JOURNAL OF FINANCIAL INTERMEDIATION 3, 300–326 (1994)

Market Structures and Liquidity: A Transactions Data Study of Exchange Listings

WILLIAM G. CHRISTIE AND ROGER D. HUANG

Owen Graduate School of Management, Vanderbilt University, 401 21st Avenue South, Nashville, Tennessee 37203

Received April 22, 1993

This paper examines the change in trading costs for firms that choose to move from a dealer market to a specialist system. Using transactions data, our empirical results reveal structurally induced average trading cost reductions of 4.7 (5.2) cents per share for firms that moved from the NASDAQ/NMS to the NYSE (AMEX) in 1990. For NYSE listed stocks, the trading cost reductions are equally divided between quote improvements and the routing of trades to the NYSE. Trading cost improvements vary inversely with trade sizes and positively with dollar spreads. Finally, the greatest liquidity benefits from listing accrue to the less liquid stocks. *Journal of Economic Literature* Classification Numbers: D40, G12, G20. © 1994 Academic Press, Inc.

1. INTRODUCTION

Equity markets with dissimilar trading structures may offer varying levels of market liquidity. Individual and institutional investors prefer liquid markets that can promptly absorb large orders without inducing large price fluctuations. Corporations seek more liquid markets since

* The paper has benefitted from the helpful comments and suggestions of Yakov Amihud, Corinne Bronfman, Gene Finn, Richard Goldberg, Sreenivas Kamma, John Lajaunie, Charles Lee, Ron Masulis, Tim McCormick, Tom McInish, Kelly McNamara, Hans Stoll, Bob Wood, workshop participants at the Commodities Futures Trading Commission, George Mason University, Memphis State University, Vanderbilt University, and the 1993 Symposium on Globalization and the Reform of Financial Institutions and Markets at Northwestern University. We are also grateful to Stuart Greenbaum (the editor) and two anonymous referees for their detailed comments. The research was supported by the Dean's Fund for Research and by the Financial Markets Research Center at the Owen Graduate School of Management, Vanderbilt University.

1042-9573/94 $6.00

lower trading costs permit them to obtain lower required rates of return.[1] The decision to switch trading location reflects the outcome of the marriage between the search for liquidity improvements and the provision of liquidity services by markets. Since the decision to relocate exchange listings does not affect a firm's assets or liabilities, the motivation may be linked to the perceived benefits inherent in different trading locations. The purpose of this paper is to test whether structurally-induced reductions in trading costs emerge when firms relocate from a dealer market to a specialist system, and to examine the nature of the hypothesized liquidity improvements.

Our research design draws from two strands of literature. First, the literature on stock listings uses the twin motives of liquidity and reputation to motivate its results.[2] Using event study methodologies and daily return data, this research examines the impact on shareholder wealth from changing trading locations. Since prices would reflect the *expected* benefits of increased liquidity and higher prestige when the intention to switch exchanges becomes public, these studies concentrate their analyses around announcement dates. In contrast, our paper uses transactions data to document the liquidity gains that are *realized* immediately after firms begin trading on their new exchange. Second, there is a growing literature that studies the differences in liquidity across market structures. Most of these studies subscribe to the definition that, in the absence of new information, liquid markets permit prompt low-cost transactions for significant order sizes. Thus, listing studies exploit the arrival of new information while liquidity studies abstract from its presence.

We test for structurally-induced liquidity effects using two relocation pairs: the National Association of Security Dealer Automated Quotation/National Market System (NASDAQ/NMS) to the American Stock Exchange (AMEX), and the NASDAQ/NMS to the New York Stock Exchange (NYSE). The NYSE and the AMEX use an auction/specialist system while the NASDAQ/NMS is a dealer market. The analysis focuses on the costs of trading as captured by both the posted and the realized quotes. The former is represented by dollar and percentage bid-ask spreads. The latter requires calculating "liquidity premiums," or one-

[1] Demsetz (1968) argues that illiquid stocks are characterized by wider bid-ask spreads that translate into higher expected returns. Amihud and Mendelson (1986) and Reinganum (1990) provide empirical evidence that highlights the relation between bid-ask spreads and required rates of returns.

[2] This literature has a long history. Ule (1937) provides an early investigation of newly listed stocks. More recent studies include Cowan, *et al.* (1992), Baker and Edelman (1992), and Kadlec and McConnell (1992). Management surveys identify better liquidity and visibility as the main reasons for listing on the AMEX/NYSE (see, for example, Baker and Johnson, 1990). The importance of the reputation motive appears to have declined since the advent of the NASDAQ/NMS in April of 1982 (Sanger and McConnell, 1986).

half the effective bid-ask spreads, measured as the absolute difference between the trade price and the mid-point of the bid-ask quotes.

To attribute the liquidity effects to dissimilar trading structures, we control for several confounding influences. First, we use a portfolio approach that relies on the averaging process across firms to diversify the idiosyncratic effects of new information that may induce quote and price changes unrelated to liquidity. Second, our portfolio approach minimizes the systematic influence of market-wide fluctuations through the dispersion of listing dates in calendar time. Third, we control for firm-specific characteristics across trading locations by following the same firms over a narrow window surrounding the listing date. Thus, our samples are confined to firms that are not just comparable, but identical.

This research design contrasts with previous studies that examine the relation between structural arrangements and market liquidity that have produced conflicting results. For example, Hui and Heubel (1984), Hasbrouck and Schwartz (1986), and Marsh and Rock (1986) find that NYSE/AMEX stocks are more liquid while Cooper *et al.* (1985) obtain the highest liquidity for NASDAQ/NMS stocks of similar size. Since these comparisons use stocks whose firm-specific characteristics are not perfectly aligned, their results may reflect residual differences in the fundamental values of the assets.[3]

Recent studies place greater emphasis on the careful matching of securities across exchanges. McInish and Wood (1992a) use linear programming techniques to construct comparable portfolios of NASDAQ/NMS and NYSE/AMEX stocks. Since no two stocks are simultaneously listed on both the NASDAQ/NMS and the NYSE/AMEX, the matching of portfolios is only achieved along a limited number of dimensions. An alternative is to study identical firms that are listed on one exchange but are traded on the two systems. Blume and Goldstein (1992), Lee (1992), and Petersen and Fialkowski (1992) study competition in the Third Market, defined as the competition for order flow from the NASDAQ/NMS for securities listed on the AMEX or NYSE, and find that liquidity is generally higher when trades are executed through a specialist.

Our empirical results indicate that large reductions in trading costs are realized when firms move from a dealer market to a specialist system. In light of the magnitude of this reduction, we examine the nature of these liquidity improvements along several dimensions. First, we decompose the liquidity gains into the proportion attributed to quotes that originate from the organized exchanges and to the choice of executing trades on the

[3] An exception is the study by Dubofsky and Groth (1984) that follows stocks around their listing date and concludes that NASDAQ/NMS provides higher liquidity than organized exchanges. However, by using daily close-to-close data, their liquidity measures are sampled too infrequently to appropriately capture liquidity effects.

NYSE rather than the Third Market. This distinction is unique to the listing sample as previous studies focused solely on differences in trading costs for trades executed in different trading locations for NYSE-listed stocks. Second, we examine differences in liquidity for different trade sizes and dollar spreads across trading structures. If a specialist system is the more efficient structure for less liquid trades, the largest liquidity gains from listing should emerge for trades with wider spreads and lower sizes. Third, we relate the liquidity improvements to firm-specific characteristics prior to listing. Amihud and Mendelson (1988) argue that the decision to list on organized exchanges involves a trade-off between the cost of listing and the anticipated liquidity improvements. Therefore, smaller firms, for which listing costs are a greater proportion of value, would realize larger reductions in trading costs.

The remainder of the paper is organized as follows. Section 2 outlines the differences in trading systems. Section 3 describes the data and defines our measures of trading costs. Section 4 presents the empirical results that test for differences in liquidity across trading structures, while Section 5 examines the nature of the liquidity improvements. Section 6 concludes the paper.

2. DISSIMILAR MARKET STRUCTURES AND LIQUIDITY

NYSE and AMEX stocks are traded in an auction/specialist setting while NASDAQ/NMS stocks are traded in a multiple dealer market.[4] Under the auction arrangement, stocks are assigned to specialists who post bid-ask quotes to smooth price changes by buying (selling) from their personal accounts when public buy (sell) orders are lacking. The specialist is not without competition since their own orders are superseded by public market orders and limit orders. The structure resembles an auction market since all public orders are exposed to one another on an exchange floor.[5] The execution of trades inside the spread, such as public buy and sell orders that cross with one another, may occur more frequently with this market structure.

