Ownership Level, Ownership Concentration and Liquidity

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Abstract

We examine the link between the liquidity of a firm's stock and its ownership structure, specifically, how much of the firm's stock is owned by insiders and institutions, and how concentrated is their ownership. We find that liquidity-ownership relation is mostly driven by institutional ownership rather than insider ownership. Importantly, liquidity is positively related to total institutional holdings but negatively related to institutional blockholdings. This finding is consistent with the hypothesis that while the level of institutional ownership proxies for trading activity, the concentration of such ownership proxies for adverse selection.

An unresolved area in the field of finance is the relation between share ownership structure and liquidity. When considering this relation, researchers focus on two hypotheses, which we refer to as the adverse selection hypothesis and the trading hypothesis. The adverse selection hypothesis posits that when informed shareholders possess superior information compared to outside shareholders, an information asymmetry arises, which reduces liquidity (e.g., Grossman and Stiglitz, 1980; Glosten and Milgrom, 1985; Kyle, 1985; Easley and O'Hara, 1987). The trading hypothesis, on the other hand, posits that when investors turnover their portfolio more often, transaction costs are reduced, which increases liquidity (Demsetz, 1968; Merton, 1987; Schwartz and Shapiro, 1992). Given these two hypotheses, studying the empirical relationship between liquidity and ownership is complex as different ownership proxies may vary in their suitability for capturing these two costs; adverse selection costs on the one side, and trading frictions on the other.

While the focus of most empirical studies on the ownership-liquidity relation is on the adverse selection hypothesis (e.g., Chiang and Venkatesh, 1988; Kini and Mian, 1995; Helfin and Shaw, 2000; Barabanov and McNamara, 2002), there is no consensus in the literature about which entities constitute the informed group of investors. Some studies focus on insiders, some focus on institutions, and some focus on blockholders.[1] The fact that all three groups have been shown to have superior information presents a challenge for several reasons.

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[1] Evidence of insiders' information superiority includes Jaffe (1974), Lin and Howe (1990), Bettis et al. (2000), and Lakonishok and Lee (2001). Evidence of blockholders' information superiority includes Bethel et al. (1988), McConnell and Servaes (1990), and Barclay and Holderness (1991). Evidence of institutions' information superiority includes Szewczyk et al. (1992), Alangar et al. (1999), and Bartov et al. (2000).

First, adverse selection costs depend on the probability that a market maker trades with an informed investor. This means that considering only one group of possibly informed shareholders may underestimate the extent of the actual information asymmetry that exists. Second, the three groups of investors are overlapping. An institutional investor can be an insider, an insider can be an institution, and a blockholder can be either an insider or an institution. Without a partition that effectively separates the three groups of investors, it would be hard to conclude which groups of investors drive the observed relation.

Third, as discussed above, adverse selection is only one of the factors hypothesized to be related to liquidity. Group-specific trading behavior may also be important. In general, it seems that institutions tend to turnover their portfolio more often than other investors. For example, mutual funds typically have to trade when exogenous shocks of cash withdrawals or infusions occur; as they are committed to provide funds to unit holders on demand and to comply with their stated investment policy. At some instances, institutional portfolio turnover may be driven by agency problems (e.g., window dressing), where a fund manager seeks to buy winners and sell losers before accounting statement are made public. Finally, some institutions trades are determined primarily by pre-determined investment objectives, such as indexing; and their trades are largely determined by movements in the index, which tend to occur continuously. Thus, to the extent that institutions as a group trade more often, institutional ownership should reduce a market maker's required inventory, which in turn may reduce spreads (e.g., Tinic, 1972; Hamilton, 1978; Schwartz and Shapiro, 1992; Gompers and Metrick, 2001).

In view of the foregoing, it seems that whether the predictions of the adverse selection and trading hypotheses are similar or different may depend on which group we consider informed. If one takes insiders to be informed, the predictions of the adverse selection and trading hypotheses on liquidity are similar, that is, higher insider ownership should be correlated with lower liquidity. However, if one takes institutions to be the informed group, the predictions of the two hypotheses are in opposite directions.

In this paper we hope to gain a better understanding of the interplay between these two hypotheses and their respective relations to liquidity. Toward this end, we construct a high-resolution set of ownership data. In broad terms, the argument is that while ownership level proxies for group-specific trading behavior, ownership concentration proxies for information asymmetry as ownership concentration measures quantify the incentives of few shareholders to obtain, analyze, and trade on information (e.g., Black, 1992; Hartzel and Starks, 2003). As such, we construct both level and concentration measures. The ownership level variables are insiders, non-insider institutions (that is, institutions or institutional investors), and others. These three mutually exclusive groups sum up to 100%. The concentration measures are insider blockholders and institutional blockholders, that is; the concentration measures are constructed for the groups of investors which may be considered informed.

A concrete example of our approach is illustrated in Figure 1.

[Insert Figure 1 about here]

The Figure presents the ownership structure of Microsoft and Federal Express as of Q4 2003. The ownership level is represented by the size of the slice, while the ownership concentration is represented by the grayscale of the slice; a white slice represents

dispersed ownership in the group, while a dark slice represents a high level of concentration in the group. The figure shows that Microsoft has a larger portion of insiders and a smaller portion of institutional investors than Federal Express. The figure also shows that while the institutional holdings of Microsoft's shares is dispersed, some institutional blockholders hold Federal Express' shares.

The above approach allows us to analyze within one framework all the ownership variables that have been used in previous liquidity-ownership studies (blockholders' ownership, institutional ownership, and insiders' ownership). In some sense we conduct a horse-race between the different ownership variables and their relations to liquidity. This horse-race approach is especially important because of the high correlations among the different ownership variables, as these high correlations can lead to spurious results in the presence of misspecification. Moreover, by partitioning between insiders and institutional concentration we are able to distinguish between two types of possibly informed investors, those who are prohibited from trading on information and those who are not. U.S. securities laws disallow insiders from trading on private information. In contrast, most institutional blockholders are permitted to trade on information as they are not classified as insiders even if they hold more than 10% of a stock's outstanding shares.

Because we want to avoid overlaps between institutions and insiders, we gather our insiders' ownership data from insider reporting statements (SEC forms 3 and 4). These data together with institutional investors' quarterly 13F schedules and the intra-day data of the NYSE Trades and Quotes (TAQ) data set allow us to construct quarterly ownership and liquidity variables for 1,369 firms during the years 1999 through 2003. We employ several liquidity measures, including volume measures, turnover, quoted depth and

spreads, effective spread, realized spread, and price impact. We construct a variety of liquidity measures because recent research argues that trade-based measures are uncorrelated with order-driven measures (Aitken and Comerton-Forbe, 2003). For our purposes this is especially important as it seems that trade-based measures should be more correlated with the trading behavior of shareholders, while order-driven measures should be more correlated with the adverse selection costs embedded in the ownership structure.

Our results support both the trading and adverse selection hypotheses; however, we find that most of the liquidity-ownership relation is driven by institutional ownership and not insiders' ownership. To continue our concrete example, Figure 2 illustrates Microsoft and Federal Express' ownership level and liquidity changes over the 20 quarters we study in this paper. One can see from the figure that changes in the time-weighted spread tend to mirror changes in institutional holdings. In contrast, there is no apparent correlation between insiders' holdings and liquidity.

[Insert Figure 2 about here]

We find that while institutional holdings are positively correlated with liquidity, suggesting more frequent trades of institutional investors compared to other investors; institutional concentration is negatively correlated with liquidity, suggesting that institutional blockholders are perceived by market makers to have superior information. This relation is rather stable and persistent across all liquidity measures. Further, we find evidence that insiders' ownership is negatively correlated with trade-based measures of liquidity, but is positively correlated with some order-driven liquidity measures. These results support the idea that legal barriers to insider trading are effective, that is, insiders

are not perceived to be among those shareholders that trade on private information. Finally, our results hold in many different specifications including a simultaneous equation specification, in which ownership level, ownership concentration, and liquidity are determined jointly.

Our main contribution to the financial literature is to provide an extensive empirical analysis on the ownership-liquidity relation over a five-year period. We explore this relation taking into account the observations that the ownership variables are inherently related, and further, that liquidity has many dimensions. The construction of the high-resolution ownership data, together with the recent availability of the NYSE TAQ intra-day data, allows us to achieve this task.

The study proceeds as follows. In Section I, we present our ownership and liquidity measures. In Section II, we provide the sample distribution and a univariate analysis of the variables. Section III presents the multivariate analysis, which for expositional purpose, is developed in a step-by-step approach that outlines how we handle the high correlations among the ownership variables. Section IV provides a simultaneous equations framework wherein ownership level, ownership concentration, and liquidity are determined jointly. In Section V, we verify the robustness of our results. Finally, Section VI concludes.

I. Data

We obtain ownership data from Vickers' Stock Research, who provided us a time series of institutional and insider holdings information for the 2,000 largest firms by asset size as of December 31, 1998. Because this data set follows the sample firms over time,

we are able to form quarterly snapshots of insiders' and institutions' holdings. We then merge this information with the NYSE TAQ data set for the period 1999 to 2003, which results in our being able to use 20 quarters of ownership and intra-day trading data. After excluding firms that have multiple share classes and firms that do not appear in one of the above data sets, we are left with 1,369 firms. This sample represents approximately 70% of the market value of U.S. public equity over the period.

A. Ownership

Ownership level variables are well suited to provide us insights about the trading behavior of shareholders. For instance, in contrast to other shareholder groups, insiders are subject to legal restrictions such as blackout periods (Bettis et al., 2000). Thus, insiders are likely to trade predominantly on the sell side in order to liquidate their holdings. Increases in institutional ownership, on the other hand, are expected to lead to increases in trading volume, the number of trades, visibility, and analyst coverage (e.g., Schwartz and Shapiro, 1992).

Distinct from ownership level, ownership concentration measures are a natural proxy for adverse selection. As first noted by Black (1992), the incentive of any investor to obtain information and trade on it depends on the incentives of other investors to do the same. A concentration measure can quantify the incentives of any specific informed investor as it measures the holdings of the informed investor compared to other investors. Thus, if institutions are in a position to obtain better information, the probability that a particular institution will incur the costs to do so is higher if it enjoys a comparatively large ownership share. Similarly, if insiders are more informed, the probability that any

one insider will trade on such information is larger if the information is held by few rather than by many. Note that one can think of an insider with large holdings not only as having more incentives to trade on information, but also as having more precise information than an insider or institution with smaller holdings. Put differently, it makes sense that Bill Gates would be more informed about the future of Microsoft than other executives of Microsoft who hold fewer shares and are less important in the firm's decision-making process.

