

Daily and Intraday Patterns in Spread and Depth for Limit Orders and Specialists

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We examine daily and intraday spreads and depth for both the specialist and limit order book. Spreads are lower and depth is greater on Tuesday than the other days of the week. This increased depth on Tuesday can be attributed to the limit order book. Quoted depth from both the specialist and limit order book exhibits an inverted U-shaped pattern on an intraday basis. We also find that the specialist provides less depth, on average, than the limit order book. This finding holds on a daily and an intraday basis.

Introduction

Much research in market microstructure focuses on trading costs—particularly the bid-ask spread,¹ while less attention is paid to the depth of a quote (the number of shares offered at the bid and ask prices). The purpose of this paper is to expand upon the previous findings of daily and intraday spreads and depth. We examine quoted depth on a daily and intraday basis and further divide our sample into quotes submitted by the NYSE specialist and the limit order book. Little research focuses on depth on a daily basis and an intraday basis. This paper adds to the literature by examining depth on a daily and intraday basis and analyzing the origination of the liquidity (quoted depth)—the specialist or the limit order book.

There are several studies that examine quoted depth (Lee, Mucklow, and Ready, 1993; Harris, 1994; and Dupont, 2000). Lee, Mucklow, and Ready study aggregate

¹ For example, Demsetz (1968), Tinic and West (1972), Beston and Hagerman (1974), Glosten and Harris (1988), Huang and Stoll (1997).

depth around earnings announcements. They find that wide spreads are accompanied by low depth and credit this finding to the specialist's behavior when faced with asymmetric information. Additionally, a study by Harris and Dupont (2000) shows that spreads and depth are used together to manage adverse selection and inventory risks. Both of these studies examine quoted depth and do not distinguish between depth provided by the specialist and limit order book.²

Several studies differentiate the specialist's quoted depth from that of the limit order book (Kavajecz, 1999; Goldstein and Kavajecz, 2000; and Kavajecz and Odders-White, 2001). These studies do not, however, examine these differences on a daily or intraday basis. Kavajecz (1999) examines changes in quoted depth of the specialist and limit order book around informational events and finds that both limit order traders and the specialist reduce depth around informational events. Goldstein and Kavajecz study differences in liquidity (depth) associated with a reduction in the tick size on the NYSE and find that liquidity is reduced with a change in tick size. Kavajecz and Odders-White analyze changes in the posted quotes and find that changes in orders from the limit order book have significant effects on the posted quotes.

We seek to extend current research by looking at quoted depth on a daily and intraday basis for both the specialist and the limit order book. Additionally, we examine quoted spreads and depth for a day-of-the-week effect.³ Chorida, Roll, and Subrahmanyam (2001) (CRS) find daily differences in spreads and depth, but provide no explanations or reasons for these findings. Chorida, Roll, and Subrahmanyam find significantly negative (positive) coefficients for Tuesday, Wednesday, and Thursdays when examining daily spread (depth) changes from 1988 to 1998. We, like Chorida, Roll, and Subrahmanyam, find lower spreads and higher depth on Tuesdays and add to their findings by showing that this finding seems to come mainly from the limit order book in the latter part of the trading day. Additionally, our results show that the specialist provides less liquidity (as measured by quoted depth) than do limit orders.

Data and Quote Identification

The data for this study come from the NYSE TORQ (Trades, Orders, Reports, and Quotes) database.⁴ This database consists of time-ordered transactions for 144

² In related work examining Nasdaq (as oppose to specialist and limit order traders), Chung and Zhao (2003) examine Nasdaq market makers and find that the market makers make more frequent revisions in depth than in spreads.

³ Harris (1986) examines intraday stock returns and finds that returns differ by weekday. Specifically, Harris finds that the Monday effect (lower returns on Monday than other days of the week) takes place during the first 45 minutes of trading.

⁴ We acknowledge that the TORQ database is somewhat dated, in that the market was trading/quoting in 1/8th increments at the time the database was put together. Now the market is

selected stocks traded on the NYSE from November 1990 through January 1991.⁵ There are 63 trading days in the sample period. We filter the database using several screens. We omit the quotes if either the bid price or ask price is equal to or less than zero or the spread is greater than \$4 or less than zero. Additionally, we limit our sample to stocks that have at least one trade in each of the 63 days in the sample. Our final sample consists of 108 stocks.

Following the quote classification procedure by Chung, Van Ness, and Van Ness (1999), all bid (ask) quotes are classified into one of three categories, according to whether the quote reflects the trading interest of the specialist, limit-order traders, or both. To determine where the quote is coming from, we partition the depth of each quote into that provided by the specialist, the limit-order book, or a combination of the two.

If a bid (ask) quote has no corresponding limit orders, the quote is identified as a specialist quote (quote class S). If a bid (ask) quote has one or more corresponding limit orders, we compare the quoted depth at the bid (ask) with the depth of the matching limit order(s). If the limit orders are equal to the quoted depth, we identify it as a limit order quote (quote class L). If the limit order depth is less than the quoted depth, we identify this quote as a mixed quote, partially from the limit order book and partially from the specialist (we call this quote class M).

