts following. Panel C of Table 3 shows that all spread measures monotonically decrease with the number of financial analysts. This result indicates that the number of financial analysts is negatively correlated with spreads. This result is inconsistent with Chung et al. (1995), who find that more financial analysts follow stocks with greater bid-ask spreads. Our correlation matrix in Table 2 shows that more analysts follow larger firms, so our results for a negative relationship between the number of financial analysts and spreads is expected because spread is negatively correlated with the size of a firm. However, we do not find a clear relationship between financial analysts and trade informativeness.

4.2. Regression results

To test whether there is any statistical difference between ownership or number of financial analysts following and spreads, depth or trade inforamtiveness, we use regression analysis. We include price, return volatility, average daily trading volume, and market capitalization as control variables in the regression equation to ascertain whether there is a clear effect of the ownership or financial analysts on the spreads, depths, and trade informativeness. The empirical regression results are shown in Table 4.

4.2.1. Spreads and ownership or number of financial analysts following

Panel A of Table 4 shows that the coefficient for the insider ownership is positive and statistically significant with quoted and effective spreads after controlling for price, volume, market capitalization, and volatility. This result is consistent with Chiang and Venkatesh (1988) and Sarin et al. (2000). Before controlling for the variables, our correlation matrix shows that insider ownership and spreads are positively correlated. However, this result is inconsistent with Dennis and Weston (2001) find that the spreads have a statistically significant negative relationship with insider ownership. Our results imply that there is strong positive relationship between insider ownership and spreads.

In addition, the coefficients for institutional ownership are negative and statistically significant even after controlling for price, volume, market capitalization, and volatility. This result shows that institutions prefer lower spread stocks. This is consistent with Dennis and Weston (2001) who find that the spread is negatively related to institutional ownership and is inconsistent with Kothare and Laux (1995) and Sarin et al. (2000) who find positive relationships between institutional ownership and spreads.

The coefficients for the number of financial analysts following in Panel A of Table 4 are negative and statistically significant. This indicates that a stock with a large number of financial analysts following shows better liquidity, which is inconsistent with Chung et al. (1995) who find that more financial analysts follow stocks with greater bid-ask spreads.

4.2.2. Depth and ownership or number of financial analysts following

In addition, we investigate the relationship between ownership or number of financial analysts following and depths following the work of Lee et al. (1993) and Kavajecz (1999), who determine that market makers decrease their depths when they face a higher probability of informed traders. The regression results are shown in Panel B of Table 4. The coefficient for insider ownership is negative but statistically insignificant after controlling for price, volume, market cap, and volatility.

In addition, the coefficient for institutional ownership is negative and significant. This indicates that institutional investors prefer lower depth stocks. But, we do not find any significance for the coefficient of financial analysts following.

4.2.3. Trade informativeness and ownership or number of financial analysts following

Panel C of Table 4 reports the regression results for trading informativeness and ownerships or number of financial analysts following. It shows that the coefficients for insider ownership and the institutional ownership are positive and statistically significant. These results imply that there is a greater tendency toward informed trading for high insider and institutional ownership stocks. This is inconsistent with Sarin et al. (2000) and Easley et al. (1998) who find a negative relationship between information asymmetry and institutional ownership. But our regression result shows that there is no significant relationship between the number of financial analysts following and trade informativeness.

5. CONCLUSION

In order to determine whether there are any relationships between information asymmetry and ownership structure or number of financial analysts following, we use percentage of shares owned by officers and directors as a proxy for insider ownership, the percentage of institutional ownership and the number of financial analysts following a firm. We find that insider ownership is significantly positively correlated with spreads after controlling for price, volume, market capitalization, and volatility. However, our regression results show institutional ownership is negatively correlated with spreads and depths. These results imply that institutions prefer lower spread and depth stocks. The number of financial analysts following is significantly negatively correlated with spreads. This indicates that a stock with a large number of financial analysts following shows better liquidity,

In addition, we investigate the relationship between trade informativeness and ownership structure or number of financial analysts following. Our results indicate that higher insider and institutional ownership have a significant positive relationship with trade informativeness. But there is no such relationship with the number of financial analysts following. These results indicate that there is more informed trading for stocks with higher insider and institutional ownership.