1. Ownership level and ownership concentration

Our measure for insider holdings is based on data contained in SEC Form 3 and Form 4. By law, all insiders, who include all executives, officers, and beneficial owners who hold directly more than 10% of the firm's shares outstanding, must report any transaction on these forms within two business days. Vickers provides us an aggregation of all insiders' holdings based on the last Form 3 or Form 4 filed by the insider such that the amount owned is held directly. To find the most recent amount owned, Vickers looks at filings for which the transaction date was within the three years prior to the ending year date. Note that occasionally some filers report a transaction but do not report the amount owned on that specific filing (the amount owned would be null); in this case, Vickers goes to the prior filing that reported an amount owned.

Our measure for institutional holdings is the combined holdings of all financial institutions that report an SEC Schedule 13F but do not report themselves as insiders on Form 3 or Form 4. According to rule 16(a)-1 of the Securities Exchange Act of 1934, an institutional investor that holds more than 10% of the shares in a company is not

considered an insider, and therefore is not required to submit Forms 3 and 4, if the shares are held for the benefit of third parties in the ordinary course of business and are not acquired by such institutions for the purpose of influencing control over the company. As our purpose here is to form mutually exclusive sets of insiders and institutions, we exclude from the institutional holdings measure those institutions that also appear as insiders. We do this by eliminating from the sample those 13F filers whose holdings exactly match those of an insider filer.[2]

Our measures of insider and institutional concentration are insiders' blockholdings and institutions' blockholdings. As a proxy for institutional concentration, we also use the measure of Hartzell and Starks (2003) (hereafter, the HS measure), which is the sum of the top five non-insiders institutional investors divided by total institutional holdings. This measure serves as a proxy for the probability that a trade is initiated by an informed non-insider investor. If the largest institutional investors monitor the firm, in which case they posses private information that other institutional and individual investors do not have, and further, if institutions are responsible for the majority of daily trading activity (Schwartz and Shapiro, 1992), then the probability of an informed trade is roughly the percentage of holdings by informed institutions divided by the percentage of holdings of all institutions. Hartzell and Starks (2003) show that this measure is related to the ability of management to monitor. Even though institutional blockholdings are more commonly used, one advantage of the HS measure is that it is not subject to the arbitrary inclusion

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[2] In many cases the filer will appear under one name when it reports itself on a Schedule 13F and under another name when it reports itself as an insider of the firm on Form 3 or 4. For example, while Berkshire Hathaway, Inc. reports itself as Berkshire Hathaway on 13Fs, it commonly appears under other names on Form 3.

cut-off point of 5%. Thus, the HS measure is a finer measure of concentration if one wants to follow the concentration level of a given firm over time.

Note that by partitioning the incentives of insiders and institutions, we are essentially partitioning between two groups of potentially informed investors. U.S. securities law and the SEC take insiders as those shareholders that have access to non-public information. If these shareholders trade on such information, they do so in violation of the securities laws. In contrast, an institutional blockholder is not considered an insider so long as it does not influence control (even if it holds more than 10% of the shares outstanding). Thus, even if these non-insider institutional blockholders are informed, the SEC perceives their information as derived from publicly available information and thus they are permitted to trade on such information.

B. Liquidity

Because liquidity has many facets, no one measure can capture all of its dimensions. For instance, dollar volume, share volume, and turnover are mostly related to the trading activity of different owners, whereas order-driven measures are probably more correlated with the adverse selection costs embedded in a stock's ownership structure spread (Linet al., 1995; Huang and Stoll, 1997; Helfin and Shaw, 2000; Barclay and Hendershott, 2004). We therefore employ ten different measures of liquidity. We construct these measures by calculating the average for a given firm in a given quarter. For measures that are dependent on intra-day data, we follow Weston (2000) and Grullon et al. (2004) and filter the TAQ database. We further filter our data such that we retain only those trades that take place during the one-hour period between 12:00 p.m. and 1:00 p.m. on any

given trading day. Our focus on this one hour of trade is consistent with McInish and Wood (1992), who find that while time-weighted spreads tend to change substantially across the trading day, they tend to vary less at the middle part of the trading day. One can view our approach as taking a middle ground with regard to the appropriate filtering of intra-day observations. On the one hand, we want to have a sufficiently large data set to create our measures; on the other hand, including trade data from all hours of the trading day without modeling the time-varying properties of the liquidity measure may be problematic. We believe that a one-hour period is both sufficiently long to produce reliable measures and sufficiently short to safely ignore the time-varying properties of liquidity.[3]

1. Volume and turnover

We construct three different measures that capture the trading activity in a given share in a given quarter. Specifically, dollar volume is the monthly share volume times the month's closing price, share volume is the monthly share volume, and turnover is the monthly share volume divided by the number of shares outstanding at the end of the month.

2. Quoted spreads and depths

Our main measure for the bid-ask spread is the time-weighted bid-ask spread. This measure is calculated by weighting the different relative bid-ask spreads (i.e., the ask price minus the bid price, divided by the quote midpoint) according to the length of time

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[3] For a subsample of eight quarters, we recalculate the measures over the three-hour period 11:00 a.m. to 2:00 p.m. The correlation between the intraday measures (of the same type) for one hour and three hours is above 0.95.

that the quote is standing (see McInish and Wood, 1992). We also use the equal-weighted bid-ask spread, where each quote gets equal weight when averaging across the quarter. We calculate our measure of dollar depth as the number of shares at the bid and ask multiplied by their respective prices.

3. Effective spread and price impact measures

Following Barclay and Hendershott (2004), we employ two measures. The effective spread is the absolute difference between the trade price and the quote midpoint at the time of the trade divided by the quote midpoint. The realized spread is the signed (positive for buyer-initiated and negative for seller-initiated trades) difference between the trade price and quote midpoint five minutes after the trade.[4] Our principal measure of price impact (intra-day) is the signed difference between the quote midpoint five minutes after the trade and the quote midpoint at the time of the trade. The effective spread, realized spread, and price impact are calculated each minute and then averaged across the quarter. Finally, price impact (daily)is the measure developed by Amihud (2000) and later employed by Acharya and Pedersen (2005). It is the ratio of the daily absolute return to the daily dollar volume.

C. Controls

Because most of the liquidity measures above are also related to return volatility, we control for it in the multivariate analysis. Note that since all of the liquidity measures of the study are calculated within a given quarter, our volatility measure is also calculated

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[4] In order to classify trades to buy and sells, we follow the Lee and Ready (1991) algorithm and delay quotes five seconds relative to transactions, with adjustments for the NASDAQ market made according to Ellis et al. (2000).

based on the daily returns in a given quarter. The other control variables that we use are size (log of the market value of the firm's equity), share price, and book to market. We include size and share price as these have been shown to be correlated with many aspects of liquidity; the role of book to market is to control for risk characteristics of the firm.

II. Univariate Analysis

A. Sample distribution

Table I reports the sample distribution properties of ownership, liquidity, and other firm characteristics. Given our sample consists of 1,369 of the top 2,000 firms by asset value, these firms are predominantly widely held. The median institution holding is approximately 60%, while the median insiders' holding is less than 2%. The table also shows that 75% of the firms have at least one institutional blockholder. Insider blockholders, in contrast, are present for only a small portion of the sample; however, once present they hold a very high percentage of the shares outstanding.

[Insert Table I about here]

Table I also provides the distribution of different types of insiders. Having partitioned manager insiders, non-manager insiders (beneficial owners and board members that are not executives), and insiders who are also financial institutions as observed in 13F statements, we find that most of the insider holdings are held by beneficial owners and directors that are not employed by the firm. We also find that there are few instances in which institutions are also insiders.

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Finally, Table I provides the distribution of liquidity measures. Consistent with the literature, the table shows that the liquidity measures are highly skewed. As a result, throughout the analysis we use the log of our liquidity measures. Our sample consists from liquid shares: the median monthly dollar volume is close to $150 million, and the median quoted spread is 2.25%. The mean effective spread is somewhat lower than what Barclay and Hendershott (2004) report for their sample of NASDAQ-only shares. However, the mean realized spread is similar in magnitude to what these authors report. Other firm characteristics reveal that the median firm equity value in our sample is over $1.5 billion, the median daily volatility is 2.53%, and the median share price is around $25.

B. Univariate analysis

Table II reports the average cross-sectional correlations that obtain between variables across the 20 quarters of our study. Panel A provides correlations between pairs of ownership variables. Note that by construction, total institutional ownership is negatively correlated to total insiders' holdings as the ownership pie must sum to 100%. If insiders hold less of the ownership pie, one would typically expect to find that institutional investors hold a larger portion of the ownership pie. In our sample, the correlation between the two is -0.29 and is highly significant. With regard to liquidity this issue is important, as almost by definition insiders trade less than institutions. Therefore, a regression that uses insiders' (institutional) holdings as a dependent variable but does not also include institutional (insiders') holdings as a dependent variable may lead to spurious results. Moreover, note that the cross-sectional correlation between insiders' holdings and

insiders' blockholdings is 0.98. In other words, insiders' ownership level and insiders' concentration are highly correlated. Including both variables in a multivariate specification would lead to almost perfect multicolinearity. Fortunately, both the trading and adverse selection hypotheses predict that insiders' holdings are negatively correlated to liquidity. Thus, our predictions are not affected by the fact that insiders' ownership level and ownership concentration must be collapsed into one measure. Finally, it is important to note that blockholdings are positively correlated with both institutions' ownership level and insider's ownership level. Running a regression with blockholdings as the only ownership variable may therefore be misleading.

[Insert Table II about here]

Panel B of Table II presents correlations between the ten liquidity variables. We split the panel into two horizontal segments and two vertical segments for convenience. For the first four liquidity variables (dollar volume, share volume, turnover, dollar depth), a high value translates into high liquidity, while for the last six liquidity variables, a low value translates into high liquidity. Thus, to maintain consistency across the liquidity variables, we expect the top-left and the bottom-right segments to have positive correlations, while we expect the bottom-left segment to have negative correlations. Panel B confirms the conjecture that all liquidity variables are correlated.[5]

Panel C of Table II provides cross-sectional correlations between major ownership and liquidity variables. We can see from the table that institutional holdings are positively related to all liquidity measures, namely, higher dollar volume, higher dollar depth, lower time-weighted spread, lower effective spread, and lower price impact (intra-day). The

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[5] Aitken and Comerton-Forde (2003) provide evidence that different liquidity variables may provide inconsistent inferences about liquidity.

opposite is true with regard to insiders' holdings, which are negatively correlated to all measures of liquidity. Blockholdings are also negatively correlated with liquidity, but this result is somewhat overshadowed by the magnitude of the correlation of insiders' holdings with liquidity. Finally, our two institutional concentration measures realize rather different correlations with the liquidity variables. While the HS measure is highly negatively correlated with liquidity, the correlation between institutional blockholdings and liquidity is low. This fact may be helpful below when we conduct robustness checks in a multivariate context as both measures should be able to quantify the incentives of institutions to trade on information.