The trading structure of the NASDAQ/NMS is fundamentally different from the organized exchanges. NASDAQ/NMS contains the largest and most actively traded firms in the NASDAQ system. It's financial requirements are comparable to those required for listing on the AMEX. Unlike the NYSE that uses floor trading, NASDAQ/NMS uses a screen-based system. NASDAQ/NMS dealers are free to make markets in stocks of

[4] Stoll (1992) provides an in-depth discussion of the principles of trading market structure.

[5] However, some of the limit orders may be hidden by the specialists. McInish and Wood (1992b) find that about 50% of limit orders with better quotes are not displayed.

their own choosing and multiple dealers per stock are common. Buyers and sellers interact directly with dealers who take the opposite side of every trade as principals. Similar to trading on the organized exchanges, trading inside the spread may occur, although such price improvement is usually reserved for active investors or for large orders.

Proponents of the two structures have heralded the advantages of their respective trading arrangement. For example, supporters of the NYSE/AMEX argue that their system offers lower trading costs since floor trading is more proficient at uncovering informed trades than the anonymous screen-based system used on the NASDAQ/NMS. Those who favor the NASDAQ/NMS stress the increased competition characterized by a market open to all dealers, not just the specialist. For example, they object to NYSE Rule 390 that prohibits NYSE member trades from being executed on the NASDAQ/NMS.

3. DATA DESCRIPTION AND LIQUIDITY MEASURES

Section A describes the procedures used to select our sample of firms that switch exchanges and provides summary statistics of their size and trading activity. Section B defines the trading cost variables used to compute differences in liquidity across exchanges.

A. *Sample Selection and Data Description*

The monthly stock master compiled by the Center for Research in Security Prices (CRSP) is used to identify firms that moved between the NASDAQ/NMS, the AMEX, and the NYSE during 1990. The choice of the 1990 calendar year is determined by the availability of trade and quote data compiled by the Institute for the Study of Security Markets (ISSM) for NASDAQ/NMS securities at the time of our study. The exchange code designated by CRSP is used to identify firms that trade on more than one of the three exchanges in 1990. The firm-specific CUSIP numbers are then used to link firms between the CRSP and ISSM data sets. Table I provides a summary of the number of firms moving between exchanges and the elimination criteria used to establish the final sample. The table shows that the procedures fail to match four firms moving from the NASDAQ/NMS to the AMEX, and one firm moving to the NYSE from the NASDAQ/NMS.[6] The ISSM data are then examined to confirm that trades and quotes are present throughout the 60-day interval surrounding

[6] To further ensure the integrity of the data set, we match firms across exchanges by manually reconciling the prices from the two data sources with the prices reported in the "Wall Street Journal" on the day the firm began trading on the new location.

TABLE I
SAMPLE IDENTIFICATION AND ELIMINATION CRITERIA FOR FIRMS MOVING BETWEEN THE NASDAQ/NMS, THE AMEX, AND THE NYSE DURING 1990

Trading location	Initial sample	Elimination criteria		Final sample
		No match between the CRSP and ISSM CUSIP	Missing ISSM data during the 60 trading days surrounding the new listing	
NASDAQ/NMS to AMEX	33	4	10	19
NASDAQ/NMS to NYSE	33	1	0	32
AMEX to NASDAQ/NMS	4	0	3	1
AMEX to NYSE	15	0	1	14
NYSE to NASDAQ/NMS	1	0	0	1
NYSE to AMEX	1	0	1	0

the listing date on the new exchange, i.e., [−30, +29], where Day 0 signifies the listing date. This procedure identifies 15 firms for which no ISSM data are available.

The restricted sample consists of 19 firms that move from the NASDAQ/NMS to the AMEX, 32 firms that move from the NASDAQ/NMS to the NYSE, and 14 firms that move from the AMEX to the NYSE. We exclude from our analysis the two firms that moved to the NASDAQ/NMS, given the limited sample size. Since our methodology uses a portfolio approach to test for differences in liquidity costs across exchanges, we do not require that firms trade throughout the interval [−30, +29]. Thus, some firms will be present for only a portion of the interval when the listing date is close to January or December of 1990. To check whether our calendar year restriction biases our results, we calculated the number of firm-days pre- and post-listing, defined as the sum of the number of trading days that each firm is present within the 60-day window. Our computation uncovered only minor differences in the number of firm-days. The final sample is then subjected to a series of filters. A description of these procedures is summarized in the Appendix.

Table II provides summary statistics for firms that survive the sampling procedures and filter requirements. The table reports the averages and distribution of share prices, number of outstanding shares, market value of equity, and dollar volume per trade for the three samples. The most striking result is the vast difference in both share prices and number of shares outstanding for firms moving from the NASDAQ/NMS to the AMEX relative to firms moving from the NASDAQ/NMS to the NYSE. The average price per share for firms that elect to move to the AMEX is only \$6.87, with 25% of the firms trading for under \$4.00. In contrast, the NASDAQ/NMS firms that move to the NYSE have an average share price of \$19.78, with the 25% quartile reaching a price of \$10.125.

TABLE II
DESCRIPTIVE STATISTICS FOR FIRMS THAT CHANGED THEIR TRADING LOCATION IN 1990

		Quartile		
	Mean	25%	50%	75%
A. Firms moving from the NASDAQ/NMS to the AMEX in 1990 (n = 19)				
Price per share	$6.87	$4.00	$5.75	$9.00
Number of shares (in thousands)	4241	1727	3029	5268
Market value of equity (in thousands)	$27,740	$12,002	$16,651	$38,705
Dollar volume (per trade)	$9436	$1875	$4000	$9500
B. Firms moving from the NASDAQ/NMS to the NYSE in 1990 (n = 32)				
Price per share	$19.78	$10.125	$17.375	$25.375
Number of shares (in thousands)	18,538	7677	17,963	23,475
Market value of equity (in thousands)	$396,391	$107,403	$208,238	$503,448
Dollar volume (per trade)	$41,223	$5250	$14,000	$35,525
C. Firms moving from the AMEX to the NYSE in 1990 (n = 14)				
Price per share	$14.88	$9.125	$13.00	$18.125
Number of shares (in thousands)	20,420	5221	9972	14,955
Market value of equity (in thousands)	$242,847	$86,050	$136,110	$190,693
Dollar volume (per trade)	$22,570	$2900	$7000	$17,063

Note. The price and share data are measured at the end of the month containing the listing date. Dollar volume includes all trades for the 60 trading days [−30, +29], where Day 0 is the listing date.

Coupling the higher share prices with the larger number of outstanding shares creates a wide disparity in market values between firms listing on the NYSE relative to the AMEX. The 75% quartile of market value for the AMEX-listed firms is only one-third as large as the 25% quartile for firms moving to the NYSE. Thus, firms electing to relocate to the AMEX are small relative to the firms electing to list on the NYSE. This difference in size is also apparent in the average dollar volume of all trades executed during the interval [−30, +29]. The median dollar volume per trade for firms moving to the AMEX from the NASDAQ/NMS is $4000 while the comparable figure for firms moving to the NYSE is $14,000. The median dollar volume for firms moving from the AMEX to the NYSE falls between these values.

B. *Variable Definitions*

In estimating our trading cost variables, we exclude all quotes that do not reflect a change in either the bid or the ask. Thus, we do not consider

quote revisions that reflect changes in the depth alone, where depth is defined as the volume that the dealer/specialist is willing to trade at the posted quotes. We exclude these quote revisions since the depth variables in the ISSM data are uninformative. The variables are defined as follows:

LP. The opportunity to transact at a price inside the bid-ask spread is one measure of liquidity as it provides information on the ability to obtain the "best price." Using the mid-point of the standing bid-ask quotes as a proxy for the "best price," we compare the actual trade price with the best price to calculate the "liquidity premium," defined as:

$$LP = \left| Price - \left(\frac{Ask + Bid}{2} \right) \right|. \tag{1}$$

Price improvements occur when trades are transacted inside the spread since public buyers (sellers) receive a lower (higher) price.

Percentage LP. Since liquidity premiums may vary with the level of stock prices, we also report a standardized measure of the liquidity premium defined as the percentage LP:

$$\%LP = \frac{|Price - (Ask + Bid)/(2)|}{(Ask + Bid)/2}. \tag{2}$$

Dollar spread. Even if all trades are executed at the bid or the ask, a reduction in the width of the spread would lower trading costs. Thus, we also include the traditional liquidity measure, defined as the dollar spread, or the ask quote minus the bid quote.