Because the origination of each ask and bid is identified as the specialist, limit order book, or both, we follow Chung, et al. (1999) in categorizing each quote as a specialist quote or a limit order quote. If a bid or ask quote belong to the quote class S and/or M, the quote is designated as a specialist quote. Limit order quotes are those that belong to the quote classes L and M.⁶

trading/quoting in decimal prices. For the purpose of this study, the TORQ contains the best data publicly available. Also, Bacidore, Battalio, and Jennings (2003) show that decimalization has not changed traders' order submission strategies, so any inferences from this paper regarding the interaction of limit orders and the specialist may still be valid. Additionally, articles using the TORQ data have appeared in the *Journal of Banking and Finance* and the *Journal of Financial Markets* in 2003.

⁵ Although the TORQ database is the best database available for this study, we acknowledge its limitations. The database only covers 144 stocks and includes only orders submitted to the NYSE. Additionally, it includes only orders submitted through the electronic routing systems, so, orders that are hand-carried to the specialist's post are not captured. Also, daily results found here might be a function of the time period of the TORQ database.

⁶ Quotes fall into several groups: the specialist on both sides of quote (S,S); the specialist at ask or bid and the limit order book on the other side of the quote (S,L); the specialist at ask or bid and both the specialist and the limit order book on the other side (S,M); limit orders at both the ask and bid (L,L); limit orders at one side of quote and both specialist and limit orders on the other (L,M); and both the specialist and limit order book at bid and ask quote (M,M). We define a specialist quote as (S,S), (S,L), (S,M), and (M,M), and limit order quotes as (L,L), (S,L), (L,M), and (M,M).

Spread Measures

We use several spread measures in our analyses. We define the quoted spread as the difference in the ask and bid prices (spread = ask – bid).

Similarly, the percentage spread is:

$$\text{Percentage spread} = \frac{(\text{ask} - \text{bid})}{\left[\frac{\text{ask} + \text{bid}}{2} \right]}.$$

We calculate the standardized spread ($\text{STSPRD}_{i,t,k}$) by subtracting the mean spread of each stock i during a 30-minute interval t ($m_{i,t}$) from each quoted spread ($s_{i,t,k}$). We then divide the difference by the standard deviation of that stock's spread during the same 30-minute time interval ($\text{std}_{i,t}$). The standardized spread is defined as:

$$\text{STDSPD}_{i,t,k} = \frac{(s_{i,t,k} - m_{i,t})}{\text{std}_{i,t}}.$$

Similarly, the standardized percentage spread is defined as above using percentage spread rather than quoted spread. We define depth as the sum of the quoted depth at both the bid and ask prices (depth = ask depth + bid depth).

Spreads and Depth by Day of the Week

Chorida, Roll, and Subrahmanyam (2001) undertake the most extensive analysis of daily changes in liquidity and trading. They find strong day of the week effects, and Tuesdays tend to show an increase in liquidity (decreased spreads and increased depth). We seek to expand upon their findings by examining spreads and depth on a daily basis for both specialists and limit orders. Each quote in the data is identified as either a specialist quote or a limit order quote (defined previously). Table 1 (panel A through E) presents spread, percentage spread, standardized spread, percentage standardized spread, and quoted depth for the specialist and limit order book. These statistics are calculated for each day of the week.⁷ We find that spreads and standardized spreads for limit order quotes are significantly lower on Tuesdays than the other days of the week. The average spread (panel A of table 1) for limit order quotes is 0.1844 and on Tuesdays it is 0.1818. An F-test of whether the mean on Tuesday is equal to the average of the other weekday means, (F_{Tue}), rejects equality at the 5 percent level for limit order quotes. (Equality is rejected for both the mean quoted spread and mean standardized spread.)

The findings that Tuesdays have lower spreads is consistent with the findings of Chorida, Roll, and Subrahmanyam (2001), who also find that spreads are lower on

⁷ There are several holidays during our sample time period, and the days before holiday have shortened trading hours which have the potential to alter our findings. For robustness we examine each week without a holiday (removing the weeks in which a holiday occurs) and find that our results are qualitatively similar.