A conclusion that is reached from the univariate analysis is that the liquidity variables are highly correlated. This is especially true when one considers the correlation amongst volume-based measures, and the correlation amongst price-based measures. It is also consistent with the findings of Hasbrouck and Seppi (2001) that show that there are common factors in different proxies of liquidity. Given these observations and for brevity of exposition, in what follows, we focus our analyses and present results for dollar volume, time-weighted spread, and price impact (intra-day). These measures together well represent the spectrum of liquidity variables, from those that mostly capture trading activity (for example, dollar volume) to those that capture the adverse selection component of the spread (for example, price impact (intra-day)). In the robustness portion of the paper (Section V) we return to the other measures to show that are results are not altered by the type of liquidity measure used.

C. Time-series

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As our sample covers 1369 firms over a relatively short period of 5 years, it is more suited for analyzing the ownership-liquidity relation in the cross-section, rather than over time. However, an analysis of the time-series properties provides for a better exposition of the main ideas presented in this paper, therefore; in this subsection we provide a time-series description of our data.

To get a feeling for the liquidity changes over our sample period, we construct equal-weighted liquidity measures of our main dependent variables.

[Insert Figure 3 about here]

Figure 3 does not reveal a time trend in the equal-weighted dollar volume and time-weighted spread measures, however; there is a significant reduction in the equal-weighted price impact measure over time. When we regress these measures on a time trend; the coefficient of the time trend is not significant for the equal-weighted dollar volume and time-weighted spread measures, but it is highly significant for the equal-weighted price impact measure.

One possibility for this reduced price impact levels in the later period of our sample is decimalization. The NYSE initiated decimalization on Jan. 29, 2001, and this was quickly followed by decimalization in Nasdaq on April 9, 2001. Thus, we may be observing a structural break in the data rather then a time trend. When we rerun the regression of the equal-weighted price impact measure on a time trend and a dummy variable that equals one for quarters Q1 2001 and forward, the significant time trend coefficient becomes insignificant, and all the explanatory power of the regression is captured by the indicator. Therefore, throughout the cross-sectional analysis we use a decimalization dummy as a control variable.

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As for ownership, over the sample period, institutional holdings increased from an average of 49.7% in Q1 1999 to an average of 63.7% in Q4 2003 – a large change considering the relatively short five-year period. This translates to an average increase in institutional holdings of 1.4% every six months. Similarly, institutional blockholdings increased from an average of 12.3% in Q1 1999 to an average of 15.0% in Q4 2003, while insiders' holdings decreased from 12.8% in Q1 1999 to an average of 6.1% in Q4 2003. Thus it seems that certain trends in ownership exist. In fact, the lack of apparent trend in equal-weighted liquidity measures may be explained by the simultaneous increase in both institutional holdings and institutional blockholdings.

Note that as our sample includes many firms, the statistical concerns over time-variation of the variables is small. Typically, one does not need to restrict the dynamic behavior of the data when the number of firms in the panel is large relative to the number of periods (see Wooldridge (2002), page 175).[6] However, we provide a variety of specifications in the robustness portion of the paper (Section V) to show that the qualitative nature of our results are not altered by the nature of the econometric specification employed.

Part of the change in institutional level can be explained by the gradual reduction of insider holdings. Over time, insiders tend to sell off their shares in the company. However, we observe that many institutional holdings increases and decreases occur when there is no apparent change in insiders' holdings nor there is a change in institutional concentration.

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[6] Also, for short panels where T (number of periods) is relatively small to N (number of firms), the tests for stationarity developed under the assumption of large T are usually unsatisfactory because the rate condition $N/T \rightarrow 0$ limits the application of the tests to cases where T is larger than N (Hadri and Larsson, 2005).

We next provide examples of how changes in institutional level and concentration occur in our sample. During Q2 2000, Pfizer's institutional holdings increased from 59.7% to 77.1%. This occurred when no changes in insiders' holdings and institutional concentration are reported. A large change in institutional concentration occurred in Sprint during Q1 2002. At that time, Capital Research and Management Corporation increased its share holdings in Sprint to 10.4%, making it the largest institutional blockholder of the company. At the same quarter, Barclays, which was the largest institutional holder of Sprint as of Q4 2001, increased its holding in the company from 4.7% to 5.4%. These two transactions had a major effect on Sprint institutional concentration. Institutional blockholdings increased from 0 to 15.8% and the HS measure increased from 22.6% to 33.9%.

III. Multivariate analysis

In this section we wish to learn how the high correlations between the different ownership variables affect the results that correspond to different types of specifications. As discussed previously, we show the results of this analysis for dollar volume, time-weighted spread, and price impact (intra-day), as these measures represent the spectrum of liquidity variables.

Throughout this analysis, the model that we test is the following:

$$Liq_i = \gamma_0 + \gamma_{1-3}(ownership\ variable)_i + \gamma_4(market\ value)_i + \gamma_5(share\ price)_i \quad (1)$$
$$+ \gamma_6(book\ to\ market)_i + \gamma_7(volatility)_i + \gamma_8(decimalization)_i + \varepsilon_i$$

where the number of ownership variables differs across the analysis. We take a two-step approach in deriving the multivariate regression specification. In the first step, we test for

the appropriate ownership level specification. In the second step, we test for the appropriate ownership concentration specification. After deriving the desired specification of ownership variables, we regress this specification on all liquidity variables. Because one could argue that our panel ownership and liquidity variables may result in the clustering of errors, we wish to correct for both time dependency and firm dependency. We therefore follow Petersen (2006) and use the two-dimensional clustered standard errors approach.[7]

A. Step 1 - ownership level

Since the sum of the ownership level variables must add up to 100%, typically there is a negative correlation between insider holdings and institutional holdings. Table III presents three types of specifications for regressing ownership level on different liquidity measures. In specifications (1), (4), and (7), the independent variable is insiders' holdings, in specifications (2), (5), and (8), the independent variable is institutions' holdings, and in specifications (3), (6), and (9), both insiders' and institutions' holdings are included. One can see from the table that insiders' holdings seem to have a negative effect on liquidity when it is the sole ownership level variable used. In contrast, when institutional holdings are the only ownership variable, the correlation between institutional ownership and liquidity is positive. This is what we would expect given the negative correlation between insiders' holdings and institutional holdings. However; one can not infer from these two specifications which ownership variable dominates the relation with liquidity. While it seems that institutional holdings are more important, as the R-squared and significance

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[7] Our results hold in alternative specifications. These are discussed in the robustness portion of the paper (Section V).

level are higher for specifications (2), (5), and (8) compared to specifications (1), (4), and (7), the appropriate specification includes both ownership level variables. Certainly, this specification provides a better description of the ownership pie. The results in the table indicate that when both variables are used in the regression, the institutional holdings variable dominates. In fact, in specification (6) the insiders' holdings' coefficient flips signs and is significant at the 5% level. It seems, therefore, that both institutions' holdings and insiders' holdings are negatively correlated with the time-weighted spread. The only negative correlation between insiders' holdings and liquidity that persists is that with dollar volume. According to specification (3), it appears that insiders trade less than other individual investors, while institutional investors trade more often than other individual investors.

[Insert Table III about here]

Note that Table III also confirms several regularities concerning liquidity and the other control variables. In particular, firm market value is highly positively correlated with liquidity and; volatility is negatively correlated with liquidity when measured by time-weighted spread and price impact, but is positively correlated with liquidity when measured by dollar volume (Anderson, 1996; Karpoff, 1987).

B. Step 2 - ownership concentration

Table IV presents regression results for different specifications of the ownership concentration variables. In specifications (1), (4), and (7), total blockholdings are the only dependent variable. According to this specification, it seems that blockholdings are negatively correlated with dollar volume, time-weighted spread, and price impact (intra-

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day). Thus, it appears that blockholdings improves liquidity as measured by order-driven liquidity measures. The main problem with this specification is that it ignores the ownership level variables. In specifications (2), (5), and (8), insiders' holdings and institutions' holdings are added to the regression specification. We can see that this specification changes the results for blockholdings (compared to (1), (4), and (7)), which now is clearly negatively correlated with volatility. However, this specification also changes the results for insiders' holdings obtained in Table III, specifications (3), (6), and (9). Insiders' holdings, similar to institutions' holdings, are now strongly positively correlated with liquidity.

[Insert Table IV about here]

From our univariate analysis, we know that blockholdings are highly correlated with insider holdings (correlation of 0.684), and thus we must take care in interpreting the above results. We do so by partitioning blockholdings into its two major components, institutional blockholdings and insider blockholdings. We also know that insider holdings and insider blockholdings are almost perfectly correlated (correlation of 0.981), so including both insiders' holdings and insiders' blockholdings will result in multicolinearity. We therefore include institutional blockholdings as the only concentration measure together with the ownership level variables. Specifications (3), (6), and (9) suggest that once ownership level variables are included in the specification, the marginal contribution in blockholders comes for its institutuional blockholdings portion. The coefficient of institutional blockholders in specifications (3), (6), and (9) is larger and more significant than the coefficient of blockholdings in specifications (2), (5), and (8). Note that the inference we draw with respect to the correlation between insiders'

holdings and liquidity is now in line with what we find in Table III (specifications (3), (6), and (9)). We feel comfortable that this last specification lends itself to better interpretation of the results as it more clearly separates the important groups of shareholders as perceived by the securities laws.

Specifications (3), (6), (9) suggest that a one standard deviation increase in institutional holdings is associated with a 30% increase, a 35% decrease, and a 21% decrease of a standard deviation of dollar volume, time-weighted spread, and price impact respectively. For institutional blockholdings increases these figures are a 14.4% decrease, a 13.8% increase, and a 7.37% increase respectively. For insiders holdings increases these figures are a 2.5% decrease, a 2.8% decrease, and an insignificant 0.06% decrease respectively.

C. The spectrum of liquidity measures

While the results with regard to the relation between institutional ownership and liquidity are very convincing as they are very significant, the same can not be said about insiders' holdings. On the one hand, insiders' holdings are negatively correlated with dollar volume; on the other hand, insiders' holdings are positively correlated with time-weighted spread, suggesting that insiders' trade may increase liquidity on some dimensions. This is somewhat problematic for two reasons. First, from a theoretical point of view, it is counterintuitive that insider holdings' would reduce spreads. Demsetz (1986) notes that uninformed investors in firms with high insider ownership tend to adopt a buy-and-hold strategy as they realize that they are relatively uninformed. This should lead to lower liquidity as the market maker understands that most transactions involve

informed investors.[8] Second, while for institutional ownership we have ownership level and ownership concentration, for insiders' holdings we are empirically forced to use only one measure. It is therefore harder to comprehend the overall effect of insiders' holdings.

To further explore this relation we make use of our spectrum of three liquidity variables. If insiders differ only in their trading activity (and do not affect the adverse selection costs), we should find that insiders' holdings do not help in explaining price impact once we control for trading activity by employing a liquidity measure that is highly correlated with trading. Similarly, if insiders only affect adverse selection costs (and not trading activity), we should find that insiders' holdings do not help in explaining trading activity once we control for adverse selection by employing a liquidity measure that is highly correlated with adverse selection..

