

Liquidity Provision and the Organizational Form of NYSE Specialist Firms

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ABSTRACT

We examine the influence of NYSE specialist firm organizational form on the nature of liquidity provision. We compare closely held firms whose specialists provide liquidity with their own capital to widely held firms whose specialists provide liquidity with diffusely owned capital. We argue that specialists using their own capital have a greater incentive and ability to reduce adverse selection costs, but face a greater cost of capital. Differences in the proportion of spreads due to adverse selection costs, large trade frequency, the sensitivity between depth and spreads, and price stabilization support this argument.

RECENT STUDIES BY CAO, CHOE, and Hatheway (1997) and Corwin (1999a) document differences across specialist firms in execution costs, trading halts due to order imbalances, and market stabilization. Why these differences in liquidity provision exist, however, is not well understood. We argue that differences in liquidity provision arise from differences in specialist firm organizational form; firms that make markets with capital supplied by their specialists (owner-specialist firms) offer economies with respect to asymmetric information costs, while firms that make markets with diffusely owned capital (employee-specialist firms) offer economies with respect to capital costs. Our empirical results support this argument.

Since March 1997, the NYSE has allowed listing firms to choose which specialist firm handles their stock from a pool provided by the NYSE Allocations Committee (New York Stock Exchange (1997)). Like the choice of debt, dividend, or compensation policies, the choice of a specialist firm po-

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tentially affects firm value. Anecdotal evidence suggests that listing firms base this decision largely on specialist firm capitalization.¹ Our findings suggest that capitalization should not be the only factor considered. In particular, a listing firm may benefit from a specialist firm whose specialists are owners rather than employees if the listing firm's stock is likely to involve a greater degree of informed trading (e.g., a firm whose value consists largely of growth opportunities).

We examine the trade-off between adverse selection and capital costs by comparing spread components, large trade frequency, the relationship between depth and spreads, and price stabilization for two groups of NYSE specialist firms. The first group is composed of three privately held (limited liability) partnerships whose specialists own the capital used for market making (Bocklet & Company, Benjamin Jacobson & Sons, and Lyden, Dolan, Nick & Company). The second group is composed of three specialist firms whose specialists do not own the capital used for market making (Merrill Lynch Specialists, JJC Specialist Corporation, and Spear, Leeds, & Kellogg).

We perform two sets of tests on a matched sample of stocks drawn from each group. First, we test whether owner-specialist firms economize on adverse selection costs by comparing the proportion of spreads due to adverse selection costs and the relative frequency of large trades across groups. Second, we test whether employee-specialist firms economize on capital costs by comparing the sensitivity of quoted depth to quoted spreads and by comparing price stabilization at the open between the two groups.

We find that while overall trading costs are similar, the proportion of the spread due to information asymmetry is smaller and the frequency of large trades is greater for owner-specialist firms. These results are consistent with the hypothesis that individuals making markets with their own wealth have a greater incentive and ability to reduce adverse selection costs. We also find that stocks handled by employee-specialists exhibit less sensitivity between changes in quoted depth and quoted spreads (quoted depth is less sensitive to other trading activity variables as well). Further, we find that employee-specialist firms provide greater price stabilization at the open. These results are consistent with the hypothesis that capital is less costly for employee-specialist firms.

Our interpretation of the evidence rests on the assumption that the allocation of new listings is independent of specialist firm organizational form. If that is not the case, then our tests may be capturing the effects of the allocation process rather than any effect of specialist firm organizational form. We do not believe this is a problem, however, for several reasons. First, most stocks in our sample were allocated to specialist firms before specialists began employing diffusely owned capital (see below). Second, NYSE doc-

¹ Richard Grasso, Chairman of the NYSE said, "There is no doubt that more capital, and certainly permanent capital, becomes an ingredient to the competitiveness of the specialist firm and that firm's attractiveness to new candidates as they seek listing" (see Merger Wave Sweeps Big Board's Floor (1998)).

umentation suggests that while the NYSE Allocations Committee considers many factors when making allocations decisions, there is no explicit reference to specialist firm organizational form (New York Stock Exchange (1998)). Finally, Corwin (1999b) finds that the primary factors that determine which specialist firm will receive a new allocation are the current composition of the specialist firm portfolio and the time since receiving a new allocation. Thus, since allocations do not appear to be based on specialist firm organizational form, we do not believe that the allocation process drives our results. We do note, however, that given the recent NYSE rule change (New York Stock Exchange (1997)) allowing listing firms some discretion over specialist firm selection, future allocations may reflect specialist firm organizational form.

The remainder of the paper is organized as follows. In Section I, we consider the evolution of the organizational form of NYSE specialist firms including the six firms in the sample, and develop hypotheses regarding liquidity provision and organizational form. In Section II, we discuss the data and provide descriptive statistics. Section III provides multivariate evidence. Section IV concludes with a discussion of the study's findings, limitations, and extensions.

I. Institutional Background and Hypotheses

A. Evolution of Specialist Firm Organizational Form

The NYSE specialist arose following the advent of continuous trading in 1871. Prior to 1871, stocks traded in a series of call auctions, in alphabetical order, so that each stock had roughly three or more call auctions per day.² Given the discrete call market structure, a broker could conceivably participate in the trading of virtually every stock. In 1871, however, the NYSE allowed stocks to trade simultaneously in a continuous auction throughout the day, making it impossible for a broker to observe or participate in the trading of every stock. In this environment, independent floor brokers discovered they could profitably "specialize" in a particular stock by working orders for other brokers and exchange members from a fixed position on the exchange floor.

Since 1871, the NYSE has altered its constitution three times to reflect the evolution of specialist firm organizational form in response to changing market conditions. On February 20, 1953, the NYSE approved an amendment to its constitution allowing member firms to incorporate.³ This change allowed specialist firms greater access to external capital and reflected the growing importance of capital in the market making process. While the NYSE

² This discussion is drawn from a historical review contained in the NYSE *Report of the Committee to Study the Stock Allocation System* (New York Stock Exchange (1976)).

³ See New York Stock Exchange (1953a).

recognized the growing importance of capital, it also recognized that increasing access to capital involved costs as well. This trade-off is highlighted in the following discussion of the 1953 amendment allowing incorporation:

Q: Will permissive incorporation as proposed make it easier to obtain capital for the security business? Will it make it easier to retain the capital now in the business or to build up capital out of earnings?

Pro

Yes. The limited liability feature of a corporation will make capital easier to secure. Retention and continuity of capital is much easier in a corporation than in a partnership. After an unprofitable year a corporation may build back lost capital and reserves out of earnings, without penalty, for the purpose of meeting reasonable needs of the business.

Contra

Permissive incorporation may make it easier to obtain a certain type of capital for the security business, but fundamentally capital for partnerships will be amply available now, as it has been in the past, when our business proves to be profitable. Limited liability capital is undesirable because *unlimited liability and responsibility form the moral cornerstones of the Exchange* (italics on original document).⁴

Thus, as early as 1953, the NYSE recognized the implicit trade-off between bonding relationships on the Exchange floor and the cost of capital.

The NYSE also amended its constitution on March 5, 1970, allowing member corporations to sell securities to the public.⁵ The 1970 amendment further increased the ability of specialist firms to raise external capital and also facilitated consolidation among specialist firms as a means of increasing capitalization. In 1972, there were 16 specialist firm mergers, more than double the quantity the previous year. Between 1970 and 1975, the number of specialist firms declined from 94 to 81 (while the number of individual specialists increased slightly from 373 to 386). The number of specialist firms continued to fall steadily from 81 in 1975, to 74 in 1980, and to 65 in early 1987.

The third change occurred on January 6, 1987, when the NYSE passed Rule 98, which lifted rules restricting the activities of specialist firm parent organizations.⁶ In particular, it permitted exemption from Rule 460, thus allowing a parent organization to conduct business transactions (e.g., underwrite securities) on behalf of firms handled by their specialist unit. Rule 98 effectively lifted obstacles keeping large investment banks from operating

⁴ See New York Stock Exchange (1953b).

⁵ See New York Stock Exchange (1970).

⁶ See New York Stock Exchange (1987a, 1987b).

NYSE specialist units.⁷ Merrill Lynch became the first large investment banking firm to undertake specialist activities when they acquired A. B. Tompane & Company on October 22, 1987.⁸ Today, other large firms operate specialist units, including Bear Stearns, Fleet Financial, and Goldman Sachs. Between September 1987 and November 1992, the number of specialist firms declined sharply (from 65 to 44), and continued to decline throughout the 1990s at a somewhat slower pace. By 1997 only 31 specialist firms remained with one-third making markets with capital not provided by their specialists.