Percentage spread. Since bid-ask spreads may vary with the level of stock prices, we also report a standardized measure of the dollar spread defined as the percentage spread:

$$\% \ spread = \frac{Ask - Bid}{(Ask + Bid)/2}. \tag{3}$$

4. LIQUIDITY DIFFERENCES ACROSS TRADING STRUCTURES

We organize our empirical tests around the following hypothesis:

For firms that transfer their exchange listing from a dealer market to a specialist system, reductions in trading costs become apparent on the first day of listing and persist thereafter.

This hypothesis specifies that dissimilar trading structures trigger the reduction in liquidity costs. Restricting the emergence of the liquidity effect to the listing date increases our confidence that the differences in market structure produce the results. However, the time period for which the liquidity effects persist is not unlimited. The further removed the trading day is from the listing date, the higher the probability that the fundamental value of the firm has changed. On the other hand, the liquidity effects must not disappear or revert to their pre-listing levels shortly after listing. To judge the persistence of the differences, we use a window of 60 trading days centered on the listing date.

One of the alleged benefits of moving to the organized exchanges is the reputation effect. Since the organized exchanges impose more stringent listing requirements, relocating from the NASDAQ/NMS may serve as a signal of value, resulting in greater visibility and market interest, especially among institutional investors. In an efficient market, the expected liquidity benefits arising from the reputation effect are permanently incorporated in prices when firms announce their intention to list on the organized exchanges. Thus, any differences in liquidity costs on the listing date can be attributed to structural rather than reputation effects. However, to the extent the reputation effect is not reflected in liquidity costs until firms begin trading on the organized exchanges, liquidity differences on the listing date may incorporate both structural and reputation effects.

To further examine the influence of liquidity effects, we include a control sample of firms that move from the AMEX to the NYSE. Since these firms change trading locations but not trading structures, we would not expect the listing date to be associated with a significant change in trading costs. However, firms may not be indifferent between listing on the NYSE and on the AMEX since the NYSE may provide increased visibility and heightened market interest because of its more stringent listing requirements. Specifically, firms listed on the NYSE are more likely to attract the attention of institutional investors. Nonetheless, the listing date should not demarcate the presence of reputation effects if these effects are first impounded on the announcement date.

The testing strategy first compares the liquidity variables using averages measured for the 30 trading days before the listing and for the first 30 days on the new exchange. Having established the pre- and post-listing differences in liquidity, we examine the patterns of the liquidity variables surrounding the listing date to ensure that these differences are structurally induced.

Table III reports the mean values for LP, percentage LP, dollar spreads, and percentage spreads as firms move between exchanges. Table IIIA summarizes the results for the NASDAQ/NMS to AMEX sample, Table IIIB contains the results for the NASDAQ/NMS to NYSE

TABLE III
DIFFERENCES IN TRADING COST VARIABLES FOR FIRMS THAT CHANGED THEIR TRADING LOCATION IN 1990

	Listed on original exchange			Listed on new exchange			t-statistic of differences in means
	Number	Mean	Standard deviation	Number	Mean	Standard deviation	
A. NASDAQ/NMS stocks that move to the AMEX (n = 19)							
LP	3815	\$0.119	\$0.153	3273	\$0.067	\$0.055	19.38
Percent LP	3815	2.04%	2.06%	3273	1.37%	1.14%	17.09
Dollar spread	1358	\$0.52	\$0.63	2587	\$0.21	\$0.10	17.82
Percent spread	1358	8.34%	7.86%	2587	3.84%	1.86%	20.83
B. NASDAQ/NMS stocks that move to the NYSE (n = 32)							
LP	75,711	\$0.11	\$0.091	35,543	0.063	\$0.052	115.15
Percent LP	75,711	0.60%	0.58%	35,543	0.43%	0.59%	45.65
Dollar spread	13,040	\$0.31	\$0.19	15,440	\$0.25	\$0.10	32.97
Percent spread	13,040	1.63%	1.27%	15,440	1.50%	1.24%	8.73
C. AMEX stocks that move to the NYSE (n = 14)							
LP	14,023	\$0.067	\$0.055	12,334	0.058	\$0.051	14.32
Percent LP	14,023	0.48%	0.44%	12,334	0.42%	0.43%	10.87
Dollar spread	5529	\$0.22	\$0.08	5402	\$0.25	\$0.12	17.12
Percent spread	5529	1.36%	0.78%	5402	1.68%	0.97%	18.67

Note. LP is computed as the absolute difference between the trade price and the mid-point of the standing bid-ask quotes. Percent LP is computed as the ratio of LP to the average of the bid-ask quotes. The dollar spread is computed as the difference between the ask and bid quotes. Percent spread is the ratio of the dollar spread to the average of the bid-ask quotes.

sample, and Table IIIC presents the results for the AMEX to NYSE sample. Tables IIIA and IIIB reveal striking differences in LP across exchanges. The liquidity premium for firms while listed on the NASDAQ/NMS prior to listing on the AMEX averages 11.9 cents per share. During the first 30 days of trading on the AMEX, the average LP falls by 5.2 cents. Similarly, an average improvement in LPs of 4.7 cents is realized by firms that move to the NYSE. Table III also shows that the percentage LP declines from 2.04% (0.60%) to 1.37% (0.43%) for the NASDAQ/NMS to AMEX (NYSE) sample. Thus, dramatic improvements in LPs are mirrored by the percentage LP that controls for the absolute price level. However, the absolute decline is significantly more important for firms that list on the AMEX.

The differences in average trading costs based on the listing location are also apparent in the decline of the standard deviations for the liquidity measures. Firms that list on the AMEX realize larger declines in both the level and the variability of the trading cost measures than firms that list on the NYSE. This result is due, in large part, to the wider spreads of AMEX-bound firms prior to listing. These wider spreads translate into larger variability given the greater latitude to trade or not trade within the spread.[7]

To test whether these economically meaningful differences are also statistically significant, we estimate the following regression,

$$L_t = \alpha + \beta D_t + \varepsilon_t, \tag{4}$$

where L_t represents a liquidity variable for trade t and D_t equals 1 for trades executed on the new exchange, and zero otherwise. The t-statistic for β indicates whether the reported differences in liquidity are significant. The last column in Table III confirms that the reduction in LP and percentage LP from transferring to an organized exchange from a dealer market is statistically significant.

Reductions in trading costs are also observed for dollar spreads and percentage spreads. For firms moving from the NASDAQ/NMS to the AMEX, sharp reductions occur in both dollar spreads and percentage spreads, with each declining by over 50% once firms begin trading on the AMEX.[8] However, NASDAQ/NMS to NYSE firms show only modest reductions in the spread, measured in either dollars or percentages.[9]

Table IIIC presents the evidence for firms that change their trading locations but not their trading structure. Despite the continuity in market

[7] The differences in standard deviations for the dollar spread of firms that list on the AMEX can be partially attributed to one firm whose dollar spread fell from \$4.00 while trading on the NASDAQ/NMS to \$1.00 after listing on the AMEX. Removing this firm lowers the NASDAQ/NMS average dollar spread to \$0.44 and the standard deviation to \$0.31. However, the average LP is virtually unaffected at \$0.114 since so few trades were recorded for this security.

[8] To test whether the results are sensitive to extreme observations, the comparisons in Table III were computed using differences in medians on a firm-by-firm basis. The results continue to support the conclusion that significant declines in trading costs are realized by firms that list on the organized exchanges, particularly for firms that list on the AMEX. The statistical inferences using the mean and the median are identical at the 1% level of significance for all but one firm in each of the NASDAQ/NMS–AMEX and NASDAQ/NMS–NYSE samples, where the statistical significance of the medians is computed using a Kruskal–Wallis test statistic.

[9] The average dollar and percentage spreads in Table III correspond closely with those reported in Kadlec and McConnell (1992) despite their larger sample of 273 firms. For example, the average dollar (percentage) spread of \$0.25 (1.5%) after listing on the NYSE for our sample compares with \$0.27 (1.5%) in their study.

structure, the average LP falls from 6.7 cents on the AMEX to 5.8 cents on the NYSE. However, the sizable gain in liquidity is not shared by our other trading cost variables. Specifically, the size of the average spread widens from \$0.22 per share on the AMEX to \$0.25 on the NYSE. Similar results are observed when the dollar spread is transformed to percentages: 1.36% on the AMEX versus 1.68% on the NYSE. These results provide conflicting evidence of improvement in liquidity for our control sample. Moreover, the high levels of statistical significance associated with the relatively small changes in liquidity costs for the control sample can be largely attributed to the large number of trades used to compute these statistics.