References

Anderson, R. C. & Lee, S. D. (1997). Ownership studies: The data source does matter. *Journal of Financial and Quantitative Analysis*, 32, 311-329.

Bacidore, J. M. & Sofianos, G. (2002). Liquidity provisions and specialist trading in NYSE-listed non-U.S. stocks. *Journal of Financial Economics*, 63, 133-158.

Bhushan, R. (1989). Firm characteristics and analyst following. *Journal of Accounting and Economics*, 11, 255-274.

Brennan, M. J. & Subrahmanyam, A. (1995). Investment analysis and price formation in securities markets. *Journal of Financial Economics*, 38, 361-381.

Chiang, R. & Venkatesh, P. C. (1988). Insider holdings and perceptions of information asymmetry: A note. *Journal of Finance*, 43, 1041-1048.

Christie, W. G. & Huang, R. D. (1994). Market structure and liquidity: A transactions data study of exchange listings. *Journal of Financial Intermediation*, 3, 300-326.

Chung, K. H., McInish, T. H., Wood, R. A. & Wyhowski, D. J. (1995). Production of information, information asymmetry, and the bid-ask spread: Empirical evidence from analysts' forecasts. *Journal of Banking and Finance*, 19, 1025-1046.

Chung, K. H.& Charoenwong, C. (1998). Insider trading and the bid-ask spread. *Financial Review*, 33, 1-20.

Copeland, T. E. & Galai, D. (1983). Information effects on the bid-ask spread. *Journal of Finance*, 38, 1457-1469.

Demsetz, H. & Lehn, K. (1985). The structure of corporate ownership: causes and consequences. *Journal of Political Economy*, 93, 1155-1177.

Denis, D. J. & Denis, D. K. (1994). Majority owner-managers and organizational efficiency. *Journal of Corporate Finance*, 1, 91-118.

Dennis, P. J. & Weston, James P. (2001). Who's informed? an analysis of stock ownership and informed trading, *Working paper*, University of Virginia.

Easley, D., O'Hara, M. & Paperman, J. (1998). Financial analysts and information-based trade. *Journal of Financial Markets*, 1, 175-201.

Glosten, L. & Milgrom, P. R. (1985). Bid, ask, and transaction prices in a specialist market with heterogeneously informed agents. *Journal of Financial Economics*, 14, 71-100.

Grullon, G. & Wang, F. A. (2001). Closed-end fund discounts with informed ownership differential. *Journal of Financial Intermediation*, 10, 171-205.

Hasbrouck, J. (1991). Measuring the information content of stock trades. *Journal of Finance*, 46, 179-207.

Hasbrouck, J. (1991). The summary informativeness of stock trades: an econometric analysis. *Review of Financial Studies*, 4, 571-595.

Huang, R. D. & Stoll, H. R. (1996). Dealer versus auction markets: a paired comparison of execution costs on NASDAQ and the NYSE. *Journal of Financial Economics*, 41, 313-357.

Kavajecz, K. A. (1999). A specialist's quoted depth and the limit order book. *Journal of Finance*, 54, 747-771.

Kothare, M. &Laux, P. A. (1995). Trading costs and the trading systems for NASDAQ stock. *Financial Analyst Journal*, 51, 42-53

Kyle, Albert S. (1985). Continuous auction and insider trading. *Econometrica* , 53, 1315-1336.