B. Description of Sample Specialist Firms

We compare the liquidity provision of owner-specialist firms to the liquidity provision of employee-specialist firms. Our owner-specialist firms are Bocklet & Company, Benjamin Jacobson & Sons, and Lyden, Dolan, Nick & Company. Our employee-specialist firms are Merrill Lynch Specialists, JJC Specialist Corporation, and Spear, Leeds, and Kellogg.⁹

The oldest owner-specialist firm in our sample is Benjamin Jacobson & Sons, which started making markets on October 21, 1931, with two partners. Lyden, Dolan, Nick & Company (initially named Nick & Co.) began market making on June 1, 1933, with James F. Nick and one other partner. Bocklet & Company was formed in 1986 when five partners left the specialist firm of Beauchamp & Company to start their own firm. These three firms have all grown modestly. By 1997 Lyden, Dolan, Nick & Company had nine partners, all of whom were specialists; Benjamin Jacobson & Sons had 18 specialists of whom 16 were partners (four with the family name); and Bocklet & Company had eight specialists of whom seven were partners (six with the family name). Discussions with Bocklet & Company confirm that the senior partners own, or are liable for, the capital used for market making. We also confirmed through discussions with Benjamin Jacobson & Sons and Lyden, Dolan, Nick & Company that their specialists own the capital—to varying degrees—that is used for market making.

⁷ Rule 98 states that there must be an “arm’s length” relationship between the specialist member firm and the parent firm. In particular, there must be “organizational separation” such that the specialist cannot function as a “downstairs” extension of an “upstairs” trading desk, and the specialist member’s capital must be dedicated exclusively to specialist activities, and must not be at risk for any liabilities of the parent firm. The parent firm, however, is not precluded from “playing a general oversight role as to the management of an associated specialist member organization, or from setting general profitability targets, overall market strategy (as opposed to strategy on particular trades), and basic trading philosophy” (New York Stock Exchange (1987a), Exhibit B, Note ii).

⁸ See Specialist Firm on Big Board Succumbs to Crash, Will Become Unit of Merrill, (1987), page 3.

⁹ Many specialist firms are private, making it difficult to determine the extent a firm uses specialists that use their own capital. Furthermore, classification using legal form leads to incorrect sorting, as some incorporated firms are essentially partnerships whose specialists own the capital and some large partnerships (e.g., Spear, Leeds, and Kellogg) use diffusely owned capital. We are grateful to representatives of Bocklet & Company, Benjamin Jacobson & Sons, and Lyden, Dolan, Nick, & Company for providing us with ownership information.

In contrast, the employee-specialist firms are relatively large. Merrill Lynch Specialists gained access to the NYSE in October 1987 (as discussed above). The firm continued to grow through the years by acquiring other specialist firms (Beauchamp & Company in 1989 and Lasker, Stone & Stern in 1991) and through the allocation of new listings. By all accounts, the firm was profitable, but under pressures stemming from the "Asian Flu," the unit was sold on December 18, 1998, to JJC Specialist Corporation for \$150 million.¹⁰ All 56 employees (including 18 specialists) of Merrill Lynch Specialists joined JJC Specialist Corporation, a unit of Quick & Reilly, Inc., which is a wholly owned subsidiary of the Fleet Financial Group, Inc.

In contrast to the owner-specialist firms, Merrill Lynch Specialists was a wholly owned subsidiary of Merrill, Lynch, Pierce, Fenner & Smith Inc., a unit of the parent holding company, Merrill Lynch & Co., Inc. Thomas Joyce, the director of Merrill Lynch's U.S. Equity Sales and Trading group (to whom the director of Merrill Lynch Specialists reported), confirmed that Merrill Lynch & Co., Inc. provided the capital used by Merrill Lynch Specialists. Similarly, the Quick & Reilly Group, which is owned by the Fleet Financial Group, Inc. (now FleetBoston, Inc.), provided the capital used by JJC Specialist Corporation.

Spear & Leeds started in 1931 with two partners (J. C. Kellogg III became a partner in 1945). Relative to the other specialist partnerships formed in the 1930s, Spear, Leeds, and Kellogg grew at an aggressive pace, becoming the largest specialist firm by 1997 (with 54 specialists). As of 1997, Spear, Leeds, and Kellogg was 75 percent owned by Spear, Leeds, and Kellogg, Inc. with the remaining 25 percent owned directly by executive officers (not specialists). In turn, Spear, Leeds, and Kellogg, Inc. operates a group of market making units (foreign exchange, fixed income, and derivatives), and a clearinghouse operation in addition to the NYSE specialist unit. In October 2000, Spear, Leeds, and Kellogg, Inc. was purchased by Goldman Sachs, Inc.

C. Hypotheses

Benveniste, Marcus, and Wilhelm (1992) argue that specialists and floor traders use information-sharing relationships to lower adverse selection costs. We extend this line of reasoning by arguing that specialists who have their personal wealth at stake have a greater incentive and ability than employee-specialists to credibly bond information-sharing relationships. This better bonding of information-sharing relationships by owner-specialist firms suggests that the stocks they handle should exhibit smaller adverse selection costs. We test this hypothesis by estimating the difference in the proportion of the effective spread due to adverse selection costs between specialist firm types.

¹⁰ Transaction details are reported in the *Wall Street Journal* (see Fleet Unit to Buy Merrill's Specialist Operation (1998), page A3). Merrill Lynch reported a \$100 million pre-tax profit on the divestiture (Merrill Lynch & Co. Inc. (1999), page 32).

As a secondary test, we examine whether lower adverse selection costs translate into a greater frequency of large trades. Easley and O'Hara (1987) argue that informed traders prefer to trade larger quantities. If true, this should result in a positive relationship between adverse selection costs and trade size. Lin, Sanger, and Booth (1995), among others, confirm this relationship by finding a positive relation between trade size and adverse selection. If owner-specialists have a greater incentive and ability to alleviate adverse selection costs, then the increase in adverse selection costs associated with an increase in trade size will be smaller for owner-specialist stocks. With a smaller increase in cost, we expect greater relative consumption of large trades, all else constant.

Alternatively, this hypothesis can also be viewed as an extension of an argument made by Benveniste et al. (1992). They argue that "active-specialists" (as opposed to "passive-specialists") are able to discriminate between brokers representing liquidity and informed traders by being able to sanction, *ex post*, those brokers who disguise their motives. This affords active-specialists the necessary leverage to weaken the adverse-selection problem and offer better terms of trade to liquidity traders (see their Theorem 3). Given that their "active-specialists" are analogous to our "owner-specialists," it follows that in markets made by owner-specialists, liquidity traders will be less likely to break up large trades to avoid higher adverse selection costs. Therefore, we expect to observe a greater relative frequency of large trades in stocks handled by owner-specialists.¹¹

While owner-specialist firms may have an advantage in reducing adverse selection costs, employee-specialist firms are likely to economize on capital costs. Their supply of capital is not limited by the wealth of the individual specialists that comprise the firm. We also argue that because of limited wealth, ill-diversified portfolios, and risk aversion, the cost of capital is likely to rise more quickly for owner-specialist firms than for employee-specialist firms as the amount of capital required increases. Additionally, our conversations with Bocklet & Company confirm that they do not use derivatives to hedge risk because the cost of doing so is prohibitive.

We test the effect of capital costs in two ways. First, we examine the sensitivity between quoted depth (the number of shares available for trade at the bid and ask price) and quoted spreads.¹² Prior research indicates that depth and spreads are negatively related (Lee, Mucklow, and Ready (1993)). This negative relationship stems from the tendency of specialists to reduce

¹¹ We do not argue that owner-specialists participate in more large trades. Although this may be the case, the greater frequency of large trades could also be the result of a greater willingness to help match floor traders with opposite orders, a service specialists often perform.

¹² The quoted depth at the NYSE includes public limit orders in addition to shares from the specialist's inventory. Without a partitioned limit order book (Kavajecz (1999)) or the NYSE SPETS file (Madhavan and Sofianos (1998)), we cannot infer the amount of shares offered by the specialist. However, given that the dynamics of public limit order placements do not vary systematically across portfolios, differences in the sensitivity between spreads and depth will be due to specialist behavior.

depth and increase spreads in the face of increased uncertainty (Kavajecz (1999)). The employee-specialist firm, with lower capital costs and risk aversion, should be less likely to jointly manage quoted depth and spreads. Thus, we expect to observe less sensitivity between quoted depth and spreads for stocks handled by employee-specialist firms.

Our second test examines the willingness to stabilize prices during market order imbalances. Market order imbalances tend to be greatest at the opening of trade. Stoll and Whaley (1990) argue that open-to-close variance ratios capture the degree to which specialists place their capital at risk to resolve these order imbalances. Corwin (1999a) uses open-to-close variance ratios to test whether specialist firms differ in their willingness to stabilize the market. If capital is less costly for employee-specialist firms, then we expect the stocks they handle to exhibit greater stabilization at the open and consequently lower open-to-close variance ratios.

II. Data and Univariate Analysis

A. Data Estimation

We test the above hypotheses using NYSE Trade and Quote (TAQ) data from September through November 1997. Given that the tests are cross-sectional, we also control for other trading and return characteristics including average trade size, trade frequency, price, return volatility, percent of NYSE executions, and dollar volume as a percent of specialist firm dollar volume.

Following Huang and Stoll (1996) and Bessembinder (1997), we estimate the level of adverse selection costs as the percentage increase (decrease) in estimated stock value following the execution of buy (sell) order—the “price impact” or “permanent component” of the order flow innovation. The price impact of a given trade is equal to $I_{it}(M_{it+n} - M_{it})/M_{it}$, where I_{it} is a binary variable equal to one for buy orders and negative one for sell orders (as determined by the Lee and Ready (1991) algorithm). The quote midpoint of the first quotation that occurs at least 10 minutes after the trade, M_{it+n} , serves as a proxy for the posttrade economic value of the stock.¹³ We note that price impacts for individual trades are likely to involve considerable measurement error. This concern is largely mitigated, however, by our use of daily averages.