Figures 1 to 4 provide graphical evidence that identifies whether the reductions in trading costs coincide with the listing date. If the improvements in liquidity are structurally induced, they should first emerge on the listing date and not dissipate shortly thereafter. Figure 1 tracks the average liquidity premiums and confirms that the reduction in LPs is structurally induced. The average value of LP floats between \$0.08 and \$0.16 for firms that are listed on the NASDAQ/NMS and declines dramatically the day trading begins on the organized exchanges. These lower trading costs persist as the average LP fluctuates between \$0.05 and \$0.08. Thus, the

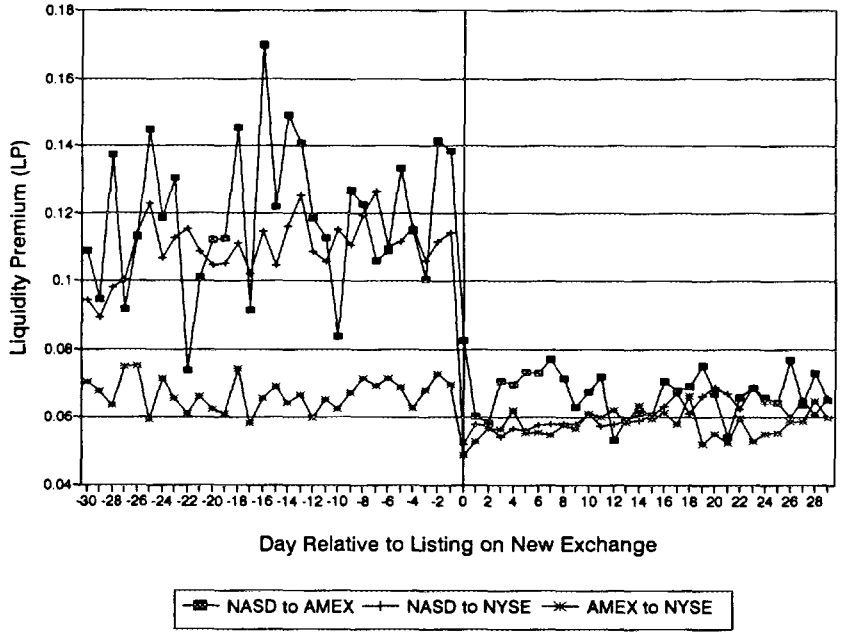

FIG. 1. Liquidity premiums surrounding the listing date.

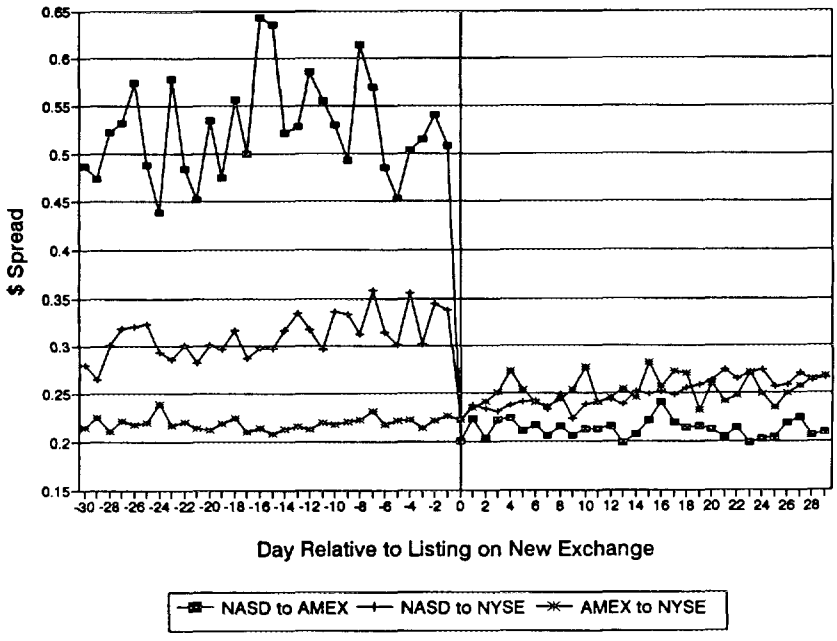

FIG. 2. Dollar spreads surrounding the listing date.

reduction is both immediate and unabating for firms moving to either the AMEX or the NYSE from the NASDAQ/NMS.

For our control sample, the figure illustrates that the reduction in LP corresponds to Day 0. However, the average LP values begin to creep upward almost immediately, violating a requirement of a structurally induced liquidity effect. The evidence is also inconsistent with a reputation effect since a recognition factor should be permanent.

Figure 2 graphs the daily averages for the dollar spreads. Consistent with the evidence in Fig. 1, there is a dramatic and permanent reduction in the dollar spread for firms moving from the NASDAQ/NMS to the AMEX. The reduction for firms moving from the NASDAQ/NMS to the NYSE begins on Day 0, but shows a slight tendency to revert over time. Thus, the NASDAQ/NMS to AMEX sample provides significantly stronger support for our central hypothesis than the NASDAQ/NMS to NYSE sample. For our control sample, dollar spreads exhibit a slight tendency to rise in the post-listing period. However, the listing date does not demarcate the dollar into pre- and post-listing regimes, suggesting that the increase in spreads is not structurally induced. Figures 3 and 4 provide the graphical evidence for LP and dollar spreads transformed into their

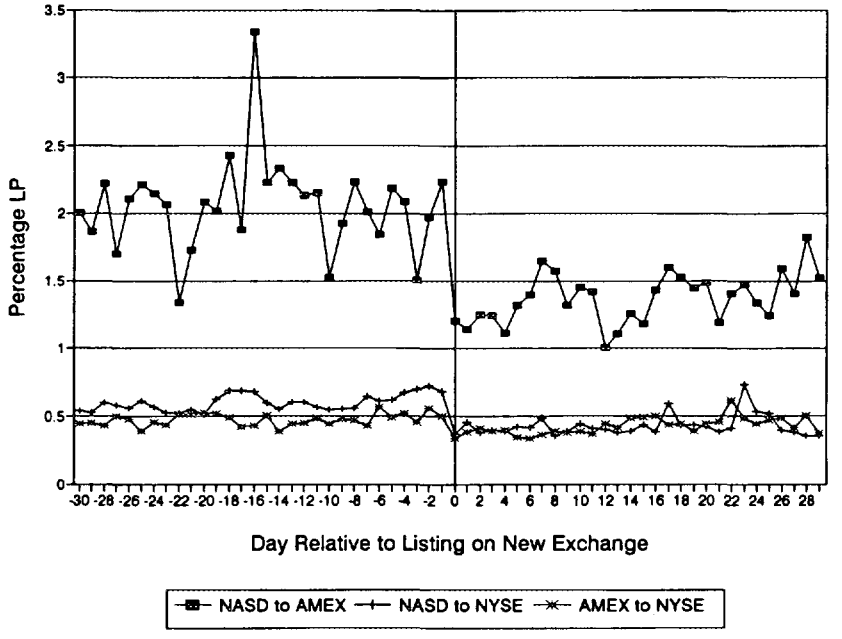

FIG. 3. Percentage liquidity premiums surrounding the listing date.

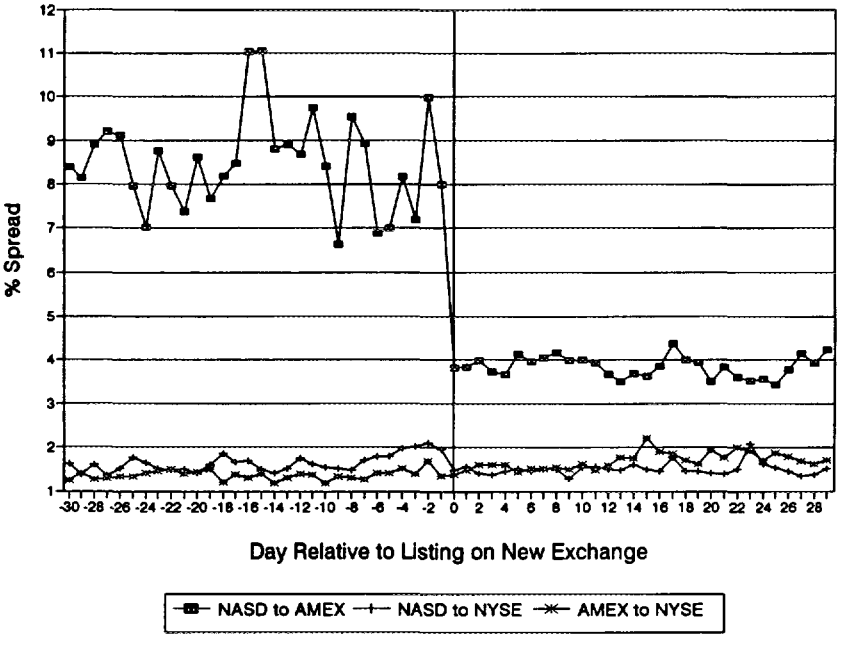

FIG. 4. Percentage spread surrounding the listing date.

proportional values, respectively. The intertemporal patterns reveal that the liquidity improvements on a percentage basis are much more dramatic for firms moving to the AMEX. In contrast, firms that move to the NYSE experience considerably more modest liquidity improvements.