Lee, C. M. C., Mucklow, B. & Ready, M. J. (1993). Spreads, depths, and the impact of earnings information: Intraday analysis. *Review of Financial Studies*, 6, 345-374.
Lee, C. M. C. & Ready, M. J. (1991). Inferring trade direction from intraday data. *Journal of Finance*, 46, 733-746
Lipson, M. L. (1999). Stock splits, liquidity and limit orders. *Working paper*, University of Georgia.
Muscarella, C. J. & Vetsuypens, M. R. (1996). Stock splits: signaling or liquidity? The case of ADR 'solo-splits'. *Journal of Financial Economics*, 42, 3-26.
Sarin, A., Shastri, K. A. & Shastri, K. (2000). Ownership structure and market liquidity. *Working paper*, Santa Clara University.
Schultz, P. (2000). Stock splits, tick size and sponsorship. *Journal of Finance*, 55, 429-450.
Seyhun, H. N. (1986). Insiders' profits, costs of trading, and market efficiency. *Journal of Financial Economics*, 16, 189-212.
Van Ness, B. F., Van Ness, R. A. & Warr, R. S. (2001). How well do adverse selection components measure adverse selection? *Financial Management*, 30, 77-98.
Wamack, K. L. (1995). Do brokerage analysts' recommendations have investment value? *Journal of Finance*, 51, 137-167.

Table 1 Descriptive Statistics

The sample period covers from July to September 2000. Share price is the average of daily mid quotes. Return volatility is the standard deviation of daily returns computed using mid-quote to mid-quote prices.

Panel A. The distribution of entire sample for insider ownership (838 Stocks)

		Standard	Percentile				
Variable	Mean	Deviation	Min	25	50	75	Max
Insider Ownership (%)	12.815	17.149	0.000	1.673	5.252	17.400	88.700
Share Price ($)	25.38	17.35	5.03	12.32	20.61	33.41	99.14
Return Volatility	0.0275	0.0114	0.0051	0.0198	0.0254	0.0323	0.0917
Market Capitalization ($M)	4997.19	16,409.05	2.20	214.74	747.05	2,488.86	195,418.97
Daily Trading Volume	570,054	1,480,524	360	30,719	134,611	472,579	20,513,565

Panel B. The distribution of entire sample for institutional ownership (1,491 Stocks)

		Standard	Percentile				
Variable	Mean	Deviation	Min	25	50	75	Max
Institutional Ownership (%)	47.556	26.826	0.000	27.170	51.800	70.110	89.850
Share Price ($)	29.35	17.38	5.04	14.06	23.20	35.88	99.22
Return Volatility	0.0264	0.0109	0.0051	0.0193	0.0240	0.0311	0.0948
Market Capitalization ($M)	6,395.38	24,550.32	3.62	321.24	939.25	3,141.60	551,677.94
Daily Trading Volume	587,905	1,459,759	548	36,978	146,184	494,236	20,513,565

Panel C. The distribution of entire sample for analysts (1,532 Stocks)

		Standard	Percentile				
Variable	Mean	Deviation	Min	25	50	75	Max
Number of Analyst Following	8.845	7.001	1	3	7	13	40
Share Price ($)	28.02	17.74	5.04	14.76	23.90	36.71	99.22
Return Volatility	0.0264	0.0106	0.0059	0.0193	0.0243	0.0311	0.0948
Market Capitalization ($M)	6,361.99	24,107.92	5.59	389.47	1,067.97	3,392.57	551,677.94
Daily Trading Volume	594,099	1,421,581	121	44,729	161,556	515,718	20,513,565

Table 2 Correlation Matrix

The sample period covers from July to September 2000. Share price is the average of daily mid quotes. Return volatility is the standard deviation of daily returns computed using mid-quote to mid-quote prices. Denote $A_{i,t}$, $B_{i,t}$, and $P_{i,t}$ as the ask, bid, and trade prices of stock i at time t, the quoted spread is $A_{i,t} - B_{i,t}$; the effective spread is $2|P_{i,t} - M_{i,t}|$, where $M_{i,t} = (A_t + B_t)/2$. Depth is the average of quoted depth in number of shares per quotation. Trade informativeness is derived based on Hasbrouck (1991b) VMA and VAR model.