We argue that the proportion of effective spreads due to adverse selection costs should be lower for stocks handled by owner-specialist firms. We estimate this proportion for each stock on a daily basis as the ratio of the average price impact to the average effective half-spread, which is equal to $100|P_{it} - M_{it}|/M_{it}$, where P_{it} is the transaction price for security i at time t .¹⁴

¹³ Huang and Stoll (1996) find no significant difference in estimates of price impact using 10- or 30-minute lead times.

¹⁴ Hasbrouck, Sofianos, and Sosebee (1993) note that trades are often reported with a median delay of 14 seconds, and should therefore be delayed when comparing trades with quotes. To be conservative, we follow Bessembinder (1997) and lag trades by 20 seconds when estimating this variable.

Madhavan, Richardson, and Roomans (1997) use a similar ratio to estimate the proportion of spread due to information asymmetry (however, they estimate spread components using an alternative order-flow innovation model). As a robustness check, we also conduct the analysis using the Madhavan, Richardson, and Roomans (1997) method and find similar results.

To test whether the frequency of large trades differs across specialist firm types, we measure the percent of trades greater than or equal to 10,000 shares on a daily basis for each stock. This quantity is typically used as a definition for a “block” trade, and is often used to measure liquidity provision (e.g., LaPlante and Muscarella (1997), and Madhavan and Cheng (1997)). Because roughly 20 percent of trades this size are executed in the “upstairs” market (Madhavan and Cheng), we control for volume bypassing the specialist by holding constant variation in the percent of dollar volume not executed on the NYSE.

We also argue that the sensitivity of spreads to depth will differ across specialist firm types. Percentage quoted half-spreads are calculated as $100(A_{it} - B_{it})/2M_{it}$, where A_{it} and B_{it} are the quoted ask and bid prices and M_{it} is the quote midpoint for security i at time t . We calculate the mean quoted half-spread for each stock, each day, using quotes that were posted at the time of each trade, independent of whether quotations were revised since the prior trade (i.e., the number of observations equals the number of trades). Depth is the average total number of shares offered at the ask price and bid price.

Finally, we expect that differences in the cost of capital will result in differences in stabilization at the open. We use open-to-close volatility ratios as a proxy for the amount of capital specialist firms expose to risk by stabilizing at the open. Following Stoll and Whaley (1990), we calculate the open-to-close volatility ratio as the ratio of the variance of returns using opening prices to the variance of returns using closing prices.

B. The Specialist Firm Portfolios

We use the September 1997 *NYSE Specialist Directory* (New York Stock Exchange (1997)) to define the set of stocks handled by each of the six specialist firms. The three employee-specialist firms make markets in 648 common stocks, and the three owner-specialist firms make markets in 206 common stocks. In total, the six specialist firms handle 854 stocks, or 30 percent of the NYSE listings.¹⁵ Figure 1 indicates that at every level of trading activity, employee-specialist firms make markets in more stocks than the owner-specialist firms. The relative mix of stocks by dollar volume, however, suggests that neither specialist firm type focuses exclusively on either heavily or thinly traded stocks.

¹⁵ The sample consists of 50,325 stock-day observations. We are 3,477 observations shy of a complete sample (854 firms \times 63 trading days = 53,802) due to stock delistings during the sample period and the occurrence of zero trades for a stock on a given day.

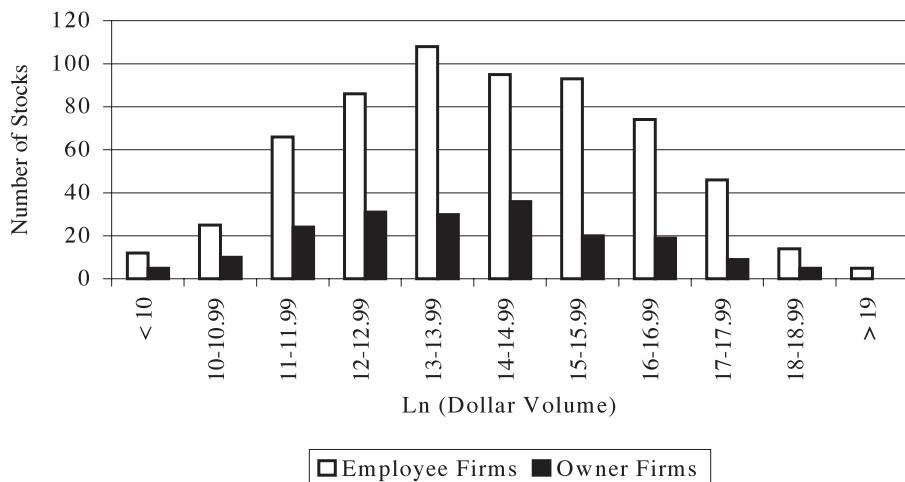


Figure 1. The frequency distribution of stocks in the specialist firm portfolios. We report the frequency distribution of all the common stocks by specialist firm type across increments of average dollar volume. The owner-specialist firms are Bocklet & Company, Benjamin Jacobson & Sons, and Lyden, Dolan, Nick and Company. The employee-specialist firms are Merrill Lynch Specialists, Spear, Leeds, and Kellogg, and JJC Specialist Corporation.

The daily dollar volumes for the two specialist firm types are also closely related. Figure 2 indicates that the two are highly correlated (simple correlation = 0.93), reflecting the well-diversified nature of each type's portfolio. It is also evident that variation in total dollar volume rarely strays beyond plus or minus two percent of the initial measure. The exceptions are a mini-correction on October 27 and 28, when total volume was up to six percent greater than the norm, and November 28 (a Friday after Thanksgiving) when volume was 10 percent less than the norm. Our results are not affected by the exclusion of these dates.

The statistics reported in Table I indicate that average (consolidated) dollar volume is greater for stocks handled by the employee-specialist firms (\$11.99 million per day) relative to the owner-specialist firm stocks (\$8.58 million per day). The greater average dollar volume, however, is not a function of both greater trade size and trade frequency. Although the stocks in the employee-specialist firm portfolios trade more frequently, the stocks in the owner-specialist portfolios have greater mean trade size. This preliminary evidence is consistent with the hypothesis that owner-specialists use better-bonded relationships to facilitate the execution of large trades.

The evidence in Table I also indicates that there are no significant differences in returns and return volatility (standard deviation of close-to-close returns and percentage price range) across the employee- and owner-specialist firm portfolios. We do find, however, that owner-specialist firms have a significantly greater mean open-to-close volatility ratio (1.1277) than



Figure 2. The relative variation in total dollar volume by specialist firm type. We plot the variation in the total dollar volume of all stocks traded for each specialist firm type as a percentage of their respective total dollar volumes on September 2, 1997, the first day of the sample. The two time-series have a correlation coefficient of 0.93.

employee-specialist firms (1.0927). Consistent with our hypothesis, this suggests that employee-specialist firms are more willing to stabilize the market at the open.

C. Matched Sample Analysis

To minimize measurement error associated with spread components, we create a matched sample of stocks that are actively traded. We create a matched sample by taking the 20 stocks with the greatest dollar volume from each owner-specialist firm and matching them with 20 comparable stocks from an employee-specialist firm based on average dollar volume and trade frequency. Bocklet & Company stocks are matched with Merrill Lynch Specialists stocks, Benjamin Jacobson & Sons stocks with Spear, Leeds, and Kellogg stocks, and Lyden, Dolan, Nick & Company stocks with JJC Specialist Corporation stocks.¹⁶ The name, symbol, average dollar volume, and number of trades of each of the matched sample stocks are listed in the Appendix. Figure 3 illustrates their similarity graphically.

The evidence reported in Table II, Panel A, indicates no significant difference in the mean returns earned by the matched stocks and the two measures of return volatility. Additionally, there is no difference in average dollar

¹⁶ Bocklet has five foreign listings among its top 20 stocks (one ADR and four ADS securities). To control for any influence of this foreign flavor on the tests, we include Coca-Cola Femsa SA DE ADS and the Indonesian Satellite Corporation ADS from Merrill Lynch even though they may not have provided the best fit across dollar volume and trade frequency.

Table I
Descriptive Statistics of Specialist Firm Portfolios

The data contains 50,325 daily observations of the 806 stocks in our six specialist firm sample. Nineteen stocks were eliminated because they traded less than half the 63-trading-day sample, and another 31 were eliminated because they traded under one dollar or had various reporting errors. We report the per day mean consolidated dollar volume, consolidated trades, average trade size, percent of trades executed at the NYSE, price, and return. We also report the mean of three measures of volatility: the daily percentage price range (high-low/average price), the standard deviation of close-to-close returns, and the ratio of open-to-close return standard deviations.