While these results provide strong evidence in support of our central hypothesis, the decline in trading costs may also be induced by differences in trading volume. In particular, the liquidity improvements may arise from greater trading volume after the listing date. However, Table I indicates that the number of trades declines after firms begin trading on the organized exchanges. When trading activity is measured by dollar volume, similar declines are observed.[10] However, these volume figures must be interpreted with caution since trades are counted differently across market structures. For example, the batching procedure used at the open on the organized exchanges may combine a number of trades that would have been observed on the NASDAQ/NMS. The number of reported trades may also differ since a buy order and a sell order involve separate transactions on the NASDAQ/NMS whereas the specialist markets may allow the orders to cross in one trade.

In addition, our trading cost variables capture the costs of liquidity trading rather than informed trading since our portfolio approach controls for information effects and firm-specific characteristics. Admati and Pfleiderer (1988) distinguish between nondiscretionary liquidity traders who trade without regard to the timing of their trades and discretionary traders who do. Discretionary liquidity traders can potentially influence our results since they may postpone trades until the listing date and immediately thereafter. However, given the persistence of the trading cost reductions that we observe, it is unlikely that discretionary liquidity traders postpone trades for over a month.

In summary, the results provide evidence of structurally induced changes in trading costs for firms that elect to move from the dealer market to a specialist system. The direction and the magnitude of the reductions in trading costs contrast with prior studies that report mixed results.[11] Despite the large savings in trading costs, it is inappropriate to judge the superiority of a trading system based on our results. Since firms relocate when the perceived benefits more than offset the costs, the results are potentially biased in favor of finding liquidity improvements for our sample. To examine this possibility, we could study firms that

[10] The total dollar volume and the total share volume decline by almost 50% after firms list on the AMEX or the NYSE. In contrast, both dollar and share volumes are virtually unaffected when firms move between different markets within the specialist system.

[11] Examples of evidence in support of lower liquidity costs on the organized exchanges are Hasbrouck and Schwartz (1986) and Marsh and Rock (1986). In contrast, Dubofsky and Groth (1984) and Cooper *et al.* (1985) are examples of studies that identify the NASDAQ/NMS as providing higher liquidity.

move from the organized exchanges to the NASDAQ/NMS. Unfortunately, only two firms satisfy this requirement in 1990, and were excluded since the liquidity effects would be tainted by idiosyncratic and market-wide influences. Moreover, it is important to recognize that we focus on the trading cost element of liquidity and do not address other components such as speed of execution, broker's commissions, and soft dollar payments.

5. ANALYZING THE NATURE OF THE LIQUIDITY IMPROVEMENTS

In light of the significant decline in trading costs that arise when firms move from a dealer market to the specialist system, Section A separates the observed price improvements into gains attributed to differences in quote setting mechanisms and differences in trading location. Section B explores the characteristics of trading cost reductions across trade size and dollar spreads. Finally, Section C examines whether the characteristics of firms that move to the AMEX differ from those that list on the NYSE.

A. *Trades, Quotes, and the Third Market*

The market for trading exchange-listed stocks by dealers on the NASDAQ/NMS is referred to as the Third Market. The literature on Third Market competition compares the execution costs of identical stocks under dissimilar market structures. Recent studies of Third Market competition include Blume and Goldstein (1992), Huang and Stoll (1993), Lee (1992), and Petersen and Fialkowski (1992). Lee compares the LP of adjacent trades executed on the NYSE and the NASDAQ/NMS and concludes that trading costs are about 1 cent per share lower for trades routed to the NYSE. Blume and Goldstein find that the lower trading costs for NYSE trades are associated with trades of less than 1000 shares. Petersen and Fialkowski also find that trading costs are lower on the NYSE using proprietary data sets. Huang and Stoll report lower trading costs for the NYSE using various execution cost measures but attribute the lower costs to several factors, including the presence of limit orders that are "picked off" by informed traders and the tendency of trades to occur on the NASDAQ/NMS when NYSE spreads are wide.

Our sample also permits us to address the benefits of trading under different market structures by comparing LPs once firms are listed on the organized exchanges. However, our sample is unique in that it permits us to compare LPs based on NASDAQ/NMS quotes prior to the listing date with LPs for trades that continue to be executed on the NASDAQ/NMS but where quotes originate from the organized exchanges after the listing

TABLE IV
ATTRIBUTING THE IMPROVEMENTS IN LIQUIDITY PREMIUMS TO THE LOCATION OF TRADE EXECUTION AND TO QUOTE ORIGIN

A. NASDAQ/NMS firms that list on the NYSE (n = 32)

Listing location:	NASDAQ/NMS	NYSE			
Trading location:	NASDAQ/NMS	NASDAQ/NMS		NYSE	
Number of trades	Average LP	Number of trades	Average LP	Number of trades	Average LP
75,711	\$0.110	3675	\$0.082[a]	29,065	\$0.058[b]

B. AMEX firms that list on the NYSE (n = 14)

Listing location: AMEX Trading location: NASDAQ/NMS		NYSE NASDAQ/NMS	
Number of trades	Average LP	Number of trades	Average LP
268	\$0.079	406	\$0.081[c]

Note. Liquidity premiums (LPs) are computed as the absolute difference between the trade price and the average of the standing bid-ask quotes.

[a] The difference in the average liquidity premiums between trades executed on the NASDAQ/NMS after firms list on the NYSE and trades executed on the NASDAQ/NMS prior to listing are statistically significant (p value = 0.0001).

[b] The difference in the average liquidity premiums between trades executed on the NYSE after firms list on the NYSE and trades executed on the NASDAQ/NMS prior to listing are statistically significant (p value = 0.0001).

[c] The difference in the average liquidity premiums between trades executed on the NASDAQ/NMS after firms list on the NYSE and trades executed on the NASDAQ/NMS prior to listing are statistically insignificant (p value = 0.6091).

date. Therefore, we can estimate the proportion of the liquidity improvement that can be attributed to differences in trading locations and to quote improvements.

Table IV decomposes the reduction in LPs for NASDAQ/NMS firms that move to the NYSE and studies the differences in LPs for Third Market trades for our control sample. We exclude the results for the NASDAQ/NMS to AMEX sample since trading activity on the NASDAQ/NMS virtually evaporates in the post-listing period. Table IVA, which presents the results for firms that move from the NASDAQ/NMS to the NYSE, shows that the average LP declines from 11 cents for trades executed on the NASDAQ/NMS in the pre-listing period to 8.2 cents for trades executed on the Third Market in the post-listing period.[12] Since the

[12] The total number of trades on the organized exchanges are lower in Table IV relative to those reported in Table III. The differences are due to our treatment of trades that are executed on the regional exchanges. In testing for liquidity improvements in Table III we do not differentiate transactions by their trading locations. Table IV only considers transactions that are executed on the NYSE or the NASDAQ/NMS.