	Institutional Ownership	Number of Analysts Following	Quoted Spread	Effective Spread	Trade Informative-ness	Depth	Share Price	Daily Trading Volume	Market Capitalization	Return Volatility
Insider Ownership	-0.1232 (0.0009)	-0.2411 (0.0001)	0.1587 (0.0001)	0.1442 (0.0001)	0.2378 (0.0001)	-0.1400 (0.0002)	0.2487 (0.0001)	-0.2900 (0.0001)	-0.2747 (0.0001)	0.1259 (0.0007)
Institutional Ownership		0.2904 (0.0001)	-0.3195 (0.0001)	-0.3524 (0.0001)	0.1807 (0.0001)	0.0351 (0.3477)	-0.1976 (0.0001)	0.3821 (0.0001)	0.3260 (0.0001)	0.0530 (0.1564)
Number of Analysts Following			-0.3979 (0.0001)	-0.4047 (0.0001)	-0.0177 (0.6357)	0.3130 (0.0001)	-0.4404 (0.0001)	0.7327 (0.0001)	0.7933 (0.0001)	-0.0251 (0.5021)
Quoted Spread				0.9703 (0.0001)	-0.0899 (0.0160)	-0.4283 (0.0001)	-0.1344 (0.0003)	-0.6161 (0.0001)	-0.4581 (0.0001)	-0.0100 (0.7884)
Effective Spread					-0.0793 (0.0338)	-0.4000 (0.0001)	-0.1136 (0.0023)	-0.6244 (0.0001)	-0.4744 (0.0001)	-0.0098 (0.7926)
Trade Informative-ness						-0.0769 (0.0396)	0.1483 (0.0001)	-0.0314 (0.4016)	-0.0475 (0.2042)	0.1263 (0.0007)
Depth							0.1735 (0.0001)	0.5111 (0.0001)	0.3223 (0.0001)	0.1299 (0.0005)
Share Price								-0.3359 (0.0001)	-0.5759 (0.0001)	0.2447 (0.0001)
Daily Trading Volume									0.8751 (0.0001)	0.2401 (0.0001)
Market Capitalization										-0.0254 (0.4968)

Table 3 Description of samples with spreads, depth and trade informativeness

The sample period covers from July to September 2000. Denote $A_{i,t}$, $B_{i,t}$, and $P_{i,t}$ as the ask, bid, and trade prices of stock i at time t, the quoted spread is $A_{i,t} - B_{i,t}$; the percentage quoted spread is $(A_{i,t} - B_{i,t})/ M_{i,t}$, where $M_{i,t} = (A_t + B_t)/2$; the effective spread is $2|P_{i,t} - M_{i,t}|$; the percentage effective spread is $2|P_{i,t} - M_{i,t}|/ M_{i,t}$. Depth is the average of quoted depth in number of shares per quotation. Trade informativeness is derived based on Hasbrouck (1991b) VMA and VAR model.

Panel A. For insider ownership

Quintile	# of Firms	Insider Ownership (%)	Quoted Spreads ($)	Quoted Spreads (%)	Effective Spreads ($)	Effective Spreads (%)	Depth (100 shares)	Trade Informativeness
1	168	0.3874	0.1746	0.8265	0.1169	0.5523	103.12	0.2944
2	167	2.2711	0.1397	0.6547	0.0883	0.4154	116.64	0.3352
3	168	5.4763	0.1537	0.8660	0.1003	0.5665	82.63	0.3464
4	167	14.0817	0.1723	1.1210	0.1117	0.7290	77.01	0.3686
5	168	41.8032	0.1835	1.4726	0.1207	0.9707	60.68	0.3752

Panel B. For institutional ownership

Quintile	# of Firms	Institutional Ownership (%)	Quoted Spreads ($)	Quoted Spreads (%)	Effective Spreads ($)	Effective Spreads (%)	Depth (100 shares)	Trade Informativeness
1	298	5.7889	0.2161	1.1512	0.1461	0.7644	90.364	0.2798
2	298	32.8929	0.1647	1.1261	0.1075	0.7397	83.911	0.3279
3	298	51.4950	0.1494	0.7800	0.0954	0.5054	109.370	0.3145
4	298	66.5696	0.1435	0.6874	0.0919	0.4407	97.791	0.3159
5	299	80.9231	0.1447	0.6045	0.0913	0.3832	83.736	0.3012