	Dollar Volume (Millions)	Trade Frequency	Trade Size	Percent Executed at NYSE (%)	Price	Return (%)	Range (%)	Return Standard Deviation (%)	Open-to-close Volatility Ratio
Employee firms									
Merrill Lynch Specialists	\$15.45	191.20	1,506	83.24	\$33.58	0.0001	2.2479	2.2350	1.1029
JJC Specialist Corporation	9.06	142.85	1,413	83.47	30.91	0.0211	2.2172	2.0412	1.1085
Spear, Leeds, and Kellogg	12.85	162.49	1,563	84.72	32.40	0.0228	2.0925	1.9446	1.0768
Group mean	11.99	160.79	1,500	84.01	32.09	0.0181	2.1613	2.0316	1.0927
Owner firms									
Bocklet & Company	8.24	121.56	1,564	83.33	30.62	-0.0178	2.2011	2.2439	1.1322
Lyden, Dolan, Nick & Company	5.16	87.42	1,511	84.34	27.16	0.0048	2.1644	2.0118	1.1421
Ben Jacobson & Sons	11.76	152.33	1,691	86.79	35.50	0.0084	2.1934	2.2168	1.1124
Group mean	8.58	122.11	1,596	85.04	31.37	0.0003	2.1855	2.1534	1.1277
Test: Equal across groups									
<i>t</i> -statistic	-8.62**	-9.25**	4.42**	5.92**	-2.77**	-0.72	1.19	1.41	2.24*
(<i>p</i> -value)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0056)	(0.4675)	(0.2334)	(0.1567)	(0.0256)

* and ** indicate significance at the 10 and 1 percent levels, respectively.

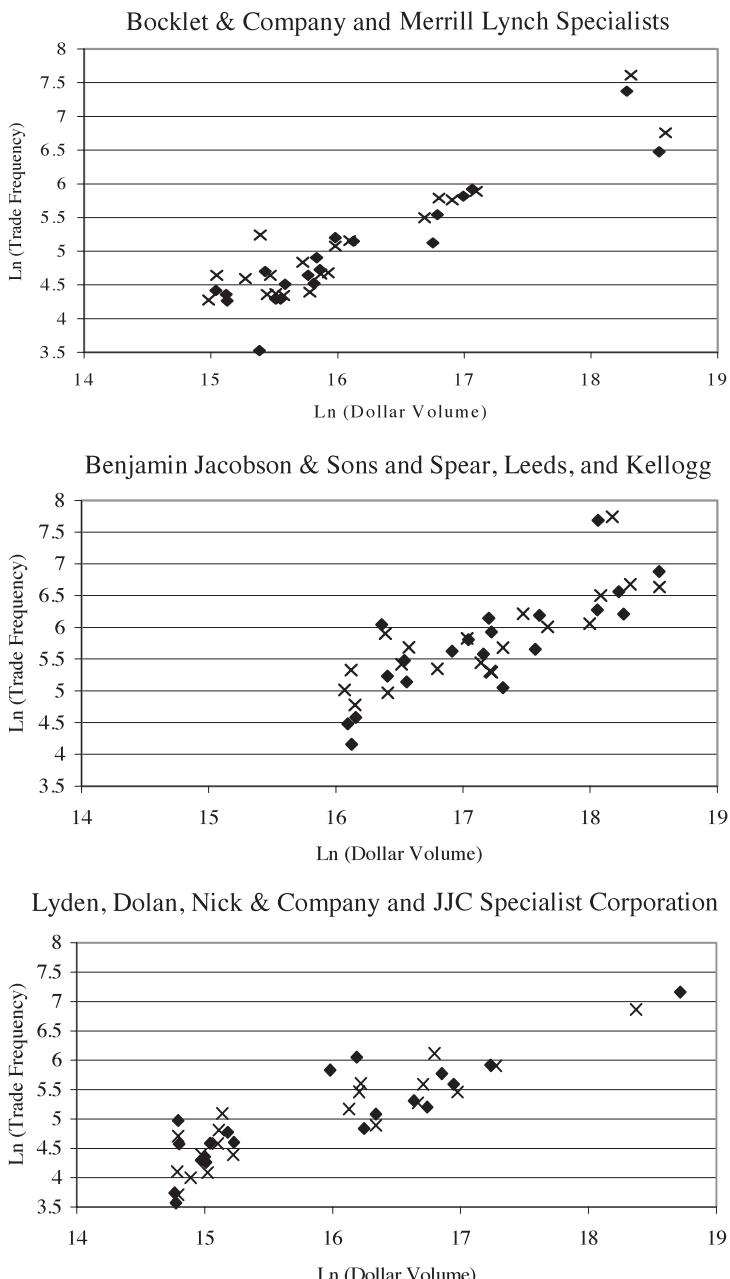


Figure 3. Plots of matched stocks. We calculate the average dollar volume and trade frequency for each stock in each of the six specialist firms. We match the 20 owner-specialist firm stocks (\blacklozenge) with the largest dollar volume with employee-specialist firm stocks (\times) so as to minimize errors on dollar volume and trade frequency. The plots depict the matched portfolios for the three specialist firm pairs.

Table II
Trading and Return Characteristics of Matching Specialist Firm Portfolios
and Liquidity Characteristics of Matching Specialist Firm Portfolios

Panel A shows the trading and return characteristics of matching specialist firm portfolios. The data contains 7,560 daily observations of the 120 stocks in our six specialist firm matching sample. We estimate the mean consolidated dollar volume, consolidated trades, average trade size, percent of trades executed at the NYSE, average size of trades executed at the NYSE, the dollar volume of each stock relative to the dollar volume of all stocks handled by the specialist firm, price, and return. We also report the mean of two measures of volatility—the percentage price range (high-low/average price) and the standard deviation of close-to-close returns. Panel B shows liquidity characteristics of matching specialist firm portfolios. The data contains 7,560 daily observations of the 120 stocks in our six specialist firm matching sample. We use the NYSE Trade and Quote database from September to November 1997. We estimate the percentage quoted half-spread, effective half-spread, price impact (10 minutes), depth (sum of round lots at bid and ask), percent of trades greater than 10,000 shares for each stock, each day. The percent adverse selection costs is the ratio of the price impact to percentage effective spread. The open-to-close volatility ratio is the variance of open-to-open returns relative to the variance of close-to-close returns.

Panel A										
	Dollar Volume (Millions)	Trade Frequency	Trade Size	Trades Executed at NYSE (%)	Size of NYSE Trades	Dollar Volume as Percent of Portfolio	Price	Return (%)	Range (%)	Return Standard Deviation (%)
Employee firms										
Merrill Lynch Specialists	\$19.12	288.60	1,603	87.34	2,019	\$1.11	\$39.68	-0.0717	2.7847	2.5655
JJC Specialist Corporation	16.03	227.92	1,631	86.95	1,913	0.79	39.68	0.0243	2.4709	2.5642
Spear, Leeds, and Kellogg	38.12	442.97	1,902	89.61	2,364	1.04	53.05	0.0661	2.7098	2.3824
Group mean	23.97	320.20	1,717	87.97	2,104	0.98	44.14	0.0064	2.6554	2.5040
Owner firms										
Bocklet & Company	18.77	241.75	1,881	88.63	2,249	4.67	42.44	0.0215	2.6488	2.5169
Lyden, Dolan, Nick & Company	14.55	208.95	1,704	88.34	2,138	4.43	35.77	-0.0052	2.8908	2.4657
Ben Jacobson & Sons	38.47	443.40	1,834	89.05	2,265	4.45	58.55	0.0075	2.4592	2.3756
Group mean	24.51	298.63	1,805	88.65	2,216	4.52	45.59	0.0079	2.6627	2.4527
Test: Equal across groups										
<i>t</i> -statistic	-0.57	-1.89*	3.20**	2.71**	3.08**	31.47**	2.73**	0.02	0.15	0.12
(<i>p</i> -value)	(0.5666)	(0.0582)	(0.0014)	(0.0067)	(0.0020)	(0.0001)	(0.0063)	(0.9807)	(0.8804)	(0.8980)

	Panel B						
	Percentage Quoted Half Spread	Percentage Effective Spread	Price Impact	Percent Adverse Selection Costs	Depth (Round Lots)	Percent of Trades over 10,000 Shares	Open-to-close Volatility Ratio
Employee firms							
Merrill Lynch Specialists	0.3986	0.1391	0.0851	62.39	35.17	2.78	1.1258
JJC Specialist Corporation	0.4218	0.1692	0.1031	61.14	35.92	2.86	1.0847
Spear, Leeds, and Kellogg	0.3078	0.1102	0.0738	69.07	37.85	3.61	1.0884
Group mean	0.3759	0.1394	0.0873	64.21	36.32	3.09	1.0996
Owner firms							
Bocklet & Company	0.3999	0.1504	0.0803	54.95	36.79	4.05	1.1750
Lyden, Dolan, Nick & Company	0.4439	0.1787	0.1039	61.94	39.83	3.22	1.1968
Ben Jacobson & Sons	0.2652	0.1003	0.0597	59.85	38.26	3.49	1.1404
Group mean	0.3696	0.1431	0.0813	58.92	38.30	3.58	1.1708
Test: Equal across groups							
<i>t</i> -statistic	-1.36	1.02	-3.49**	-6.31**	2.35*	6.35**	5.61**
(<i>p</i> -value)	(0.1723)	(0.3054)	(0.0005)	(0.0001)	(0.0187)	(0.0001)	(0.0194)

* and ** indicate significance at the 10 and 1 percent levels, respectively.

volume per day (by construction). Because we use the 20 largest owner-specialist stocks, however, there is a significant difference in the percent dollar volume each stock represents of the total dollar volume of each specialist firm—4.52 percent for owner-specialist stocks and 0.98 percent for employee-specialist stocks. Since this difference in relative activity within the portfolio may cause differences in how specialists manage the market, we control for this difference in the multivariate analysis.