Table V reports results of a regression in which both the dependent variable and one of the independent variables are liquidity measures. That is, when the dependent variable is dollar volume, we use either the time-weighted spread or price impact as our control. When the dependent variable is price impact, we use either dollar volume or time-weighted spread as controls. By doing so, we are able to verify whether our three ownership structure variables are able to provide extra explanatory power on both aspects of liquidity: i.e., trading activity and adverse selection, or is the explanatory power derived through an effect on a certain liquidity dimension. For example, if insiders trade less, they may indirectly also affect price impact, however; it would be hard to conclude that this is due to adverse selection costs.

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[8] Chaing and Venkatesh (1988) find a positive correlation between insider ownership and spreads for a small sample of firms in 1973. In contrast, Glosten and Harris (1988) report an insignificant relation between spreads and insiders' holdings for a sample of 250 NYSE stocks over the 1981 to 1983 period.

[Insert Table V about here]

The results clearly show that institutional holdings and institutional concentration provide explanatory power even when we control for other dimensions of liquidity. With respect to insiders, we conclude that there is relatively strong evidence that insiders' holdings are negatively correlated with trading activity, but the results concerning price impact are not significant.

IV. Simultaneous equations

Next we consider the endogeneity that may exist in the determination of ownership structure and liquidity. Falenstein (1996) finds that institutions prefer large, liquid stocks. Hence, liquidity and institutional ownership may be simultaneously determined, that is, an institutional investor's decision to become a shareholder or a blockholder may depend on the firm's liquidity. To address this concern, we rely upon the work of Demsetz and Lehn (1985), Denis and Sarin (1999), Helfin and Shaw (2000), and Gompers and Metrick (2001) and add the following explanatory variables as instruments: quarterly equity return, leverage (long-term debt divided by market value of equity), firm age (number of years since the firm first appears on CRSP tape), diversification (log of the ratio of the sum of the segments' sales squared divided by total sales squared), and industry classification (two-digit SIC code).

Table VI presents the simultaneous equation estimation of the three-step least squares; the two-step procedure yields similar results. Note that these are Fama-McBeth regressions. Thus, we run the simultaneous equation specification separately for each

quarter and present the average and standard deviation of the coefficients across these 20 regressions. To facilitate comparison with other studies, we present the most commonly used measures of liquidity, namely, the time-weighted spread and the effective spread.

[Insert Table VI about here]

In broad terms, we find that institutional holdings are affected by a stock's liquidity. As can be seen in specifications (1b) and (2b), institutional holdings decrease with increases in the time-weighted spread or the effective spread. The results with regard to institutional blockholdings are less conclusive; in specification (1c) the time-weighted spread has no effect on blockholdings, while in specification (2c) institutional blockholdings are positively correlated with the effective spread. The rest of the results are consistent in both specifications: institutional holdings have a positive effect on liquidity, institutional blockholdings have a negative effect on liquidity, and insiders' holdings have a positive effect on some order-driven measures of liquidity.

Our regression coefficients from specifications (1a) and (2a) suggest that a one standard deviation increase in institutional holdings causes a 58% of a standard deviation reduction in the time-weighted spread, and a 65% of a standard deviation reduction in the effective spread. We also find that a one standard deviation increase in institutional blockholdings causes a 61.7% standard deviation increase in the time-weighed spread, and a 43.2% of a standard deviation increase in the effective spread. These numerical estimates indicate that both institutional ownership level and institutional concentration have an economically significant effect on liquidity.

V. Robustness

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In this Section we provide robustness analysis. Our aim here is to merely show that are results with regard to institutional holdings' and institutional blockholdings are robust across different specifications. Table VII provides regression results for our three main dependent variables; dollar volume, time-weighed spread, and price impact (intra-day). The specifications used throughout are those of specification (3), (6), and (9) of Table IV; however, the econometric analysis is different.

In specification (1)-(3) we difference both the dependent and independent variables. This is done for two reasons. First, we wish to mitigate any concerns of time variation violations of the dependent or independent variables. Second, it is interesting to see whether the relation observed on the level, also holds when we study changes. If a relation holds also for changes, then that would mean that ownership changes are impounded in liquidity almost immediately; while if the relation does not hold, we could only argue that in the long term there is a relation between ownership level and liquidity. As can be seen in specification (1)-(3) the relation of institutional holdings and institutional block holdings persists, however; the effect of changes of insiders' holdings is not significant in two out of the three specifications. In fact, insiders' holdings increases seem to be positively correlated with price impact, something that has not be revealed when studying the level variables.

[Insert Table VII about here]

In specification (4)-(6), we present firm and time fixed-effect regression. The purpose is to provide another verification of our results. By nature, firm fixed-effects rely on the time variation within a given firm, and the cross-sectional variation plays a minor role in

these specifications. The results persist with regard to institutional holdings and institutional concentration.

Finally, specification (7)-(9) show whether the coefficient are significant when we regress each cross-sectional regression (in a given quarter) separately. The numbers presented in each cell are four, two of which are in parenthesis. A positive (negative) sign followed by a number represents the number of regressions (out of 20) for which the coefficient was positive (negative) and significant at the 1% level. Similarly coded, the numbers in parenthesis represent coefficients which are significant at the 5% level. In this specification again, we can see that the correlation of institutional holdings and institutional concentration are strongly significant with the same signs as before. As for insiders, it seems that they trade less often, but their effect on price-based liquidity measures is not very significant.

Another test, which we conduct in Table VIII, is to include an interaction term between institutional level and institutional concentration. In specifications (1) and (2), we include an interaction term between institutional holdings and the HS measure to check if the marginal effect of one decreases in the other.[9] We note that for the time-weighed spread, the effect of the interaction term is insignificant, while for the price-impact measure it is negative and significant. Moreover, in specification (2) the inclusion of the interaction term eliminates the institutional holdings coefficient significance. This suggests that

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[9] The correlation between institutional blockholdings and the interaction term institutional blockholdings × institutional holdings is 0.964, while the correlation between the HS measure and the interaction term of the HS measure × institutional holdings is 0.127. The correlations of these two interactions terms with institutional holdings are 0.669 and 0.714 respectively. Therefore, to mitigate the problem of deriving inference from highly correlated dependent variables, the interaction term of institutional holdings with the HS measure is used

institutional concentration may be somewhat more important than institutional holdings if one considers the price-impact measure.

[Insert Table VIII about here]

Given that so far we have focused our analyses on only three liquidity variables, in specifications (3)-(9) of Table VIII, present results for all the other liquidity variables used in the study. We also arbitrarily choose either the HS measure or the institutional blockholdings to show that both measures yield similar results even though their correlations with the ownership level variables are different

Specification (3)-(9) are consistent with previous results. We find that institutional holdings are positively correlated with liquidity, while institutional concentration is negatively correlated with liquidity. Moreover, the correlation of insiders' holdings with liquidity is negative for trade-based measures such as volume, turnover, and depth; but tends to be either insignificant or somewhat positive for order-driven measures such as the quoted spread and the realized spread. The positive correlation that insiders' holdings have on the price impact (daily) measure is not surprising, given that the latter is probably more related to volume-based measures than price-based measures.

We next conduct a simple event study whose purpose is to see how ownership changes lead to changes in liquidity. To eliminate contemporaneous changes in different ownership dimensions, we analyze *extreme changes* in one ownership variable when other ownership variables changes are small. For example, an extreme change in institutional holdings would be defined as one in which there is a large change in institutional holdings in a given firm-quarter at a time in which insiders' holdings and the HS measure change for that specific firm are relatively small. Similarly we study extreme

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changes in the HS measure (insiders' holdings) when institutional holdings and insiders' holdings (HS measure) changes are relatively small.[10] In particular, a change in institutional holdings would be defined by applying the following steps:

(i)   we first winsorize the sample and keep only observations for which the change in insiders' holdings and the change in the HS measure are in the range of 25%-75% percentile of their respective empirical distribution (e.g., as can be learned from Table IX Panel A, for insiders' holdings that would translate to a change range of -0.03% to 0.04%);

(ii)   we then define an extreme increase as that where institutional holdings changes by more than the 90% percentile value of its empirical distribution in the winsorized sample. Similarly we define an extreme decrease as that where institutional holdings changes by less than the 10% percentile value of its empirical distribution in the winsorized sample.

This approach was respectively applied for extreme changes in insiders' holdings and institutional concentration.

[Insert Table IX about here]

Table IX provides difference of means and median tests on changes in the liquidity measures following such changes in ownership. Overall, we find that institutional level increases tend to increase liquidity (though, this result is not significant for the price impact measure), while increases in institutional concentration tend to reduce liquidity. The effect of changes in insiders' holdings is not significant in explaining changes in liquidity.

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[10] We choose the HS measure for this rather than institutional blockholdings as it is a more continuous measure. Institutional blockholdings tend to jump when an institutional blockholder reduces (increases) ownership below (above) the 5% level

Finally, note that another way to check for the insider-liquidity relation is to partition insiders' holdings along the management versus non-management dimension (see the sample distribution in Table I). Accordingly, we run a specification (not reported but available from authors upon request) in which we partition these two groups of insiders and find that the coefficients of both groups are not significantly correlated with liquidity. We suspect that the strict reporting laws of the SEC and the legal liabilities that all insiders are subject to substantially reduce trading on information by insiders.

Summarizing our results, we find that liquidity is positively correlated with institutional ownership level and negatively correlated with institutional concentration. We find that insiders' holdings tend to be negatively correlated with trade-based measures, but find no evidence that insiders' holdings contribute to adverse selection costs, as insiders' holdings coefficient tends to be either insignificant or negatively correlated with various measures of spreads. We interpret these results as evidence in support of both the trading hypothesis and the adverse selection hypothesis. Our results are consistent with the idea that institutions turn over their portfolios more often than insiders and other investors; however, if institutional holdings are concentrated in a few large blockholders, market makers perceive them as being in an inferior informational position, which results in lower liquidity

V. Conclusion

In this paper we conduct an extensive empirical study on the ownership-liquidity relation of U.S.-traded shares. By constructing high-resolution ownership data that cover

20 quarters, we conduct a step-by-step analysis to determine the nature of the ownership-liquidity relation. We find there is a two-sided relation between institutional ownership and liquidity. On the one hand, liquidity tends to increase with institutional ownership levels; on the other hand, liquidity tends to decrease with institutional concentration. We also find that insider ownership is negatively correlated with trade-driven measures of liquidity, but is positively correlated with some order-driven measures of liquidity. Overall, the qualitative results with regard to institutional holdings and concentration are robust and suggest that liquidity is mainly determined by the ownership structure of institutional investors.

An interesting implication of the results presented in this paper is that if ownership levels and concentration affect liquidity, then firms may optimally choose both ownership levels and concentration when considering the optimal capital structure. For choosing ownership optimally, one must bear in mind that at least theoretically; institutional blockholdings do not only entail cost, but may also provide benefits by reducing the managerial agency conflict. As the results of this paper suggest, there are real costs from institutional concentration, however, there is also some evidence that institutional blockholdings create value by creating better governance (Hetzel and Starks, 2003).