Panel C. For number of financial analysts following

Quintile	# of Firms	# of Analysts	Quoted Spreads ($)	Quoted Spreads (%)	Effective Spreads ($)	Effective Spreads (%)	Depth (100 shares)	Trade Informativeness
1	642	2.9159	0.1856	1.1770	0.1229	0.7778	66.83	0.3210
2	391	7.7775	0.1564	0.7239	0.1004	0.4640	87.13	0.2931
3	222	12.7568	0.1378	0.4938	0.0875	0.3122	106.02	0.2933
4	150	17.7000	0.1215	0.4406	0.0764	0.2811	151.50	0.2923
5	127	24.8110	0.1205	0.3388	0.0765	0.2154	142.63	0.3080

Table 4 Regression Results

Panel A. The Relationship between Quoted Percentage Spread or Percentage Effective Spread and Ownerships or Number of Analysts Following

This table shows the results of the following regression models:

Quoted percentage $Spread_{i,t}$ or Percentage Effective $Spread_{i,t} = \beta_0 + \beta_1$ ($Insider_{i,t}$, $Institutional_{i,t}$, or $Analysts_{i,t}$) + β_2 ($Price_{i,t}$) + β_3 Log(Dollar trading $volume_{i,t}$) + β_4 Log(Market value of $equity_{i,t}$) + β_5 Return $volatility_{i,t}$ + $\varepsilon_{i,t}$;

where Quoted $spread_{i,t}$ is the mean quoted spread of stock i in time t, Effective $spread_{i,t}$ is the mean effective spread of stock i in time t, Insider, institutional ownership and Analysts are percentage of insider, institutional ownership or number of financial analysts following of stock stock i in time t, $Price_{i,t}$ is the mean price of stock i in time t, Dollar trading $volume_{i,t}$ is the mean daily dollar trading volume of stock i in time t, Market value of $equity_{i,t}$ is the market value of equity of stock i in time t, Return $volatility_{i,t}$ is the standard deviation of daily closing quote-midpoint returns of stock i in year t, and $\varepsilon_{i,t}$ is the error term.

	Quoted Percentage Spread			Percentage Effective Spread		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	1.0051 (16.16***)	1.1939 (28.12***)	1.0071 (25.79***)	0.6433 (15.32***)	0.7802 (27.34***)	0.6603 (25.07***)
Insider Ownership	1.0918 (8.84***)			0.7342 (8.80***)		
Institutional Ownership		-0.6973 (-14.61***)			-0.4955 (-15.45***)	
Number of Analysts Following			-0.0366 (-17.45***)			-0.0252 (-17.83***)
Share Price	-0.0132 (-14.69***)	-0.0099 (-19.83***)	-0.0045 (-12.64***)	-0.0085 (-13.94***)	-0.0063 (-18.89***)	-0.0028 (-11.79***)
Log(Daily Trading Volume)	-0.1262 (-6.17***)	-0.1173 (-9.31***)	-0.0525 (-3.98***)	-0.0837 (-6.06***)	-0.0764 (-9.02***)	-0.0318 (-3.57***)
Log(Market Cap.)	0.0041 (2.43**)	0.0020 (2.69**)	-0.0022 (3.02***)	0.0026 (2.28**)	0.0013 (2.54**)	0.0014 (2.96***)
Return Volatility	9.1178 (4.90***)	13.1556 (10.85***)	10.8304 (9.10***)	6.2836 (5.00***)	9.1111 (11.18***)	7.2136 (8.98***)
Adj. R Square	0.38	0.40	0.36	0.36	0.40	0.36
F-Value	104.758**	204.66***	178.35***	98.77***	200.91***	173.21***

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level.

Table 4 (Cont.)