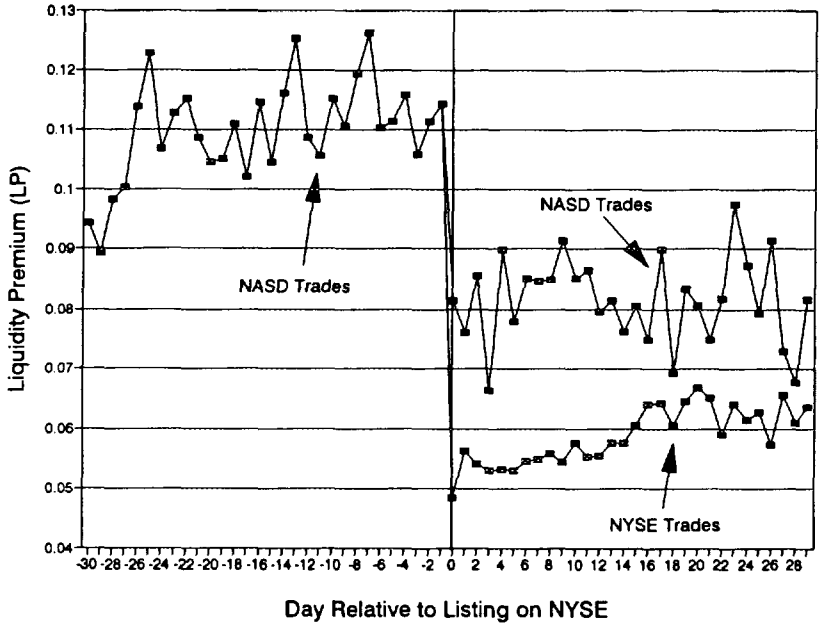

FIG. 5. Decomposing the improvements in liquidity premiums.

trading location is unchanged, this reduction can be attributed to quote improvements from the specialist market.

The average LP for trades executed on the NYSE rather than the Third Market during the post-listing period is 5.8 cents, indicating a further improvement of 2.4 cents due to differences in trading locations. These results are supplemented by Fig. 5, which plots the daily average LP values by exchange listing and by trading location. The decline in LPs on Day 0 is apparent for trades on both the NASDAQ/NMS and the NYSE, as is the difference in LPs between trades executed on the different trading systems. Thus, the differences in quote-setting behavior and the choice of trading location appear to be equally important sources of the liquidity improvements.

Table IVB reports the LP results for trades executed on the NASDAQ/NMS for our control sample of firms that move from the AMEX to the NYSE. Since both the pre- and post-listing quotes are set in the auction/specialist environment, quote-induced liquidity improvements for NASDAQ/NMS trades are predicted to be absent. The evidence in Table IVB supports this prediction since the pre- and post-listing LP values are not significantly different from one another.

TABLE V
TESTS FOR DIFFERENCES IN LIQUIDITY PREMIUMS (LP) ACROSS TRADE SIZE AND DOLLAR SPREAD CATEGORIES

A. Liquidity premiums by trade size

	Trade size (in shares)				
	<500	500–999	1000–1999	2000–4999	≥5000
Average LP values for firms moving from the NASDAQ/NMS to the AMEX					
α coefficient	0.1638	0.1295	0.1053	0.0808	0.0789
β_1 coefficient	−0.0962	−0.0592	−0.0377	−0.0161	−0.0201
β_1 t statistic	−14.08	−10.82	−9.67	−4.39	−3.10
$\chi^2(1)$ test of $\beta_3 - \beta_2 - \beta_1 = 0$	na	17.92	10.24	16.32	0.29
p value for $\chi^2(1)$ test	na	0.0000	0.0014	0.0001	0.0591
Average LP values for firms moving from the NASDAQ/NMS to the NYSE					
α coefficient	0.1382	0.1149	0.0914	0.0918	0.0978
β_1 coefficient	−0.0750	−0.0547	−0.0328	−0.0350	−0.0424
β_1 t statistic	−98.49	−51.27	−39.84	−30.10	−29.44
$\chi^2(1)$ test of $\beta_3 - \beta_2 - \beta_1 = 0$	na	237.83	266.12	2.45	16.01
p value for $\chi^2(1)$ test	na	0.0000	0.0000	0.1173	0.0001

B. Liquidity premiums by dollar spreads

	Dollar spread		
	$0.125 or under	$0.126 to $0.25	Larger than $0.25
Average LP values for firms moving from the NASDAQ/NMS to the AMEX			
α coefficient	0.0458	0.0915	0.2217
β_1 coefficient	0.0184	−0.0246	−0.1001
β_1 t statistic	22.47	−8.06	−6.25
$\chi^2(1)$ test of $\beta_3 - \beta_2 - \beta_1 = 0$	na	145.83	21.48
p value for $\chi^2(1)$ test	na	0.0000	0.0000
Average LP values for firms moving from the NASDAQ/NMS to the NYSE			
α coefficient	0.0656	0.1036	0.1819
β_1 coefficient	−0.0023	−0.0502	−0.1056
β_1 t statistic	−9.73	−80.52	−82.42
$\chi^2(1)$ test of $\beta_3 - \beta_2 - \beta_1 = 0$	na	5179.6	1510.1
p value for $\chi^2(1)$ test	na	0.0000	0.0000

Note. LP is defined as the absolute difference between the trade price and the mid-point of the standing bid-ask quotes. Dollar spread is defined as the difference between the ask and bid quotes. To test for differences in liquidity gains between adjacent trade size and dollar spread categories, we estimate the multiple regression

$$L_t = \alpha + \beta_1 D_t^{is} + \beta_2 D_t^{jd} + \beta_3 D_t^{js} + \eta_t, \qquad i < j,$$

B. *Liquidity Improvements across Trade Sizes and Dollar Spreads*

This section tests whether the liquidity improvements reported in Section 4 are universally shared across two important trade characteristics: trade sizes and dollar spreads. If the specialist system can more easily accommodate trades inside the spread as inferred by Lee (1992), Blume and Goldstein (1992), and others, then liquidity gains are expected to show their greatest improvement among trades with wider posted quotes. In addition, Blume and Goldstein (1992) and Huang and Stoll (1993) find that lower liquidity costs for trades routed to the NYSE relative to the NASDAQ/NMS are concentrated in trades of less than 1000 shares. Thus, the reductions in trading costs experienced by firms relocating to the organized exchanges may increase with decreasing trade size and wider quoted spreads.

A prerequisite for measuring the differences in liquidity across market structures is the proper control for firm-specific characteristics. Since we compare liquidity gains within trade size and dollar spread categories, our research design must preserve the composition of both the pre- and the post-listing sample. Thus, we eliminate firms within a specific category when the stipulated trade size or dollar spread is absent on either exchange.

Our results are reported in Table V. Tables VA and VB contain the results for LP as a function of trade size and dollar spread, respectively. Trade sizes (dollar spreads) are partitioned into five (three) categories that contain a similar number of trades. To test for differences in liquidity between adjacent categories, we estimate the regression

$$L_t = \alpha + \beta_1 D_t^{is} + \beta_2 D_t^{jd} + \beta_3 D_t^{js} + \eta_t, \qquad i < j, \tag{5}$$

where L_t is the liquidity variable for trades in categories i and j, D_t^{is} is the indicator variable that equals 1 for trades in category i that are executed on the specialist system, D_t^{jd} is the indicator variable that equals 1 for trades in category j that are executed on the dealer system, and D_t^{js} is the indicator variable equaling 1 for trades in category j executed on the specialist system. The t-statistic of β_1 tests for liquidity differences within category i. For across-category differences, we specify the null hypothe-

---

where L_t is the liquidity variable for trades in size (spread) categories i and j, D_t^{is} is the indicator variable that equals 1 for trades in size (spread) category i executed on the specialist system, D_t^{jd} is the indicator variable that equals 1 for trades in size (spread) category j executed on the dealer system, and D_t^{js} is the indicator variable that equals 1 for trades in size (spread) category j executed on the specialist system. The t statistic of β_1 tests for liquidity differences within size (spread) category i. The restriction $\beta_3 - \beta_2 - \beta_1 = 0$ tests the null hypothesis that the liquidity gains between adjacent size (spread) categories are insignificantly different from one another. A Wald test of the restriction is distributed as $\chi^2(1)$.

sis that the liquidity gains between adjacent categories are insignificantly different from one another: $\beta_3 - \beta_2 - \beta_1 = 0$. A Wald test of the null is distributed χ^2 with one degree of freedom.

For firms switching to either the AMEX or the NYSE from the NASDAQ/NMS, two common patterns emerge in Table VA. First, a significant reduction in LPs is observed across all trade size categories as indicated by the β_1 coefficients. Second, the reduction in trading costs declines with increasing trade size. For example, an average price improvement of almost 10 cents per share is observed for trades under 500 shares for firms moving to the AMEX. The price improvement for the same data set falls to 2 cents per share for trade sizes exceeding 5000 shares. Additionally, the differences in trading cost reductions between adjacent trade-size categories are generally statistically reliable as indicated by the χ^2 statistics. For the NASDAQ/NMS to NYSE sample, the reduction in LPs is most pronounced for trade sizes of under 500 shares. The reduction in LPs declines with increasing trade size with the exception of the largest trade category.