Although the portfolios match on dollar volume, there still remain significant differences in other trading and return variables. The owner-specialist stocks have significantly larger trades. The difference in the average trade size of those trades executed at the NYSE is 112 shares ($2,216 - 2,104$). The difference in trade size is not driven by differences in price, since on average, the owner-specialist stocks had a greater price (\$45.59 to \$44.14). The difference in large trades is consistent with the notion that owner-specialists offer economies with respect to adverse selection costs.

The evidence in Table II, Panel B, indicates no difference in quoted half-spreads or effective half-spreads across the sample. However, the permanent spread component (“price impact”) is significantly smaller for owner-specialist stocks. This suggests that while total trading costs are similar, the components are different. That notion is borne out when we compare the proportion of the spread due to adverse selection costs (price impact/effective half-spread). For the owner-specialist firms 58.92 percent of the effective spread is due to adverse selection, compared to 64.21 percent for the employee-specialist firms (the difference is statistically significant at the one percent level). Additionally, the frequency of large trades is greater for owner-specialists (3.58 percent versus 3.09 percent) as are open-to-close variance ratios (1.1708 versus 1.0996). The difference in large trade frequency is consistent with the hypothesis that owner-specialists have a greater incentive and ability to reduce adverse selection costs, and the variance ratio difference suggests that employee-specialist firms are more willing, on average, to stabilize markets.

III. Multivariate Analysis

A. Do Owner-Specialists Offer Economies with Respect to Adverse Selection Costs?

A.1. Fraction of Spread Due to Information Asymmetry

We use the following regressions to test for differences in proportion of the spread due to information asymmetry across the matched sample:

$$(price\ impact/effective\ half-spread) = \beta_0 + \beta_1(Owner) + \mathbf{X}\boldsymbol{\beta} + \epsilon, \quad (1)$$

$$\begin{aligned} price\ impact &= \beta_0 + \beta_1(Owner) + \mathbf{X}\boldsymbol{\beta} \\ &\quad + \delta(effective\ half-spread) + \epsilon, \end{aligned} \quad (2)$$

where *Owner* equals one for owner-specialist firm stocks and zero for employee-specialist firm stocks. We include the price impact regression (controlling for effective half-spreads) to assure that the results are not due to the use of a ratio as a dependent variable.

The β matrix contains coefficient estimates for our control variables, including the natural log of price, trade size, trade frequency, in addition to depth, volatility, the percent of dollar volume executed at the NYSE, and the percent of specialist firm dollar volume provided by the stock. Price is included because tick-size discreteness can lead to a negative relationship between spreads and price (Harris (1994)). Trade size is included because it is positively related to spreads through an inventory effect (Stoll (1978a, 1978b)) and through an effect on the probability of informed trade (Easley and O'Hara (1987)). Trade frequency may also affect spreads negatively through an inventory effect (the more rapidly a stock trades, the quicker a specialist can work off suboptimal inventory positions), or positively through signals about information flow (Jones, Kaul, and Lipson (1994)). The dollar volume of trades executed at the NYSE may have an effect on the degree of information asymmetry for two reasons. First, as the percent of dollar volume executed at the NYSE increases, more volume is available for specialists to manage suboptimal inventories. This could, in turn, reduce the percent of the spread due to inventory costs and increase the percent due to information asymmetry. Second, to the extent trading off of the NYSE represents purchased order flow and to the extent purchased order flow dries up during periods of increased informed trading, the percent of dollar volume executed at the NYSE could reflect the degree of informed trading.

The evidence in Table III indicates that the proportion of the effective spread due to information asymmetry is significantly lower for owner-specialist firm stocks. For example, the second regression indicates that this proportion is 6.07 percentage points lower for owner-specialist firm stocks (*t*-statistic = -7.50). Using the estimated coefficients and evaluating the function at the means of the explanatory variables, the implied adverse selection component of the spread for employee-specialist firm stocks is 64.63 percent compared to 58.56 percent for owner-specialist firm stocks. Keeping in mind our earlier result that total trading costs are similar across the specialist firm types, this multivariate evidence supports the hypothesis that owner-specialists have a greater incentive and ability to reduce adverse selection costs.

A.2. Relative Frequency of Large Trades

As a secondary test of differences in ability to bond information-sharing relationships, we examine whether there are differences in the relative frequencies of large trades across specialist firm types. The regressions reported in Table IV indicate that owner-specialist firm stocks have a higher frequency of large trades. In the first regression, we hold price and trade frequency constant, and find that stocks handled by owner-specialists have

Table III
Adverse Selection Spread Component Regressions

We test whether the adverse selection component of the effective spread is significantly different across the specialist firm matched samples. The percent of spread due to adverse selection is the price impact divided by percentage effective half-spread. The number of trades, average price, trade size, percentage quoted half-spread, effective half-spread, price impact (10 minutes), percentage price range, percent of NYSE executions, and the percent of dollar volume of the specialist firm portfolio dollar volume are estimated for each stock, each day, using the NYSE TAQ data. *Owner* equals one for stocks handled by owner-specialist firms, and equals zero otherwise. Each cell contains the coefficient and *t*-statistic in parentheses; *N* = 7,560.

	Dependent Variable			
	Percent of Spread Due to Adverse Selection	Percent of Spread Due to Adverse Selection	Price Impact	Price Impact
Intercept	0.1400*	−0.2124**	0.3092**	0.2158**
	(2.05)	(−2.87)	(22.66)	(16.23)
Owner	−0.0615**	−0.0607**	−0.0051**	−0.0082**
	(−7.50)	(−7.11)	(−3.12)	(−5.53)
Ln(price)	0.1573**	0.1738**	−0.0425**	−0.0289**
	(18.55)	(16.30)	(−25.11)	(−15.04)
Ln(trade size)	0.0119	0.0287**	−0.0025	0.0055**
	(1.57)	(3.41)	(−1.63)	(3.78)
Ln(trades)	−0.0308**	−0.0481**	−0.0092**	−0.0179**
	(−7.23)	(−8.49)	(−10.78)	(−18.07)
Range (%)		5.3777**		1.8044**
		(24.39)		(46.30)
NYSE executions (%)		0.2802**		0.0266**
		(7.08)		(3.91)
Ln(depth)		−0.0378**		−0.0142**
		(−4.74)		(−9.62)
Proportion of specialist firm portfolio dollar volume (%)		−0.1977*		0.0186
		(−1.97)		(1.07)
Effective half-spread (%)				0.0478**
				(10.26)
Adjusted <i>R</i> ²	0.0525	0.1567	0.1046	0.3868

* and ** indicate significance at the 10 and 1 percent levels, respectively.

0.57 percentage points more large trades (*t*-statistic = 7.62). In the second regression, we control for other trading characteristics, and find that the difference decreases to 0.47 percentage points, but remains significant. In the final two regressions, we control for average trade size because the owner-specialist firm stocks in our sample may have other characteristics (like

Table IV
Large Trade Relative Frequency Regressions

We test whether the relative frequency of large trades is significantly different across the specialist firm matched samples. *Owner* equals one for stocks handled by owner-specialist firms, and equals zero otherwise. We use NYSE Trade and Quote (TAQ) data from September to November 1997. Each cell contains the coefficient and *t*-statistic in parentheses; *N* = 7,560.

	Dependent Variable: Percent of Trades > 10,000 Shares			
	(1)	(2)	(3)	(4)
Intercept	0.0713** (21.73)	−0.0974** (−20.81)	−0.3088** (−82.51)	−0.3211** (−82.77)
Owner	0.0057** (7.62)	0.0047** (7.16)	0.0028** (6.30)	0.0027** (6.26)
Ln(price)	−0.0156** (−20.64)	0.0048** (5.31)	−0.0011* (−2.48)	0.0033** (5.47)
Ln(trade size)			0.0492** (118.69)	0.0458** (97.07)
Ln(trades)	0.0032** (8.43)	−0.0061** (−13.75)	−0.0028** (12.33)	−0.0049** (−16.85)
Range (%)		0.2552** (13.60)		0.0847** (6.71)
NYSE executions (%)		0.0463** (14.05)		0.0073** (3.27)
Ln(depth)		0.0283** (43.88)		0.0069** (14.42)
Adjusted <i>R</i> ²	0.0625	0.2857	0.6735	0.6829

* and ** indicate significance at the ten and one percent levels, respectively.

greater institutional ownership) that influence the results. In these two regressions, we find that the frequency of large trades for stocks handled by owner-specialist firms is 0.28 percentage points greater (*t*-statistic = 6.30).