Panel B. The Relationship between Depth and Ownerships or Number of Analysts Following

This table shows the results of the following regression models:

$$\text{Quoted Depth}_{i,t} = \beta_0 + \beta_1 (\text{Insider}_{i,t}, \text{Institutional}_{i,t}, \text{or Analysts}_{i,t}) + \beta_2 (1/\text{Price}_{i,t}) + \beta_3 \text{Log(Dollar trading volume}_{i,t}) + \beta_4 \text{Log(Market value of equity}_{i,t}) + \beta_5 \text{Return volatility}_{i,t} + \varepsilon_{i,t};$$

where Quoted $\text{Depth}_{i,t}$ is the mean quoted depth of stock i in time t, Insider, institutional ownership and Analysts are percentage of insider, institutional ownership or number of financial analysts following of stock stock i in time t, $\text{Price}_{i,t}$ is the mean price of stock i in time t, Dollar trading $\text{volume}_{i,t}$ is the mean daily dollar trading volume of stock i in time t, Market value of $\text{equity}_{i,t}$ is the market value of equity of stock i in time t, Return $\text{volatility}_{i,t}$ is the standard deviation of daily closing quote-midpoint returns of stock i in year t, and $\varepsilon_{i,t}$ is the error term.

	Depth		
	Model 1	Model 2	Model 3
Intercept	-224.6111 (-3.50***)	-197.7933 (-3.15***)	-193.6489 (-2.66***)
Insider Ownership	-13.1894 (-0.63)		
Institutional Ownership		-69.0980 (-5.64***)	
Number of Analysts Following			61.0277 (0.86)
1/Price	952.6061 (9.56***)	880.7500 (9.11***)	943.6353 (9.61***)
Log(Daily Trading Volume)	54.1511 (11.87***)	60.7751 (13.67***)	54.2731 (12.14***)
Log(Market Cap)	-16.1969 (-3.31***)	-19.3632 (-4.07***)	-18.0304 (-3.54***)
Return Volatility	-1733.6442 (-5.33***)	-1870.3797 (-6.00***)	-1750.9515 (-5.48***)
Adj. R Square	0.42	0.11	0.42
F-Value	104.16***	115.05***	104.28***

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level.

Table 4 (Cont.)

Panel C. The Relationship between Trade Informativeness and Ownerships or Number of Analysts Following

This table shows the results of the following regression models:

$$\text{Trade Informativness}_{i,t} = \beta_0 + \beta_1 (\text{Insider}_{i,t}, \text{Institutional}_{i,t}, \text{or Analysts}_{i,t}) + \beta_2 (1/\text{Price}_{i,t}) + \beta_3 \text{Log(Dollar trading volume}_{i,t}) + \beta_4 \text{Log(Market value of equity}_{i,t}) + \beta_5 \text{Return volatility}_{i,t} + \varepsilon_{i,t};$$

where Trade Informativeness$_{i,t}$ is the mean of informativeness of trading based on Hasbrouck's model for stock i in time t, Insider, institutional ownership and Analysts are percentage of insider, institutional ownership or number of financial analysts following of stock stock i in time t, Price$_{i,t}$ is the mean price of stock i in time t, Dollar trading volume$_{i,t}$ is the mean daily dollar trading volume of stock i in time t, Market value of equity$_{i,t}$ is the market value of equity of stock i in time t, Return volatility$_{i,t}$ is the standard deviation of daily closing quote-midpoint returns of stock i in year t, and $\varepsilon_{i,t}$ is the error term.

	Trade Informativeness		
Model	Model 1	Model 2	Model 3
Intercept	0.1412 (2.10**)	0.0979 (1.47)	-0.1760 (2.26**)
Insider Ownership	0.1169 (5.32***)		
Institutional Ownership		0.0855 (6.57***)	
Analysts			0.0959 (1.26)
1/Price	0.3216 (3.07***)	0.4909 (4.77***)	0.4175 (3.97***)
Log(Daily Volume)	-0.0066 (-1.38)	-0.0204 (-4.31***)	-0.0140 (-2.93***)
Log(Market Cap)	0.0108 (2.10**)	0.0183 (3.61***)	0.0128 (2.34**)
Volatility	0.7828 (2.2***)	1.2787 (3.86***)	1.2026 (3.52***)
Adj. R Square	0.07	0.09	0.04
F-Value	12.13***	15.24***	6.56***

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level.