To confirm that the evidence presented in Table VA is structurally induced, we graph the LPs across trade size categories for the 60 trading days surrounding the listing date. For brevity, we only present the results for the sample of firms moving from the NASDAQ/NMS to the NYSE. This sample also maximizes the number of trades per trade size category. Figure 6 shows that the reduction in LPs coincides with the listing date and persists thereafter, clearly supporting the hypothesis that the reduction in LPs is structurally induced, even when data are categorized by trade size. The width of the relative positions of the LPs pre- and post-listing also illustrate the reduction in LP across trade sizes.

Table VB reports the differences in LPs across dollar spread categories. The results provide strong evidence of significant reductions in LPs with increasing dollar spreads for firms that move to either the AMEX or the NYSE.[13] This evidence is also illustrated in Fig. 7, where the widest pre- and post-listing differentials are reserved for the widest spread categories. More importantly, Fig. 7 shows that the listing date separates the dollar spreads into two regimes, extending the importance of the structurally induced differences in LPs across dissimilar market structures to dollar spread categories. Interestingly, average trading costs increase as firms move from the NASDAQ/NMS to the AMEX for posted spreads of 12.5 cents or less. This increase may arise from the lower minimum tick

[13] To the extent that illiquid stocks are characterized by wider posted spreads and smaller trade sizes, our results are consistent with the predictions of Grossman and Miller (1988). Their model predicts that specialist systems (dealer markets) are the preferred choice for illiquid (liquid) stocks.

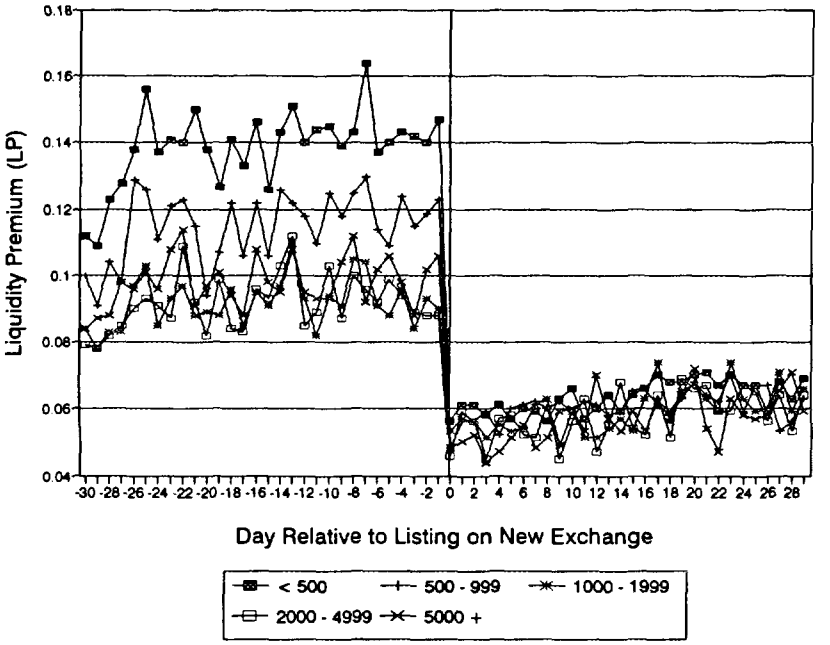

FIG. 6. Liquidity premiums across trade size categories.

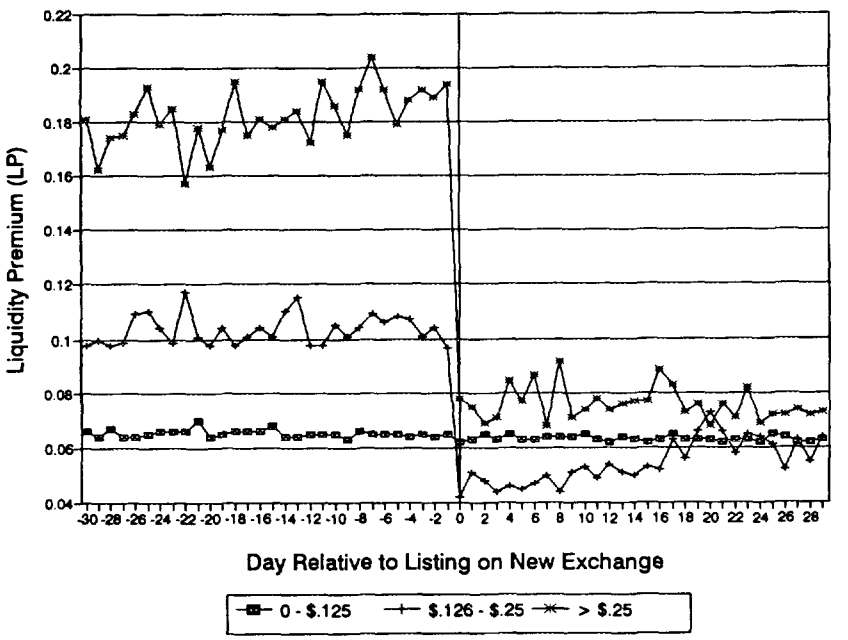

FIG. 7. Liquidity premiums across dollar spread categories.

size (6.25 cents versus 12.5 cents) available for smaller firms trading in a dealer market.[14]

C. *Liquidity Improvements and Firm Characteristics*

This section attempts to link trading cost improvements to the liquidity of firms prior to listing on the organized exchanges. Amihud and Mendelson (1988) suggest that highly liquid stocks on the NASDAQ/NMS would realize little gain in liquidity from listing on the organized exchanges. In contrast, illiquid firms have higher expected liquidity benefits from listing and will move to the organized exchanges when these benefits exceed the listing costs. Since our results indicate that firms listing on the AMEX realize superior liquidity gains relative to firms listing on the NYSE, we hypothesize that AMEX-bound firms are less liquid. We proxy for liquidity using market value of equity and trading activity measures. Thus, we expect firms that list on the NYSE rather than the AMEX to be larger and more actively traded while they were listed on the NASDAQ/NMS.

The evidence on differences in firm-specific characteristics are contained in Tables II and III. Table II presents the distribution of statistics for price per share, number of shares outstanding, market value of equity, and dollar volume per trade. A comparison of Table IIA and Table IIB shows that these distributions are uniformly lower for firms moving to the AMEX relative to the NYSE. For example, the median market value of firms moving to the AMEX is less than 10% of the median market value of firms listing on the NYSE. Table IIIA and Table IIIB reveal that the number of trades and quote revisions while firms trade on the NASDAQ/NMS are dramatically higher for firms that list on the NYSE. Specifically, the number of trades (quotes) increase by a factor of 20 (10) for firms that move to the NYSE relative to those that move to the AMEX. Thus, based on these firm-specific characteristics, smaller and less active firms move to the AMEX rather than the NYSE, and realize the largest improvements in liquidity from relocating their listing.

6. CONCLUSIONS

Firms often justify a change of trading venue with the expectation of a lower cost of capital that is driven by a reduction in liquidity costs. This paper examines the differences in liquidity for a sample of firms that moves from a dealer market to a specialist system. We find that when the

[14] For completeness, we repeated the analysis with the control sample. No systematic reductions in trading costs are observed across trade size or dollar spread categories. This evidence is confirmed by the lack of statistical significance of the χ^2 statistics that test for differences in trading cost improvements between adjacent categories. These results are available from the authors upon request.

trading cost component of liquidity is isolated, the decision to transfer trading location based on anticipated liquidity gains are well founded. The average price improvement for firms that move from the NASDAQ/NMS to the NYSE (AMEX) is 4.7 (5.2) cents per share. While these results are consistent with management making value-maximizing decisions by identifying the lowest-cost trading structure, the magnitudes are unexpectedly large. The results cannot be contested on grounds that they are confounded by a mismatching of firms across exchanges. Attributing the reduction in liquidity costs to structural effects is supported by the coincidence of the reduction in trading costs with the listing date and an absence of a reversal in the immediate post-listing period.

Our analysis also examines the nature of the trading cost reductions along several dimensions. First, by comparing the costs of trading on the NYSE versus the NASDAQ/NMS after firms are listed on the NYSE, our results show an average reduction in trading cost of 2.4 cents per share for trades executed on the NYSE. These savings for firms that elect to relocate are dramatically higher than the savings of about 1 cent per share identified by previous studies that focus on Third Market competition using a broad sample of NYSE securities. Moreover, we identify an additional cost reduction of 2.8 cents per share for trades that continue to be executed on the NASDAQ/NMS after firms list on the NYSE. We show that this added liquidity improvement arises from quotes that originate from the NYSE. Second, we document that the reduction in trading cost varies inversely with trade size and positively with the width of the spread. In addition, we confirm that these liquidity improvements are structurally induced since they coincide with the listing date and tend to persist. Finally, we find that the reduction in trading costs is a much larger proportion of stock price for firms that move to the AMEX as opposed to the NYSE. A comparison of firm characteristics reveals that those listing on the AMEX are significantly smaller, much less actively traded, and generate far fewer quote revisions while they were listed on the NASDAQ/NMS.