While the institutional level-liquidity relation is probably driven by their increased trading activity compared to other shareholders, the results with regard to concentration do not provide for a clear understanding of the relevance of trading versus adverse selection. It is not clear how much of the negative correlation between institutional blockholdings and liquidity is due to reduced trading activity of blockholders and how much is due to their superior information. A better understanding of the effect of

asymmetric information versus trading activity is important if one wants to shed light on the ways in which firms with different ownership structure can increase liquidity. For example, Hong and Huang (2005) present a model where insiders, who typically care about liquidity more than dispersed shareholders, may tend to over-invest in investor relation in order to increase liquidity. However, without a clear understanding of the importance of adverse selection, it would be hard to know the effectiveness of such activities so long as institutional blockholdings are not reduced.

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MSFT - Microsoft Corporation

Insider block holdings
10.71%

Insiders
(16.00%)

Others

Institutions
54.03%

Institutional block
holdings - 0%

FDX - Fedex Corporation

Insider block holdings
5.14%

Insiders
(6.03%)

Others

Institutions
72.47%

Institutional block
holdings - 23.37%
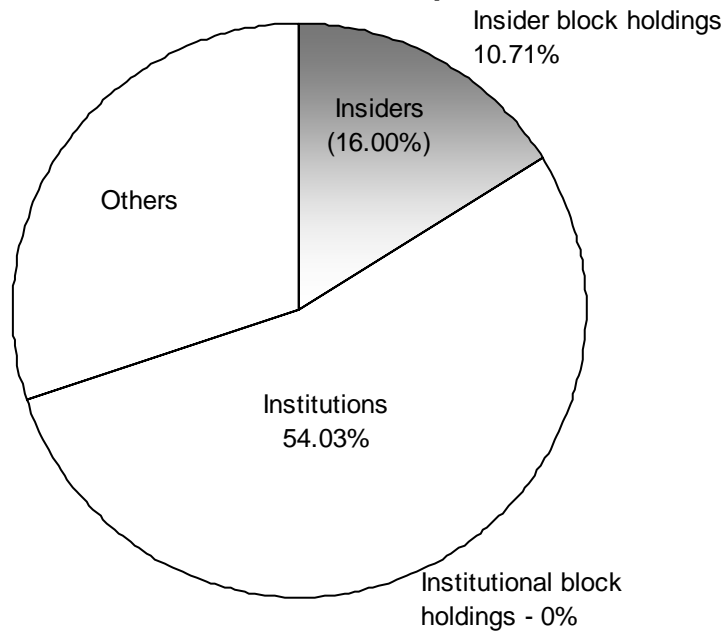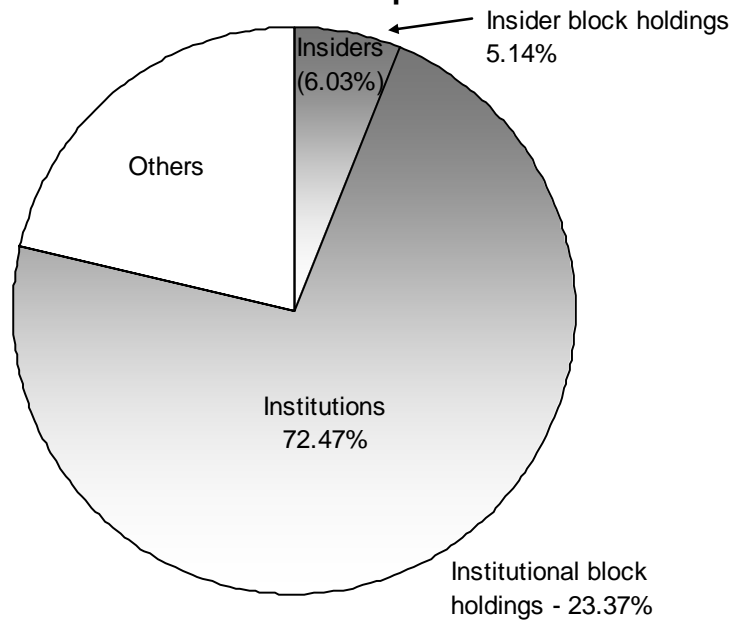
Figure 1: The ownership structure of Microsoft and Federal express as of Q4 2003. The ownership level is represented by the size of the slice, while the ownership concentration is represented by the color of the slice. A darker shade represents higher concentration.
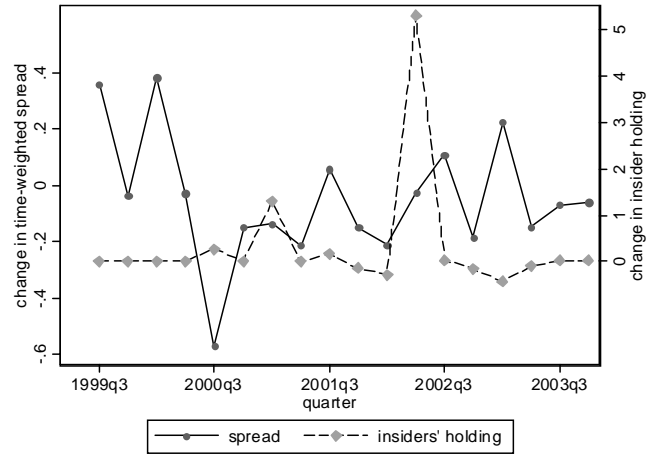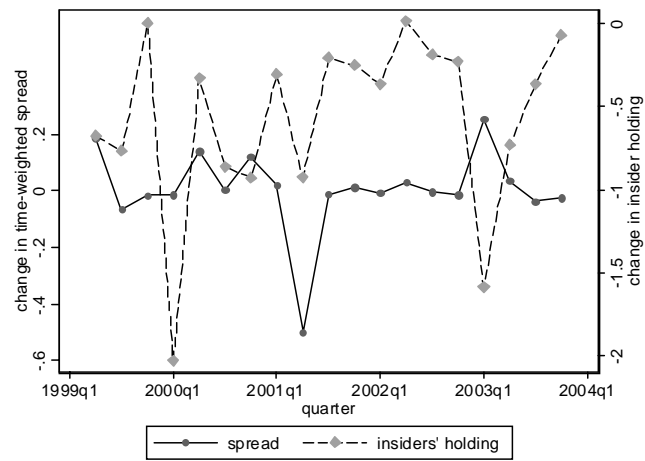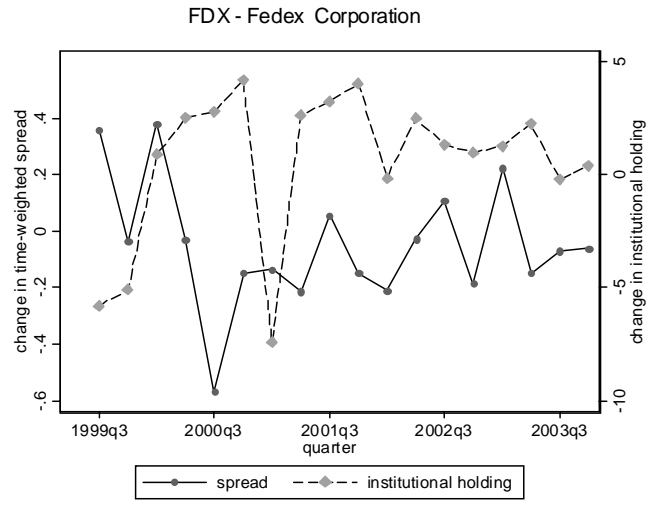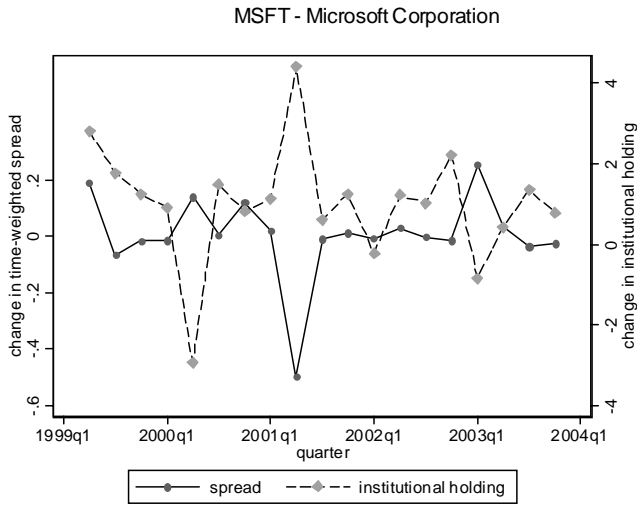
Figure 2: Ownership level changes and time-weighted spread changes over the 20 quarters: Microsoft and Federal Express.
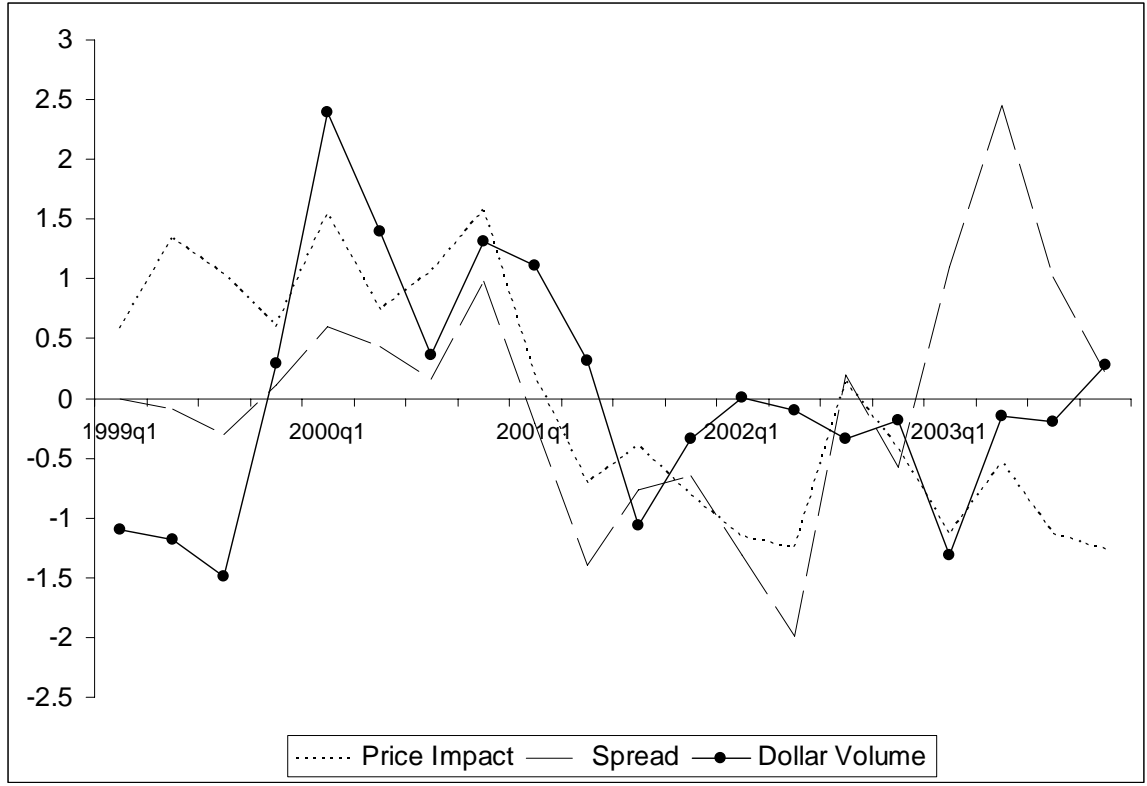
Figure 3: Equal-weighted dollar volume, time-weighted spread, and price impact over sample period.