Using the most conservative difference (0.28 percentage points), we evaluate the regression at the mean of the independent variables, and find that large trades comprise 3.20 percent of all trades in employee-specialist stocks, and 3.48 percent of all trades in owner-specialist stocks (an 8.75 percent difference). Since the average stock in the matched sample trades roughly 309 times per day, this implies that owner-specialist firm stocks have 0.86 more large trades per day. At the 60-stock matched sample level, this suggests that owner-specialist stocks have 51.6 more large trades per day, or 3,251 more large trades over the 63-day sample period. This difference in the relative frequency of large trades is economically meaningful as well as statistically significant.

In sum, the evidence in Tables III and IV is consistent with the hypothesis that owner-specialist firms economize on adverse selection costs relative to

employee-specialist firms. In particular, we find that stocks handled by owner-specialists have a lower fraction of effective spreads due to adverse selection and a greater frequency of large trades. These differences are economically meaningful as well as statistically significant.

B. Do Employee-specialist Firms Offer Economies with Respect to the Cost of Capital?

B.1. The Relationship Between Quoted Depth and Quoted Spreads

As argued above, if capital is less costly for employee-specialists, we expect to observe less sensitivity between quoted depth and spreads for employee-specialist firm stocks. We estimate whether there are different sensitivities between depth and spreads using the following regression:

$$\ln(depth) = \beta_0 + \beta_1(pqhs) + \beta_2(pqhs * Owner) + \mathbf{X}\boldsymbol{\beta} + \epsilon, \quad (3)$$

where $pqhs$ is the percentage quoted half spread.¹⁷ It is important to note that this regression suffers from a potential endogeneity problem. While we assume depth is a function of spreads, it may also be that spreads are a function of depth. As a robustness check, we estimate coefficients for several simultaneous systems (two-stage least squares) in which we also allow spreads to be a function of depth. That analysis yields results similar to that using ordinary least squares. Absent any theory suggesting the appropriate system of equations, we report coefficients found employing ordinary least squares.¹⁸

In estimating the sensitivity between spreads and depth, we control for trading activity (natural logarithms of price, trade size, and trades), percent of NYSE executions, and the percent of specialist firm dollar volume attributed to each stock. We also control for the proportion of the effective spread due to adverse selection (as defined above) as a proxy for the degree of information asymmetry in a given market since the sensitivity between spreads and depth is likely to be related to information asymmetry as well.

The evidence reported in Table V reveals a strong negative relationship between quoted spreads and depth, indicating the tendency for specialists (and other participants) to reduce depth and widen spreads in the presence of increased uncertainty (Kavajecz (1999)). Also consistent with earlier research, we find depth to be negatively related to price and information asymmetry (the proportion of the spread due to information asymmetry). We also find a positive relationship between depth and average trade size, trade frequency, percent of NYSE executions, and percent of specialist firm dollar volume provided by a given stock.

¹⁷ We also estimate these sensitivities using effective half-spreads rather than percentage quoted half-spreads. The signs on the relations are unchanged, but at lower levels of significance.

¹⁸ The simultaneous equation estimates are available from the authors upon request.

Table V
Regressions Analyzing the Sensitivity Between
Market Depth and Percentage Spreads

We test whether the sensitivity between depth and spreads is significantly different across the specialist firm matched samples. $\ln(\text{depth})$ is the natural log of the mean number of shares quoted at the bid and ask prices during the day. *Owner* equals one for stocks handled by owner-specialist firms, and equals zero otherwise. We use NYSE Trade and Quote (TAQ) data from September to November 1997. Each cell contains the coefficient and *t*-statistic in parentheses; $N = 7,560$.

	Dependent Variable: $\ln(\text{Depth})$			
	(1)	(2)	(3)	(4)
Intercept	4.2091** (40.82)	4.2293** (41.09)	4.2436** (38.64)	4.39** (38.71)
% Quoted half-spread	−2.0224** (−53.59)	−1.8511** (−38.00)	−1.9722** (−52.23)	−1.82** (−36.65)
Owner*% quoted half-spread		−0.3463** (−5.81)		−0.3153** (−5.03)
Price	−1.1694** (−78.71)	−1.1184** (−63.67)	−1.1528** (−73.95)	−1.1165** (−56.52)
Owner*price		−0.1060 (−5.69)		−0.0920** (−4.05)
$\ln(\text{trade size})$	0.4520** (49.92)	0.3994** (35.44)	0.4335** (45.55)	0.3792** (31.23)
Owner* $\ln(\text{trade size})$		0.1016** (7.85)		0.0892** (6.19)
$\ln(\text{trades})$	0.1709** (32.55)	0.1925** (25.75)	0.1587** (26.65)	0.1696** (18.83)
Owner* $\ln(\text{trades})$		−0.0434** (−4.22)		−0.0491** (−4.09)
% NYSE executions			0.1711** (3.49)	0.1410* (2.09)
Owner*% NYSE executions				0.0723 (0.75)
% of specialist firm portfolio dollar volume			0.6037** (5.29)	2.3578** (4.36)
Owner*% of specialist firm portfolio dollar volume				−1.5051** (−2.75)
Proportion of spread due to adverse selection			−0.1369** (−9.89)	−0.1083** (5.47)
Owner*proportion of spread due to adverse selection				−0.0523* (−1.89)
Adjusted R^2	0.6451	0.6482	0.6514	0.6554

* and ** indicate significance at the 10 and 1 percent levels, respectively.

The regressions reported in Table V allow the slope coefficients to vary between the two specialist firm types. Consistent with the hypothesis that capital is cheaper for employee-specialist firms, we find the relationship between spreads and depth to be more negative for stocks handled by owner-specialists (t -statistic = -5.03). To get a sense of the economic significance of the estimated coefficients, we evaluate the equation at the means of the independent variables for both groups, and then reestimate the implied level of depth given a one-eighth increase in the quoted spread. For a one-eighth increase, the mean percentage quoted half spread increases from 0.3727 (14.8 cents) to 0.6900 (27.3 cents). In turn, that increase implies a 17.50 percent decrease in depth for owner-specialist stocks but only a 10.95 percent decrease in depth for employee-specialist firm stocks. This result suggests that there is a substantial difference in the relationship between quoted depth and quoted spreads for the two specialist firm types, and that this difference is consistent with capital being less costly for employee-specialist firms.

Although not the focus of our analysis, the remaining coefficients also suggest that liquidity provision is affected by lower capital costs for employee-specialist firms. For example, the sensitivity between depth and price is greater for stocks handled by owner-specialist firms, suggesting that as the cost of depth increases, owner-specialists reduce depth at a greater rate. Also, as trade frequency increases, the depth in stocks handled by both types of specialist firms increases. However, the increase in depth for stocks handled by owner-specialist firms is significantly less than the increase for employee-specialist firms. Finally, there is an increase depth as a given stock accounts for a greater portion of the total volume in the specialist firm portfolio, but this increase is smaller for owner-specialist firm stocks.

B.2. Price Stabilization at the Open

Stoll and Whaley (1990) argue that the open-to-close return variance ratio captures the degree to which specialists stabilize prices at the open, which is when market order imbalances are typically greatest. The greater the open-to-close volatility ratio, the less price stabilization provided by the specialist. Using this ratio, Corwin (1999a) finds significant differences in stabilization across specialist firms. We extend his study by testing whether owner-specialists are less likely to stabilize prices at the open than are employee-specialists. We estimate an open-to-close volatility ratio for each stock in the matching sample, providing 120 observations.

The first regression in Table VI reflects the univariate result that the owner-specialist stocks have a significantly higher average open-to-close volatility ratio (difference is 0.0711; t -statistic = 2.37). The multivariate evidence confirms this result. Regardless of the regression specification, stocks handled by owner-specialist firms exhibit an open-to-close volatility ratio that is roughly 0.07 points greater than the stocks handled by employee-specialist firms.

Table VI
Open-to-close Volatility Ratio Regressions

We test whether open-to-close volatility ratios differ significantly across the specialist firm matched samples. The open-to-close volatility ratio is the variance of returns estimated from opening prices to the variance of returns estimated from closing prices. This estimate is calculated for each of the 120 stocks in the matching firm sample. *Owner* equals one for stocks handled by owner-specialist firms, and equals zero otherwise. We use NYSE Trade and Quote (TAQ) data from September to November 1997. Each cell contains the coefficient and *t*-statistic in parentheses; *N* = 120.

	Dependent Variable: Open-to-Close Volatility Ratio		
	(1)	(2)	(3)
Intercept	1.0996** (51.79)	1.1028** (3.11)	0.7439* (1.96)
Owner	0.0711* (2.37)	0.0759* (2.55)	0.0716* (2.45)
Price		−0.0466 (−1.42)	0.0999 (1.43)
Ln(trade size)		−0.0051 (−0.12)	−0.0494 (−0.74)
Ln(trades)		0.0392* (2.26)	−0.0228 (−0.73)
Range (%)			6.9539** (2.66)
NYSE executions (%)			−0.1629 (−0.42)
Ln(depth)			0.1276* (2.00)
Adjusted <i>R</i> ²	0.0373	0.0671	0.1027

* and ** indicate significance at the ten and one percent levels, respectively.