In a perfect market, the decision to switch trading location is immaterial since the fundamental determinants of value are unaffected. However, when differences in trading structures are present, the decision to change trading location can be value enhancing when the structural differences translate into varying trading costs. Our results strongly support the importance of microstructure effects and are consistent with firms attempting to minimize their costs of equity with their choice of trading venues.

APPENDIX: DATA FILTERS

This appendix describes the various filters and procedures used to minimize errors in our data set.

A. *Suspicious Data*

Prior to releasing the data, ISSM uses a filter to flag suspicious trade prices, volumes, and bid-ask quotes. Those prices, volumes, or quotes that are considered to be suspicious are assigned a negative value. Thus, to avoid the use of data that may be incorrect, we eliminate all trades with negative prices or volumes, and all quotes whose bid or ask prices are negative.

Additional efforts to locate potential data errors focus on the intraday range of price differences, bid-ask spreads, and trade sizes (in shares). We check whether unusual price changes are legitimate by comparing them to the nearby quotes. We also sort the trades by share volume to examine whether there are any anomalous trades within the highest trade volumes. This exercise reveals suspicious trades on the AMEX and the NYSE. For example, the largest trade that reappears for different firms is exactly 9,435,000 shares. Elimination of this share size results in the removal of 1 trade for firms moving to the AMEX from the NASDAQ, 13 trades for firms moving from the NASDAQ/NMS to the NYSE, and 4 trades for firms listing on the NYSE after trading on the AMEX. Finally, we eliminate all quotes when the ask price is equal to or less than the bid.

B. *Quotes Originating from Regional Exchanges*

Once a firm is listed on the AMEX or the NYSE, it becomes eligible for trading on the regional and the NASDAQ/NMS exchanges. We exclude quotes from these exchanges since they tend to be courtesy quotes that are based on the specialists' quotes. The result is that all quotes originate from the AMEX or the NYSE when firms are listed on these exchanges, and from the NASDAQ/NMS when firms are listed on the NASDAQ/NMS.

C. *First Trades on the AMEX and the NYSE*

The first trade on the AMEX and NYSE executed after the market opens is handled differently than all other trades. Specifically a call market is used for opening trades while an auction market is used for all subsequent trades. Since the initial trade reported on the ISSM system reflects the outcome of the call market, to focus on the structural differences between a continuous auction market and a competitive dealer system, we eliminate the first trade after the open for all stocks trading on the NYSE or AMEX.

D. *Timing of Trades and Quotes*

The posting of quotes and the execution time of trades are examined to ensure uniformity across exchanges. Since the market is open for trading between 9:30 AM and 4:00 PM, eligible trades must be time-stamped within

this trading interval. All trades executed outside the regular trading hours are eliminated. The treatment of quotes is somewhat different across exchanges. For stocks listed on the AMEX or NYSE, we only include quotes posted during normal trading hours. However, since the NASDAQ/NMS operates as a screen-based dealer market, quotes will often be posted before the start of trading at 9:30 AM and are considered legitimate.

In addition, the time stamps associated with the quote and trade records may not accurately reflect their relative position in time. In particular, Lee and Ready (1991) have documented that for a sample of NYSE companies in 1988, the quote record sometimes precedes the related transaction even though the transaction occurs first. They recommend treating quotes that appear up to 5 seconds before the trade as if they occur after it. Application of this rule to our sample is complicated by the presence of different trading systems and the use of 1990 rather than 1988 data. Fortunately, results that are not presented in the paper document that the average elapsed time between trades and the posting of the preceding quote is over 1.5 hours for firms moving to the AMEX and exceeds 20 minutes for firms moving to the NYSE. Given this time differential, the Lee and Ready criterion is unnecessary.

E. *Trades without Preceding Quotes*

We only consider trades and quotes within the day. Thus, trades on Day t must be preceded by a quote on Day t. In those instances where we observe trades for a particular stock without a same-day quote, the trades and quotes for that stock are eliminated for the day in question. This ensures that a trade price can be matched with a prior quote posted during the same trading day.

REFERENCES

ADMATI, A. R., AND PFLEIDERER, P. (1988). A theory of intraday patterns: Volume and price variability, *Rev. Finan. Stud.* **1,** 3–40.

AMIHUD, Y., AND MENDELSON, H. (1986). Asset pricing and the bid-ask spread, *J. Finan. Econ.* **17,** 223–249.

AMIHUD, Y., AND MENDELSON, H. (1988). Liquidity and asset prices: Financial management implications, *Finan. Manage.* **17,** 5–15.

BAKER, H. K., AND EDELMAN, R.B. (1992). AMEX-to-NYSE transfers, market microstructure, and shareholder wealth, *Finan. Manage.* **21,** 60–72.

BAKER, H. K., AND JOHNSON, M. (1990). A survey of management views on exchange listing, *Quart. J. Bus. Econ.* **29,** 3–20.

BLUME, M., AND GOLDSTEIN, M. (1992). "Differences in Execution Prices among the NYSE, the Regionals and the NASD," Working Paper, Wharton School.

COOPER, S. K., GROTH, J. C., AND AVERA, W. E. (1985). Liquidity, exchange listing, and common stock performance, *J. Econ. Bus.* **17,** 19–33.

COWAN, A. R., CARTER, R. B., DARK, F. H., AND SINGH, A. K. (1992). Explaining the NYSE listing choices of NASDAQ firms, *Finan. Manage.* **21,** 73–86.

DEMSETZ, H. (1968). The cost of transacting, *Quart. J. Econ.* **2,** 33–53.

DUBOFSKY, D. A., AND GROTH, J. C. (1984). Exchange listing and stock liquidity, *J. Finan. Res.* **7,** 291–302.

GROSSMAN, S., AND MILLER, M. (1988). Liquidity and market structure, *J. Finance* **43,** 617–633.

HASBROUCK, J., AND SCHWARTZ, R. A. (1986). "The Liquidity of Alternate Market Centers: A Comparison of the New York Stock Exchange, the American Stock Exchange and the NASDAQ National Market System," American Stock Exchange Transactions Data Research Project Report 1.

HUANG, R. D., AND STOLL, H. R. (1993). "Competitive Trading of NYSE Listed Stocks: Trading Costs in the Period 1987–1991," Working Paper, Vanderbilt University.

HUI, B., AND HEUBEL, B. (1984). "Comparative Liquidity Advantages among Major U.S. Stock Markets," Data Resources Inc. Financial Information Group Study Series 84081.

KADLEC, G. B., AND MCCONNELL, J. J. (1992). "The Effect of Market Segmentation and Illiquidity on Asset Prices: Evidence from Exchange Listings," Working Paper, Purdue University.

LEE, C. (1992). "Purchase of Order Flows and Favorable Executions: An Intermarket Comparison," Working Paper, University of Michigan.

LEE, C., AND READY, M. (1991). Inferring trade direction from intraday data, *J. Finance* **46,** 733–746.

MARSH, T., AND ROCK, K. (1986). "Exchange Listing and Liquidity: A Comparison of the American Stock Exchange with the NASDAQ National Market System," American Stock Exchange Transactions Data Research Project Report 2.

MCINISH, T., AND WOOD, R. (1992a). "Volatility of NASD/NMS and Listed Stocks," Working Paper, Memphis State University.

MCINISH, T., AND WOOD, R. (1992b). "Hidden Limit Orders on the NYSE," Working Paper, Memphis State University.

PETERSEN, M. A., AND FIALKOWSKI, D. (1992). "Price Improvement: Stocks on Sale," CRSP Working Paper, University of Chicago.

REINGANUM, M. R., (1990). Market microstructure and asset pricing: An empirical investigation of NYSE and NASDAQ securities, *J. Finan. Econ.* **28,** 127–147.

SANGER, G. C., AND MCCONNELL, J. J. (1986). Stock exchange listing, firm value and security market efficiency: The impact of the NASDAQ, *J. Finan. Quant. Anal.* **21,** 1–25.

STOLL, H. R. (1992). Principles of trading market structure, *J. Finan. Serv. Res.* **6,** 75–107.

ULE, M. G. (1937). Price movements of newly-listed common stocks, *J. Bus.*, 346–369.