Table I
Sample Distribution of Ownership, Liquidity and other Firm Characteristics

The sample has 1369 firms in the top 2000 firms by asset value as of 31.12.1998. All variables are calculated for each firm-quarter during the 5 year period of Q1 1999 – Q4 2003. The liquidity measures are calculated as the average across the quarter. Institutional holdings is the combined holdings of all institutional investors (calculated from 13F schedules) that have not reported themselves as insiders in forms 3 or 4 (hence, non-insiders). Institutional blockholdings is the combined holdings of all non-insiders institutional investors that hold more than 5% of the shares outstanding. HS measure is calculated based on Hertzel and Starks (2003) and is the combined holdings of the top five non-insiders institutional investors divided by the combined holdings of all non-insiders institutional investors. Insiders' holdings is the combined holdings of insiders as aggregated from forms 3 and 4. Insiders blockholdings is the combined holdings of insiders that hold more than 5% of the shares outstanding. Insiders – management is the combined holdings of insiders that are employed by the company (e.g., CEO, CFO, Controller, etc). Insiders – no management are insiders that report themselves as either B/O (beneficial owners) or as board members. Insiders – institutions are institutions that report themselves both on 13F schedules and on form 3 or 4. Dollar volume is the monthly share volume times the month's closing price. Share volume is the monthly share volume. Turnover is the monthly share volume divided by the number of shares outstanding at the end of the month. Dollar depth is the number of shares at the bid and ask multiplied by their respective prices. The equal-weighted bid/ask spread is the relative spread, where each quote update receives equal weight. Time-weighted bid/ask quote spread is the relative spread calculated as in McInish and Wood (1992), where longer standing quotes receive higher weight. Effective spread is the absolute difference between the trade price and the quote midpoint at the time of the trade. The realized spread is the signed (positive for buyer-initiated and negative for seller-initiated trades) difference between the trade price and quote midpoint 5 minutes after the trade. Price impact (intra-day) is the signed difference between the quote midpoint 5 minutes after the trade and the quote midpoint at the time of trade. The effective, realized spread and price impact (intra-day) are calculated each minute. Price impact (daily) is based on Amihud (2000) and is calculated as abs(daily return)/(daily volume). Market value is the market value of the firm as of the end of the quarter. Volatility is daily return volatility during the quarter. Share price is the share value of the firm's common shares as of the end of the quarter. Book to market is the book value of equity (*Compustat* item 59) divided by the market value of equity.

	Mean	Standard deviation	Percentile						
			1st	5th	25th	50th	75th	95th	99th
A1. Institutional Ownership									
Institutional holdings (%)	55.95	23.99	3.00	11.54	38.73	59.58	74.83	89.92	96.66
Institutional blockholdings (%)	13.91	13.28	0.00	0.00	5.03	11.45	21.20	38.39	55.67
HS measure (%)	45.78	17.32	21.34	24.93	33.23	41.46	54.35	83.16	97.32
A2. Insider Ownership									
Insiders' holdings (%)	7.19	13.93	0.01	0.07	0.48	1.61	6.65	34.26	75.2
Insiders' blockholdings (%)	5.10	13.60	0.00	0.00	0.00	0.00	0.00	31.18	74.03
Insiders – management	1.44	4.30	0.00	0.00	0.00	0.22	0.89	6.52	23.40
Insiders – no management	3.91	11.34	0.00	0.00	0.00	0.20	1.66	22.15	68.74
Insiders – institutions	0.24	3.33	0.00	0.00	0.00	0.00	0.00	0.00	6.03
B. Liquidity Measures									
Dollar volume ($million)	904.3	3095.9	0.7	3.2	27.7	144.5	637.4	3808.9	11769.7
Share volume (million)	26.86	88.92	0.06	0.18	1.61	6.41	20.68	105.09	311.26
Turnover (%)	11.20	11.27	0.68	1.52	4.75	8.20	13.70	31.36	54.05
Dollar depth ($000)	769.77	1138.95	48.53	86.48	202.53	439.18	929.27	2458.93	4814.03
Equal-weighted bid/ask spread (%)	5.17	11.32	0.48	0.65	1.29	2.49	5.36	16.22	41.84
Time-weighted bid/ask spread (%)	4.71	11.04	0.47	0.63	1.19	2.25	4.79	14.73	38.06
Effective spread (%)	3.39	52.48	0.02	0.03	0.09	0.23	0.77	8.08	33.40
Realized spread (%)*	0.16	0.62	0.01	0.01	0.03	0.06	0.14	0.55	1.50
Price impact (intra-day) (%)*	0.11	0.40	0.00	0.01	0.02	0.03	0.08	0.37	1.32
Price impact (daily) (%)	1.11	5.94	0.00	0.00	0.02	0.07	0.33	4.55	19.72
C. Other firm characteristics									
Market value ($million)	8263.9	28367.8	39.8	114.1	514.4	1517.5	5111.1	31137.4	140000
Volatility (%)	2.92	1.50	1.29	1.56	2.07	2.53	3.35	5.41	7.66
Share price ($)	89.82	2004.59	1.47	4.96	15.63	25.46	39.25	69.25	121.00
Book to market *	0.70	1.71	0.00	0.08	0.32	0.53	0.79	1.64	3.70

* About 4% of realized spread and price impact (intra-day) observations are negative and therefore are regarded as missing values. Similarly, negative book to market observations are discarded.

Table II
Cross Section Correlation

Panel A shows the average cross-sectional correlation between pairs of the ownership variables. Panel B shows the average cross sectional correlation between pairs of the liquidity variables. Panel C shows the average cross sectional correlation between pairs of major liquidity and ownership variables. The average is taken over the 20 quarters starting with Q1, 1999 through the Q4, 2003. The liquidity measures are calculated as the log of the measure after it has been averaged across the quarter. Definitions of variables are provided in Table I.

	Institutional holdings	Insiders' holdings	Block-holdings	Institutional block-holdings	Insiders' block-holdings	HS measure	Insiders – management	Insiders – no management
Panel A								
Institutional holdings	1.000 (0.00)							
Insiders' holdings	-0.290 (0.015)	1.000 (0.00)						
Blockholdings	0.254 (0.027)	0.657 (0.052)	1.000 (0.00)					
Institutional blockholdings	0.595 (0.023)	-0.085 (0.017)	0.679 (0.050)	1.000 (0.00)				
Insiders' blockholdings	-0.243 (0.016)	0.981 0.002	0.684 (0.051)	-0.066 (0.016)	1.000 (0.00)			
HS measure	-0.509 (0.022)	0.224 (0.012)	0.340 (.038)	0.278 (0.043)	0.185 (0.012)	1.000 (0.00)		
Insiders – management	-0.134 (0.028)	0.388 (0.029)	0.230 (0.029)	-0.038 (0.023)	0.354 (0.025)	0.118 (0.019)	1.000 (0.00)	
Insiders – no management	-0.263 (0.016)	0.927 (0.007)	0.617 (0.046)	-0.081 (0.017)	0.923 (0.007)	0.193 (0.014)	0.062 (0.012)	1.000 (0.00)

Panel B

	Dollar volume	Share volume	Turnover	Dollar depth	Equal-weighted spread	Time-weighted spread	Effective spread	Effective realized spread	Price impact (intra-day)	Price impact (daily)
Dollar volume	1.000 (0.00)									
Share volume	0.921 (0.012)	1.000 (0.00)								
Turnover	0.666 (0.031)	0.732 (0.021)	1.000 (0.00)							
Dollar depth	0.809 (0.044)	0.692 (0.044)	0.376 (0.073)	1.000 (0.00)						
Equal-weighted spread	-0.846 (0.040)	-0.659 (0.054)	-0.430 (0.048)	-0.766 (0.036)	1.000 (0.00)					
Time-weighted spread	-0.830 (0.046)	-0.631 (0.057)	-0.398 (0.054)	-0.744 (0.041)	0.998 (0.001)	1.000 (0.00)				
Effective spread	-0.709 (0.063)	-0.642 (0.093)	-0.450 (0.058)	-0.632 (0.086)	0.753 (0.046)	0.742 (0.051)	1.000 (0.00)			
Effective realized spread	-0.744 (0.063)	-0.551 (0.074)	-0.373 (0.093)	-0.676 (0.081)	0.875 (0.060)	0.874 (0.059)	0.667 (0.089)	1.000 (0.00)		
Price impact (intraday)	-0.664 (0.035)	-0.552 (0.054)	-0.275 (0.063)	-0.647 (0.026)	0.783 (0.051)	0.777 (0.056)	0.640 (0.052)	0.518 (0.176)	1.000 (0.00)	
Price impact (daily)	-0.946 (0.008)	-0.966 (0.006)	-0.661 (0.031)	-0.771 (0.036)	0.769 (0.043)	0.748 (0.048)	0.715 (0.077)	0.654 (0.086)	0.632 (0.045)	1.000 (0.00)

Panel C

	Dollar volume	Dollar depth	Time-weighted spread	Effective spread	Price impact (intra-day)
Institutional holdings	0.540 (0.013)	0.449 (0.058)	-0.482 (0.028)	-0.504 (0.040)	-0.377 (0.040)
Insiders' holdings	-0.223 (0.020)	-0.218 (0.040)	0.203 (0.027)	0.201 (0.029)	0.177 (0.030)
Blockholdings	-0.151 (0.030)	-0.137 (0.026)	0.147 (0.047)	0.088 (0.032)	0.134 (0.037)
HS measure	-0.736 (0.027)	-0.587 (0.041)	0.671 (0.041)	0.634 (0.054)	0.550 (0.036)
Institutional blockholdings	-0.039 (0.033)	-0.021 (0.054)	0.046 (0.040)	-0.031 (0.030)	0.047 (0.034)