Together, Tables V and VI provide evidence that is consistent with the hypothesis that employee-specialist firms economize on costs of capital relative to owner-specialist firms. Specifically, we find less sensitivity between quoted depth and spreads for employee-specialist firm stocks, and that employee-specialists are more likely to stabilize prices at the open of trade.

IV. Discussion of Findings, Limitations, and Extensions

We examine the influence of specialist firm organizational form on the nature of liquidity provision at the NYSE. Stocks handled by three owner-specialist firms are compared to stocks handled by three employee-specialist

firms. The ownership position of owner-specialists provides a greater incentive and ability to mitigate costs associated with information asymmetry, but this benefit comes with the expense of greater capital costs. Consistent with this trade-off, we find that stocks handled by owner-specialists have a lower proportion of trading costs due to information asymmetry, and a greater frequency of large trades. But, we also find that the depth provided by owner-specialists is more sensitive to changing market conditions and that owner-specialists are less likely to stabilize prices at the open. In sum, the empirical evidence supports the hypothesis that the organizational form of NYSE specialist firms influences the provision of liquidity.

Our study is subject to several potentially important criticisms. First, our empirical tests implicitly treat the allocation of new listings as independent of specialist firm organizational form. That implicit assumption is problematic if the NYSE either explicitly or implicitly conditions its allocation decision on specialist firm organizational form. While it is possible that the NYSE considers specialist firm organizational form in making the allocation decision, we believe it is unlikely for three reasons. First, most stocks in our sample listed at the NYSE before 1987, when differences in specialist organizational form were not nearly as pronounced as they are today. Second, while there is mention of many factors considered by the NYSE Allocation Committee, NYSE documents describing the process do not explicitly mention specialist firm organizational form. Third, Corwin (1999b) finds that the current composition of specialist firm portfolio and time elapsed since receiving a new allocation are the primary determinants of the allocation decision. We note, however, that the NYSE's recent decision (1997) to allow listing firms some influence over which specialist firm will handle their stock may change the importance of specialist firm organizational form in the allocation process. In fact, we contend that the choice of specialist firm may affect firm value because of its effect on how liquidity is provided in the secondary market.

Another potential criticism is that our cross-sectional analysis may suffer from an omitted variables bias. One alternative test would be to examine the provision of liquidity by a specialist firm as it changes organizational form. We examine the case of LaBranche & Co. (a large partnership that sold equity to the public on August 18, 1999) and find support for our cross-sectional results. The evidence indicates that stocks handled by LaBranche & Co. exhibited a significant increase in the percent of spread due to adverse selection after going public (in absolute terms and relative to a matched sample). We note, however, that we do not find any significant changes in large trade frequency, the sensitivity between depth and spreads, and price stabilization. In a related time-series test, Hatch and Johnson (2000) examine the provision of liquidity surrounding seven recent specialist firm acquisitions. They find that stocks handled by small specialist firms experience an increase in adverse selection after being acquired by another (large) specialist firm. If it is reasonable to assume that small specialist firms tend to be owner-specialist firms, then their time-series results are consistent with our cross-sectional results.

A third potential criticism is that our sample is limited in scope. We compare trading in stocks handled by six specialist firms on the NYSE. A more comprehensive study would compare trading by individual specialists for a larger number of specialist firms. We limit our sample to six specialist firms principally because of the difficulty in obtaining accurate ownership information for specialist firms (who, with the exception of LaBranche & Co., are not publicly traded entities). Our sample is also limited to three months near the end of 1997. This limitation is not likely serious, however, given the millions of individual trade and quote observations used to estimate the daily spread and trading characteristics. Nonetheless, it may be true that our results are peculiar to our sample firms and sample time period.

Finally, we note that internal contracting and monitoring by the NYSE may serve as substitutes for the incentive-aligning effects of ownership. To the extent that is the case, we expect to observe less of a difference in how the two organizational forms supply liquidity. Given that we still observe differences in the nature of liquidity provision between the two specialist firms, our results suggest that organizational form is an important determinant of how liquidity is provided to the market.

While acknowledging its limitations, we believe the study's results are important. Since Rule 98 passed in 1987, the NYSE has been shifting toward corporate market making and away from traditional partnership specialist firms. The rationale has been that corporate specialist firms have greater access to capital, and thus have greater ability to provide orderly markets in times of market stress. While our study supports this rationale, it also highlights the fact that those specialists who use their own wealth offer an advantage relative to corporate market makers—reduced adverse selection costs. Thus, the evidence suggests that the NYSE consider the benefits of maintaining a place for closely held specialist firms at the exchange.

We also believe our study is important for financial economists and regulators to consider in studying the performance and structure of markets. As most OTC dealers are corporations, our study raises the question of whether previously reported differences in market performance across Nasdaq and the NYSE should be attributed solely to differences in market structure. For example, LaPlante and Muscarella (1997) find greater rates of block trading on the NYSE compared to Nasdaq. Is this due to the structure of the market, *per se*, or due to the fact that there are relatively more closely held firms making markets at the NYSE? We leave this and other related questions to future research.

Appendix: The Matching-firm Sample

In Table AI, we provide the name, ticker symbol, average dollar volume, and trade frequency during our sample period for the 120 stocks in the matching sample. The 20 stocks from each owner-specialist firm represent those with the largest dollar volume. We match Bocklet & Company with Merrill Lynch Specialists, Benjamin Jacobson & Sons with Spear, Leeds, & Kellogg, and Lyden, Dolan, Nick & Company with JJC Specialist Corporation.

Table AI

	Symbol	Dollar Volume	Trades
Bocklet & Company			
Telefonos De Mexico S.A.	TMX	\$112,311,412	649
Nike Incorporated	NKE	87,062,851	1,599
CompUSA Incorporated	CPU	25,736,904	374
Office Depot Incorporated	ODP	23,979,670	337
State Street Corporation	STT	19,539,661	258
Telefonica De Argentina S.A.	TAR	18,852,464	170
Great Lakes Chemical Corporation	GLK	10,052,267	175
Unitrode Corporation	UTR	8,737,830	183
Ultramar Diamond Shamrock Corporation	UDS	7,731,028	114
Millpore Corporation	MIL	7,521,232	137
First America Bank Corporation	FOA	7,370,869	93
Gulfstream Aerospace Corporation	GAC	7,033,215	106
TV Azteca SA DE ADS	TZA	5,865,804	92
AllAmerica Financial Corporation	AFC	5,667,764	75
Finova Group Incorporated	FNV	5,461,484	74
Symbol Technologies Incorporated	SBL	5,233,436	105
ENI S P A	E	4,800,236	35
Security Capital Pacific Trust	PTR	3,718,617	72
Daimler-Benz Aktiengesellschaft	DAI	3,681,361	78
Hudson Foods Incorporated	HFI	3,403,791	84
Merrill Lynch Specialists			
Royal Dutch Petroleum GLDR 5	RD	118,308,764	863
Seagate Technology Incorporated	SEG	89,947,902	2,023
USX Marathon Group	MRO	26,524,687	363
ICN Pharmaceuticals Incorporated	ICN	21,966,587	320
USX-U.S. Group	X	19,757,702	329
Sysco Corporation	SYY	17,644,146	247
Synovus Financial Corporation	SNV	9,780,812	175
Enron Oil and Gas Company	EOG	8,724,425	162
Coca-Cola FEMSA S.A. DE C.V.	KOF	8,258,416	109
Blyth Industries Incorporated	BTH	7,776,825	108
Ocean Energy Incorporated	OEI	7,136,252	83
Felcor Suite Hotels Incorporated	FCH	6,752,252	127
Fieldcrest Cannon Incorporated	FLD	5,813,752	77
GATX Corporation	GMT	5,446,621	80
Mercantile Stores Incorporated	MST	5,092,013	80
Stanley Works	SWK	5,016,469	112
Galoob Toys Incorporated (DEL)	GAL	4,821,729	191
Indonesian Satellite Corporation 7 SHRS	IIT	4,292,389	100
Allen Telecom Incorporated	ALN	3,421,793	105
Legg Mason Incorporated	LM	3,210,846	74
Benjamin Jacobson & Sons			
Bell Atlantic Corporation	BEL	115,511,048	992
Waste Management Incorporated	WMX	85,457,750	724
United Technologies Corporation	UTX	84,033,437	502
Allstate Corporation (THE)	ALL	69,767,922	529
LSI Logic Corporation	LSI	68,540,878	2,167
United Airlines Corporation	UAL	43,277,134	292
Anheuser Busch Companies Incorporated	BUD	43,137,287	492