Table III
Liquidity and Ownership Level

Insiders' holdings is the combined holdings of insiders as aggregated from forms 3 and 4. Institutional holdings is the combined holdings of all institutional investors (calculated from 13F schedules) that have not reported themselves as insiders in forms 3 or 4 (hence, non-insiders). The liquidity measures are calculated by taking the log of the average across the quarter. Dollar volume is the monthly share volume times the month's closing price. Time-weighted bid/ask quote spread is the relative spread calculated as in McInish and Wood (1992), where longer standing quotes receive higher weight. Price impact (intra-day) is calculated each minute and is defined as the signed difference between the quote midpoint 5 minutes after the trade and the quote midpoint at the time of trade. Market value is the log of the market value of the firm as of the end of the quarter. Share price is the share value of the firm's common shares as of the end of the quarter. Book to market is the book value of equity (*Compustat* item 59) divided by the market value of equity. Volatility is the log of the daily return volatility during the quarter. Decimalization is a dummy variable that equals 1 for Q1 2001 – Q4 2003. The standard deviation of the coefficients is calculated with two-dimensional clustered standard errors as in Petersen (2006); *t*-stats of coefficient are provided in parenthesis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent	Dollar volume	Dollar volume	Dollar volume	Time-weighted spread	Time-weighted spread	Time-weighted spread	Price impact (intraday)	Price impact (intraday)	Price impact (intraday)
Insiders' holdings	-0.01242		-0.00543	0.00286		-0.00134	0.00454		-0.00012
	(-7.91)		(-4.40)	(3.88)		(-2.05)	(5.25)		(-0.13)
Institutional holdings		0.01798	0.01709		0.00097	-0.01010		-0.01097	-0.01099
		(20.03)	(-19.23)		(-10.15)	(-9.95)		(-12.44)	(-11.74)
Control variables									
Market value	1.19737	1.11194	1.10972	-0.42550	-0.38293	-0.38374	-0.46246	-0.42140	-0.42148
	(88.90)	(97.61)	(97.69)	(-22.09)	(-24.74)	(-24.78)	(-28.28)	(-30.80)	(-30.70)
Share price	-0.00004	-0.00003	-0.00003	-0.00162	-0.00101	-0.00098	0.00029	0.00102	0.00103
	(-44.75)	(-29.16)	(-29.99)	(-1.70)	(-1.14)	(-1.12)	(0.41)	(1.54)	(1.54)
Book to market	0.00752	0.00926	0.00867	0.00751	0.00599	0.00584	0.00649	0.00236	0.00230
	(1.27)	(1.89)	(1.85)	(0.69)	(0.53)	(0.52)	(0.63)	(0.24)	(0.23)
Volatility	1.09927	0.91499	0.94102	0.35385	0.44786	0.45441	0.43690	0.54417	0.54476
	(22.07)	(17.98)	(18.46)	(8.19)	(8.53)	(8.49)	(10.25)	(11.81)	(11.45)
Decimalization	0.16781	0.06769	0.06180	-0.47582	-0.41207	-0.41344	-0.74222	-0.67752	-0.67762
	(3.91)	(1.73)	(1.60)	(-7.07)	(-5.82)	(-5.84)	(-10.94)	(-10.96)	(-10.96)
R squared	0.8827	0.9079	0.9090	0.6882	0.7319	0.7323	0.5241	0.5562	0.5562

Table IV
Liquidity, Ownership Level and Ownership Concentration

Blockholdings is the combined holdings of all investors that hold more than 5% of the shares outstanding. Institutional blockholdings is the combined holdings of all non-insiders institutional investors that hold more than 5% of the shares outstanding. The remaining variables are defined in Table III. The standard deviation of the coefficients is calculated with two-dimensional clustered standard errors as in Petersen (2006); *t*-stats of coefficient are provided in parenthesis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent	Dollar volume	Dollar volume	Dollar volume	Time-weighted spread	Time-weighted spread	Time-weighted spread	Price impact (intraday)	Price impact (intraday)	Price impact (intraday)
Insiders' holdings		0.01746	-0.00392		-0.01114	-0.00200		-0.00866	-0.00071
		(8.22)	(-3.26)		(-8.95)	(-3.04)		(-5.48)	(-0.75)
Institutional holdings		0.02698	0.02734		-0.01429	-0.01449		-0.01460	-0.01492
		(24.48)	(25.01)		(-12.35)	(-12.24)		(-13.52)	(-13.65)
Blockholdings	-0.00245	-0.02205		-0.00171	0.00945		-0.00178	0.00825	
	(-1.87)	(-11.91)		(-2.34)	(9.99)		(-2.13)	(7.59)	
Institutional blockholdings			-0.02372			0.01027			0.00934
			(-12.53)			(10.67)			(8.63)
Control variables									
Market value	1.21009	1.04972	1.03641	-0.43309	-0.35728	-0.35085	-0.47287	-0.39974	-0.3930
	(87.02)	(101.47)	(97.26)	(-21.73)	(-23.39)	(-23.25)	(-28.13)	(-28.81)	(-28.85)
Share price	-0.00004	-0.00003	-0.00002	-0.00149	-0.00117	-0.00125	0.00046	0.00087	0.00079
	(-45.24)	(-29.83)	(-27.51)	(-1.57)	(-1.46)	(-1.54)	(0.68)	(1.54)	(1.41)
Book to market	0.00899	0.01276	0.01084	0.00727	0.00419	0.00498	0.00427	-0.00227	-0.00099
	(1.32)	(2.07)	(1.91)	(0.68)	(0.42)	(0.48)	(0.41)	(-0.23)	(-0.10)
Volatility	1.07339	0.94350	0.94131	0.37732	0.44862	0.44760	0.46684	0.53874	0.53697
	(20.23)	(20.08)	(19.91)	(8.43)	(8.50)	(8.42)	(11.011)	(11.47)	(11.37)
Decimalization	0.19285	0.02320	0.01964	-0.48354	-0.39723	-0.39599	-0.75213	-0.66424	-0.66307
	(4.39)	(0.60)	(0.51)	(-7.22)	(-5.61)	(-5.58)	(-11.05)	(-10.80)	(-10.78)
R squared	0.8772	0.9187	0.9193	0.6876	0.7411	0.7418	0.5224	0.5605	0.5612

Table V
Ownership and the Liquidity Spectrum

Institutional blockholdings is the combined holdings of all non-insiders institutional investors that hold more than 5% of the shares outstanding. HS measure is calculated based on Hertzel and Starks (2003) and is the combined holdings of the top five non-insiders institutional investors divided by the combined holdings of all non-insiders institutional investors. The remaining variables are defined in Table III. The standard deviation of the coefficients is calculated with two-dimensional clustered standard errors as in Petersen (2006); *t*-stats of coefficient are provided in parenthesis.

Dependent	(1) Dollar volume	(2) Dollar volume	(3) Dollar volume	(4) Dollar volume	(5) Price impact (intraday)	(6) Price impact (intraday)	(7) Price impact (intraday)	(8) Price impact (intraday)
Insiders' holdings	-0.00318	-0.00472	-0.00286	-0.00450	-0.00120	0.00096	-0.00125	0.00104
	(-3.11)	(-4.58)	(-2.75)	(-4.13)	(-1.42)	(1.54)	(-1.39)	(1.59)
Institutional holdings	0.01140	0.00931	0.02399	0.02088	-0.00681	-0.00284	-0.00992	-0.00448
	(14.87)	(10.86)	(22.11)	(17.33)	(-6.88)	(-5.14)	(-7.66)	(-5.41)
Institutional blockholdings			-0.02121	-0.01930			0.00499	0.00242
			(-12.32)	(-11.54)			(4.56)	(2.86)
HS measure	-0.02026	0.00140			0.00782	0.00408		
	(-14.48)	(-13.16)			(7.14)	(3.91)		
Control variables								
Market value	0.96418	0.87484	0.99088	0.89878	-0.20101	-0.13678	-0.19101	-0.14450
	(77.39)	(40.06)	(78.19)	(39.83)	(-8.04)	(-10.48)	(-7.52)	(-10.37)
Share price	0.00015	-0.00045	-0.00027	-0.00088	0.00049	0.00136	0.00072	0.00150
	(0.24)	(-0.68)	(-0.44)	(-1.25)	(0.94)	(2.89)	(1.38)	(2.98)
Book to market	0.02244	0.01579	0.01593	0.01140	-0.00161	-0.02492	0.00229	-0.02301
	(1.94)	(2.00)	(1.37)	(1.37)	(-0.15)	(-2.83)	(0.22)	(-2.73)
Volatility	1.03743	1.13897	1.00828	1.11271	0.67821	0.23675	0.72409	0.24160
	(22.46)	(21.46)	(20.86)	(20.18)	(15.77)	(8.97)	(17.55)	(8.98)
Decimalization	-0.03410	-0.11497	-0.05465	-0.12940	-0.65984	-0.37667	-0.66022	-0.37314
	(-0.83)	(-1.88)	(-1.29)	(-2.03)	(-10.19)	(-4.83)	(-10.16)	(-4.72)
Liquidity control								
Dollar volume					-0.16579		-0.19585	
					(-6.93)		(-8.41)	
Time-weighted spread		-0.35152		-0.37486		0.03896		0.03789
		(-5.94)		(-5.97)		(17.64)		(18.43)
Price impact (intra-day)	-0.08326		-0.10148					
	(-6.03)		(-6.73)					
R squared	0.9196	0.9271	0.9164	0.9245	0.5726	0.6375	0.5695	0.6365

Table VI
Simultaneous Equation Estimation – 3SLS

Institutional blockholdings is the combined holdings of all non-insiders institutional investors that hold more than 5% of the shares outstanding. Effective spread is the absolute difference between the trade price and the quote midpoint at the time of the trade and is calculated each minute. The measure used in the regression is the log of the average measure calculated across the quarter. Return is the firm's share price return during the quarter. Leverage is the book value of long term debt (*Compustat* item 9) divided by the market value of equity. Firm's age is the number of years since the firm's share appears on the CRSP tape. HHI segment is the log of the ratio: sum of the segments sales squared divided by total sales squared. The remaining variables are defined in Table III. The N range is the range of number of firms in the 20 cross-sectional regressions. *t-stats* of coefficient are calculated using Fama-McBeth procedure.

Dependent	(1a) Time-weighted spread	(1b) Institutional holdings	(1c) Institutional block-holdings	(2a) Effective spread	(2b) Institutional holding	(2c) Institutional block holdings
Time-weighted spread		-28.51 (-22.45)	-0.9983 (-0.31)			
Effective spread					-13.9306 (-19.62)	3.3102 (14.69)
Institutional holdings	-0.0240 (-10.16)		0.3367 (11.16)	-0.0460 (-21.97)		0.3883 (30.73)
Institutional blockholdings	0.0255 (9.02)	1.1560 (59.19)		0.0547 (18.87)	1.2674 (54.79)	
Exogenous variables						
Insiders' holdings	-0.0041 (-6.41)	-0.2039 (-21.75)		-0.0039 (-3.62)	-0.1580 (-9.20)	
Market value	-0.2750 (-23.54)	-6.1478 (-14.38)	-3.5187 (-2.79)	-0.2767 (-9.76)	-1.7026 (-5.97)	-1.8988 (-13.82)
Share price	-0.0015 (-3.31)	-0.0473 (-3.27)		0.0087 (17.87)	0.1010 (13.51)	
Book to market	0.0256 (6.28)	0.6219 (3.05)		0.0107 (1.05)	-0.1617 (-1.26)	
Volatility	0.5244 (7.45)	14.1183 (8.59)	-4.2004 (-1.83)	0.6471 (6.76)	9.5981 (5.36)	-3.3831 (-6.49)
Return		1.5457 (2.09)			0.5610 (0.96)	
Leverage			-0.0894 (-2.40)			-0.1281 (-5.36)
Firm's age			-0.0269 (-6.15)			-0.0319 (-11.68)
HHI segment			-0.6765 (-9.63)			-0.5341 (-7.89)
2 digit SIC Indicator	No	No	Yes	No	No	Yes
N range		757-834			769-848	

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Table VII
Robustness of Regression Specifications

Specification (1)-(3) provide regression results after differencing both dependent and independent variables. Specification (4)-(6) include firm and time fixed-effects. Specifications (7)-(9) provide significance of coefficient when each cross-sectional regression in a given quarter is run separately. Institutional blockholdings is the combined holdings of all non-insiders institutional investors that hold more than 5% of the shares outstanding. The remaining variables are defined in Table III. For specification (1)-(3), the standard deviation of the coefficients is calculated with two-dimensional clustered standard errors as in Petersen (2006). For specification (4)-(9), the standard errors are calculated with White-corrected standard errors.

Dependent	Δ in dependent and independent Variables			Firm and time fixed-effect regressions			Fama-MacBeth regressions: sign and # of significant cases out of 20 regressions: 1% (5%) level		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dollar volume	Time-weighted spread	Price impact (intraday)	Dollar volume	Time-weighted spread	Price impact (intraday)	Dollar volume	Time-weighted spread	Price impact (intraday)
Insiders' holdings	0.00054	-0.00056	0.00346	0.00185	-0.00229	-0.00028	-11,+0	-3,+0	-1,+1
	(0.48)	(-0.38)	(2.00)	(3.65)	(-5.51)	(-0.33)	(-16,+0)	(-5 ,+0)	(-1,+2)
Institutional holdings	0.01074	-0.00601	-0.00639	0.01293	-0.00812	-0.00647	-0,+20	-20,+0	-20,+0
	(5.06)	(-3.44)	(-3.12)	(22.11)	(-16.02)	(-6.87)	(-0,+20)	(-20,+0)	(-20,+0)
Institutional blockholdings	-0.00959	0.00388	-0.04964	-0.01247	0.00319	0.00241	-20,+0	-0,+20	-0,+16
	(-7.29)	(4.12)	(2.12)	(-23.98)	(6.40)	(2.60)	(-20,+0)	(-0,+20)	(-0,+18)
Control variables									
Market value	0.68962	-0.47203	-0.39094	0.98285	-0.58772	-0.61203	-0,+20	-20,+0	-20,+0
	(18.67)	(-6.19)	(-4.93)	(93.44)	(-56.55)	(-29.86)	(-0,+20)	(-20,+0)	(-20,+0)
Share price	0.00000	0.00011	-0.00003	-0.00002	0.00048	0.00061	-11,+0	-10,+2	-1,+4
	(0.22)	(0.22)	(-0.04)	(-3.19)	(2.23)	(1.23)	(-19,+0)	(-12,+2)	(-2,+10)
Book to market	0.01106	-0.00534	-0.00275	0.01860	-0.00688	-0.02733	-0,+4	-0,+6	-0,+0
	(2.95)	(-2.66)	(-0.12)	(2.98)	(-4.90)	(-2.91)	(-0,+7)	(-0,+9)	(-2,+1)
Volatility	0.29909	0.08229	0.17321	0.36134	0.05943	0.15116	-0,20	-0,+20	-0,+20
	(8.48)	(1.56)	(3.04)	(12.00)	(2.59)	(3.20)	(-0,+20)	(-0,+20)	(-0,+20)
Decimalization	0.12064	-0.21670	-0.18063	0.13269	-0.32858	-0.67603	_	_	_
	(4.97)	(-5.14)	(-6.65)	(6.81)	(-15.61)	(-20.13)			
R squared	0.1994	0.1211	0.0186	0.9691	0.8637	0.6711			

Table VIII
Liquidity and Ownership Structure

Institutional blockholdings is the combined holdings of all non-insiders institutional investors that hold more than 5% of the shares outstanding. HS measure is calculated based on Hertzel and Starks (2003) and is the combined holdings of the top five non-insiders institutional investors divided by the combined holdings of all non-insiders institutional investors. The liquidity measures are calculated by taking the log of the average across the quarter. Share volume is the monthly share volume. Turnover is the monthly share volume divided by the number of shares outstanding at the end of the month. Dollar depth is the number of shares at the bid and ask multiplied by their respective prices. The equal-weighted bid/ask spread is the relative spread, where each quote update receives equal weight. The effective spread is the absolute difference between the trade price and the quote midpoint at the time of the trade. The realized spread is the signed (positive for buyer-initiated and negative for seller-initiated trades) difference between the trade price and quote midpoint 5 minutes after the trade. The effective and realized spreads are calculated each minute. Price impact (daily) is based on Amihud (2000) and is calculated as abs(daily return)/(daily volume). The remaining variables are defined in Table III. The standard deviation of the coefficients is calculated with two-dimensional clustered standard errors as in Petersen (2006); *t*-stats of coefficient are provided in parenthesis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent	Time-weighted spread	Price impact (intraday)	Share volume	Turnover	Dollar depth	Equal-weighted spread	Effective spread	Effective realized spread	Price impact (daily)
Insiders' holdings	-0.00190	-0.00050	-0.00812	-0.00403	-0.00260	-0.00164	-0.00015	-0.00284	0.00891
	(-2.98)	(-0.57)	(-6.38)	(-3.71)	(-3.26)	(-2.60)	(-0.12)	(-4.00)	(6.48)
Institutional holdings	-0.00972	-0.00324	0.02070	0.01248	0.00798	-0.01406	-0.01617	-0.01119	-0.02533
	(-5.05)	(-1.07)	(14.63)	(16.00)	(7.87)	(-12.54)	(-11.59)	(-12.57)	(-16.69)
Institutional blockholdings			-0.02157		-0.00326	0.01007			0.02508
			(-8.15)		(-2.63)	(10.59)			(9.16)
HS measure	0.00812	0.01704		-0.02171			0.0010	0.01147	
	(5.43)	(6.06)		(-15.13)			(13.74)	(13.70)	
HS measure× institutional holdings	0.00003	-0.00011							
	(1.13)	(-2.33)							
Control variables									
Market value	-0.33483	-0.36342	0.81572	-0.00681	0.39775	-0.35960	-0.45408	-0.32499	-0.91462
	(-20.75)	(-22.80)	(45.70)	(-0.60)	(28.69)	(-23.96)	(-16.46)	(-17.51)	(-45.76)
Share price	-0.00144	0.00043	-0.00013	-0.00003	0.00297	-0.00132	0.00882	-0.00369	0.00013
	(-1.70)	(0.70)	(-46.82)	(-34.77)	(3.10)	(-1.72)	(5.64)	(-2.98)	(57.82)
Book to market	0.00292	-0.00564	0.05054	0.01068	0.02127	0.00472	0.00814	0.00862	-0.04781
	(0.29)	(-0.51)	(1.71)	(2.84)	(2.38)	(0.47)	(-2.88)	(0.79)	(-1.78)
Volatility	0.43253	0.49824	1.86216	0.92577	-0.12604	0.44100	0.08682	0.39595	-1.06587
	(8.24)	(10.48)	(21.63)	(21.79)	(-2.85)	(8.81)	(2.98)	(7.43)	(-14.74)
Decimalization	-0.39709	-0.67070	0.17860	0.01084	-0.83306	-0.37792	-0.67169	-0.59334	-0.40040
	(-5.56)	(-10.93)	(2.99)	(0.29)	(-10.79)	(-5.33)	(-6.60)	(-9.75)	(-6.11)
R squared	0.7450	0.5683	0.8267	0.5818	0.7231	0.7642	0.6033	0.6621	0.8406

Table IX
Changes in Ownership Level and Ownership Concentration

Panel A shows distribution properties of changes in ownership variables. Panel B provides difference of mean and median tests of changes (upward changes minus downward changes) in log liquidity variables during quarters in which one (and only one) of either institutional holdings, insiders' holdings or institutional concentration changed by more than the 90% (upward changes) or less than the 10% (downward changes) of its respective empirical distribution, while the other ownership variables changes are small. Definitions of variables are provided in Table I.

Panel A

| | Mean | Standard deviation | Percentile | | | | | | |
			1st	5th	25th	50th	75th	95th	99th
Ownership Level									
Δ Institutional holdings	0.67	5.67	-15.06	-5.84	-0.97	0.53	2.34	7.75	16.66
Δ Insiders' holdings	-0.08	4.61	-12.15	-1.34	-0.03	0.00	0.04	0.89	11.14
Ownership Concentration									
Δ HS measure	-0.17	4.77	-12.95	-6.79	-2.05	-0.14	1.72	6.12	12.07
Δ Institutional blockholdings	0.17	4.98	-14.08	-7.18	-0.56	0.00	0.91	7.65	13.98
Δ Insiders' blockholdings	-0.08	4.55	-12.25	-0.30	0.00	0.00	0.00	0.07	11.09

Panel B

	Number of upward (downward) events	Mean upward (downward) change	Median upward (downward) change	Difference of means (median) test upward-downward
Big change in institutional holdings				
Δ Dollar volume	289 (290)	0.055 (-0.058)	0.065 (-0.050)	3.53 (4.06)
Δ Time-weighted spread	286 (286)	-0.097 (0.001)	-0.103 (-0.031)	-3.56 (-4.69)
Δ Price impact (intra-day)	275 (268)	-0.070 (-0.000)	-0.085 (-0.035)	-1.05 (1.11)
Big change in insiders' holdings				
Δ Dollar volume	321 (320)	-0.041 (-003)	-0.070 (-0.033)	-1.01 (-1.32)
Δ Time-weighted spread	277 (286)	-0.014 (0.030)	-0.027 (-0.027)	-1.27 (-0.49)
Δ Price impact (intra-day)	221 (248)	-0.000 (-0.131)	-0.055 (-0.096)	1.45 (1.21)
Big change in HS measure				
Δ Dollar volume	280(279)	-0.075 (0.230)	-0.048 (0.154)	-7.50 (-7.31)
Δ Time-weighted spread	261 (258)	0.040 (-0.122)	0.001 (-0.079)	4.74 (4.56)
Δ Price impact (intra-day)	229 (229)	0.074 (-0.186)	0.016 (-0.249)	2.98 (3.17)