Table AI—Continued

	Symbol	Dollar Volume	Trades
Benjamin Jacobson & Sons (<i>continued</i>)			
Student Loan Marketing Association	SLM	\$ 34,818,396	160
MBNA Corporation	KRB	30,560,023	472
PNC Bank Corporation	PNC	30,122,300	373
Tenet Healthcare Corporation	THC	27,680,718	262
Kellogg Company	K	24,805,871	332
Storage Technology Corporation	STK	22,671,338	278
Thomson Microelectronics N.V.	STM	15,879,347	184
Bear Stearns Companies Incorporated	BSC	15,598,612	242
Interpublic Group Companies Incorporated	IPG	13,221,878	189
Callaway Golf Company	ELY	12,765,956	427
Magna International Incorporated	MGA	11,234,390	89
Greenpoint Financial Corporation	GPT	10,311,531	99
American Radio Systems Corporation	AFM	10,052,353	63
Spear, Leeds, & Kellogg			
American International Group Incorporated	AIG	115,151,434	771
Mobil Corporation	MOB	88,977,565	789
Gateway 2000 Incorporated	GTW	77,640,661	2,299
Sara Lee Corporation	SLE	71,508,998	658
Union Pacific Corporation	UNP	64,447,758	437
Baxter International Incorporated	BAX	48,070,194	401
US Airways Group Incorporated	U	38,091,831	482
BJ Services Company	BJS	36,959,977	316
Northrop Grumman Corporation	NOC	30,414,677	199
Pioneer Hi-Bred International Incorporated	PHB	30,361,071	205
Tandy Corporation	TAN	27,784,338	233
Union Pacific Resources Group Incorporated	UPR	25,487,131	350
Hercules Incorporated	HPC	20,045,735	212
IKON Office Solutions Incorporated	IKN	15,118,711	285
Woolworth F. W.	Z	14,515,156	220
Weatherford Enterra Incorporated	WII	13,915,437	145
Placer-Dome Incorporated	PDG	13,457,218	379
Alltel Corporation	AT	10,459,332	204
Trinity Industries	TRN	10,430,432	120
Triton Energy Limited	OIL	9,752,719	154
Lyden, Dolan, Nick & Company			
Columbia/HCA Healthcare Corporation	COL	98,621,302	969
Duke Power	DUK	33,216,535	373
Cooper Cameron Corporation	RON	28,945,809	264
US Surgical Corporation	USS	20,022,129	451
Apache Corporation	APA	17,715,242	270
Vencor Incorporated	VC	16,987,509	193
Canadian Pacific Limited	CP	12,124,943	133
Humana Incorporated	HUM	10,953,694	268
Edwards (A.G.) Incorporated	AGE	10,604,444	234
Dana Corporation	DCN	10,130,246	175
Computer Task Group Incorporated	TSK	3,949,952	77
Benton Oil & Gas Company	BNO	3,847,153	165
Sitel Corporation	SWW	3,672,666	122
Consolidated Papers Incorporated	CDP	3,293,368	60

Table AI—Continued

	Symbol	Dollar Volume	Trades
Lyden, Dolan, Nick & Company (<i>continued</i>)			
POTLATCH Corporation	PCH	\$ 3,065,799	79
Hambrecht & Quist Group	HQ	2,897,383	78
First Industrial Realty Trust Incorporated	FR	2,848,274	55
Caribiner International Incorporated	CWC	2,671,633	41
Designer Holdings Limited	DSH	2,577,283	107
Hormel Foods Corporation	HRL	2,460,908	59
JJC Specialist Corporation			
Sears Roebuck Company	S	131,454,558	1,295
Weyerhaeuser Company	WY	31,067,818	379
Seagram Limited	VO	24,569,569	262
Clorox Company	CLX	21,259,694	323
Perkin-Elmer Corporation	PKN	19,256,707	184
Alcan Aluminum Limited	AL	15,903,925	201
Knight-Ridder Incorporated	KRI	12,483,575	160
Interstate Bakeries Corporation	IBC	11,195,134	125
Barnes & Noble Incorporated	BKS	10,195,186	411
Harrahs Entertainment Incorporated	HET	8,950,525	337
DPL Incorporated Holding Company	DPL	4,725,488	101
Great Atlantic & Pacific Tea	GAP	3,794,659	114
Chiquita brands Company	CQB	3,403,065	96
Talbots Incorporated	TLB	3,402,891	74
Vitro Sociedad Anonima	VTO	3,151,921	75
CTS Corporation	CTS	3,143,466	74
Rochester Gas & Electric Corporation	RGS	2,732,545	98
Dimon Incorporated	DMN	2,732,140	44
Thornburg Mortgage Asset Corporation	TMA	2,630,393	145
The E. W. Scripps Company	SSP	2,566,609	36

REFERENCES

- Benveniste, Laurence M., Alan J. Marcus, and William J. Wilhelm, 1992, What's special about the specialist? *Journal of Financial Economics* 32, 61–86.
- Bessembinder, Hendrik, 1997, The degree of price resolution and equity trading costs, *Journal of Financial Economics* 45, 9–34.
- Cao, Charles, Hyuk Choe, and Frank Hatheway, 1997, Does the specialist matter? Differential execution costs and inter-security subsidization on the NYSE, *Journal of Finance* 52, 1615–1640.
- Corwin, Shane A., 1999a, Differences in trading behavior across NYSE specialist firms, *Journal of Finance* 54, 721–745.
- Corwin, Shane A., 1999b, Specialist portfolios, specialist performance, and new listing allocations on the NYSE, Working paper, University of Notre Dame.
- Easley, David, and Maureen O'Hara, 1987, Price, trade size, and information in securities markets, *Journal of Financial Economics* 19, 69–90.
- Fleet Unit to Buy Merrill's Specialist Operation, 1998, *Wall Street Journal*, November 9, A3.
- Harris, Lawrence, 1994, Minimum price variations, discrete bid-ask spreads, and quotation sizes, *Review of Financial Studies* 7, 149–178.
- Hasbrouck, Joel, George Sofianos, and Deborah Sosebee, 1993, New York Stock Exchange systems and trading procedures, Working paper, New York Stock Exchange.

- Hatch, Brian, and Shane Johnson, 2000, The impact of specialist firm acquisitions on market quality, Working paper, Louisiana State University and University of Cincinnati.
- Huang, Roger, and Hans R. Stoll, 1996, Dealer versus auction markets: A paired comparison of execution costs on Nasdaq and the NYSE, *Journal of Financial Economics* 41, 313–357.
- Jones, Charles M., Gautam Kaul, and Marc L. Lipson, 1994, Transactions, volume, and volatility, *Review of Financial Studies* 7, 631–651.
- Kavajecz, Kenneth A., 1999, A specialist's quoted depth and the limit order book, *Journal of Finance* 54, 747–771.
- LaPlante, Michele, and Chris Muscarella, 1997, Do institutions receive comparable execution in the NYSE and Nasdaq markets? A transaction study of block trades, *Journal of Financial Economics* 45, 97–134.
- Lee, Charles M. C., Belinda Mucklow, and Mark Ready, 1993, Spreads, depths, and the impact of earnings information: An intraday analysis, *Review of Financial Studies* 6, 345–374.
- Lee, Charles M. C., and Mark Ready, 1991, Inferring trade direction from intraday data, *Journal of Finance* 46, 733–746.
- Lin, Ji-Chai, Gary Sanger, and G. Geoffrey Booth, 1995, Trade size and the components of the bid-ask spread, *Review of Financial Studies* 8, 1153–1183.
- Madhavan, Ananth, and Minder Cheng, 1997, In search of liquidity: Block trades in the upstairs and downstairs markets, *Review of Financial Studies* 10, 175–203.
- Madhavan, Ananth, Matthew Richardson, and Mark Roomans, 1997, Why do security prices change? A transaction-level analysis of NYSE stocks, *Review of Financial Studies* 10, 1035–1064.
- Madhavan, Ananth, and George Sofianos, 1998, An empirical analysis of NYSE specialist trading, *Journal of Financial Economics* 48, 189–210.
- Merger Wave Sweeps Big Board's Floor, 1998, *Wall Street Journal*, November 10, C1, C6.
- Merrill Lynch & Company, Incorporated, 1999, *The 1998 Annual Report to Shareholders*.
- New York Stock Exchange, Inc., 1953a, *NYSE Press Release (on incorporation of present and future member firms)*, February 20.
- New York Stock Exchange, Inc., 1953b, *Effect on Members and Member Firms* (attachment to NYSE Press Release, February 20, 1953).
- New York Stock Exchange, Inc., 1970, *Special Membership Bulletin: Proposed Constitutional Amendments Relating to Public Ownership of Member Corporations*, March 5.
- New York Stock Exchange, Inc., 1976, *Report of the Committee to Study the Stock Allocation System*, January 27.
- New York Stock Exchange, Inc., 1987a, *Information Memo 87-1: New Rule 98—Facilitates Diversified Organizations' Entry into NYSE Specialist Business*, January 6.
- New York Stock Exchange, Inc., 1987b, *Information Memo 87-41: Amendment of Rule 98*, November 2.
- New York Stock Exchange, Inc., 1997, *Information Memo 97-13: NYSE Stock Allocation Policy*, March 7.
- New York Stock Exchange, Inc., 1998, *Information Memo 98-06: Allocation Policy and Procedures*, January 30.
- Specialist Firm on Big Board Succumbs to Crash, Will Become Unit of Merrill, *Wall Street Journal*, October 22, 3.
- Stoll, Hans R., 1978a, The pricing of security dealer services: An empirical study of Nasdaq stocks, *Journal of Finance* 33, 1153–1172.
- Stoll, Hans R., 1978b, The supply of dealer services in securities markets, *Journal of Finance* 33, 1133–1151.
- Stoll, Hans R., and Robert E. Whaley, 1990, Stock market structure and volatility, *Review of Financial Studies* 3, 37–71.