Table 1—Daily Statistics

Five weekday means for spread, percentage spread, standardized spread, and depth (ask depth + bid depth). AVG_4 is the mean for every weekday except Tuesday. F-tests of whether the five weekday means are equal (F_5), of whether the Monday mean is equal to the other weekday means (F_{MON}), of whether the Tuesday mean is equal to the other weekday mean (F_{TUE}), etc. are listed. *F-statistics with corresponding tail areas between 0.05 and 0.10 are marked with an asterisk. Those with tail areas of less than 0.05 are marked by a double asterisk. We use the 108 TORQ common stocks that trade on each of the 63 trading days in the sample—from November 1, 1990 to January 31, 1991

	Means					F Statistic							
	Mon (1)	Tue (2)	Wed (3)	Thu (4)	Fri (5)	All Day	AVG ₄	F ₅	F _{MON}	F _{TUE}	F _{WED}	F _{THU}	F _{FRI}
Panel A: Mean Spread for Weekdays													
Specialist	0.2113	0.2078	0.2100	0.2119	0.2104	0.2103	0.2109	0.4767	0.2694	1.4516	0.0193	0.6808	0.0062
Limit Order	0.1830	0.1818	0.1848	0.1852	0.1847	0.1840	0.1844	1.3745	0.7398	3.4091*	0.7114	1.5693	0.5345
Panel B: Mean Percentage Spread for Weekdays													
Specialist	0.0126	0.0120	0.0121	0.0124	0.0126	0.0124	0.0124	0.5296	0.6190	0.8713	0.5111	0.0138	0.6480
Limit Order	0.0104	0.0091	0.0095	0.0094	0.0097	0.0096	0.0098	1.3935	4.8346*	1.6953	0.0649	0.3827	0.0038
Panel C: Mean Standardized Spread for Weekdays													
Specialist	0.0773	0.0452	0.0768	0.0711	0.0748	0.0690	0.0750	0.3340	0.1747	1.2869	0.1556	0.0112	0.0843
Limit Order	-0.0335	-0.0513	-0.0028	-0.0089	-0.0094	-0.0212	-0.0136	1.8643	0.9133	4.7793*	2.0283	0.9032	0.8287
Panel D: Mean Standardized Percentage Spread for Weekdays													
Specialist	0.0897	0.0548	0.0667	0.0631	0.0837	0.0716	0.0758	0.1735	0.3479	0.2650	0.0260	0.0761	0.1567
Limit Order	-0.0215	-0.0388	-0.0097	-0.0229	-0.0032	-0.0192	-0.0143	0.1947	0.0073	0.4728	0.1279	0.0192	0.3589
Panel E: Mean Depth for Weekdays													
Specialist	23.442	25.051	24.286	24.920	23.419	24.262	24.017	0.5566	0.7257	0.7164	0.0046	0.5758	0.7679
Limit Order	28.913	31.700	28.613	30.904	27.947	29.626	29.094	2.0477*	0.5215	4.0468*	1.0639	1.7558	2.9403

*statistically different at the 5 percent level. The F-statistics are obtained from analysis of regressions on five weekday dummy variables. The degrees of freedom associated with these F-statistics are F_5 (4, 58), F_{MON} (1, 58), F_{TUE} (1, 58), F_{WED} (1, 58), F_{THU} (1, 58), F_{FRI} (1, 58)

Tuesdays than other days of the week. We also show that the decrease in spreads on Tuesdays is primarily attributable to limit orders. We also find that Monday has a significantly larger spread for limit order quotes than do the other days of the week.⁸

Lee, Mucklow, and Ready (1993) suggest that the lower spreads imply larger depth. Given our findings of lower spreads on Tuesdays (for limit order quotes), we expect, and find that significantly greater depth for the limit order book on Tuesdays than on the other days of the week (average quoted depth of 29,626 and a quoted depth of 31,700 on Tuesdays). Neither the specialist's quoted depth nor the spread measure is significantly different on any of the days of the week.

Intraday Depth

Table 2 examines the intraday depth for each of the quote classes. The largest average depth occurs when both the specialist and limit order book determine the quote. Quote class (M,M) averages 46,293 shares combined at the ask and bid prices. The smallest quoted depth occurs when the specialist alone has both the bid and ask quotes (quote class (S,S) averages 7,400 shares). When the limit order book has both sides of the quote there is more quoted depth than when the specialist has both sides (quote class (L,L) averages 16,493 shares). Generally, the intraday patterns of depth (for all categories of specialist and limit order book quotes) exhibit inverted U-shaped patterns, which is opposite to the observed intraday patterns of spreads found by McNish and Wood (1992), Chan, Christie, and Schultz (1995), and Chung, Van Ness, and Van Ness (1999). The inverted U pattern is consistent with the relation of low spreads and high depth found by Lee, Mucklow, and Ready (1993)⁹ and the findings regarding the cumulative depth of the limit order book shown by Chung, Van Ness, and Van Ness (1999).¹⁰

Panel A of Table 3 lists the average depth for the entire day, while panel B shows the average intraday depth for the specialist and limit order book. We find that the limit order book has the largest average depth, 29,626 shares, while the specialist provides a depth of 24,262 shares. Biais, Hillion, and Spatt (1995) show that traders

⁸ We speculate that this observation may be related to the findings of Harris (1986), who shows that Monday has a different intraday pattern of returns than other days of the week and that differential intraday pattern is a result of the first 45 minutes of trading.

⁹ The inverted U-shaped pattern can be interpreted as consistent with Rock (1990) and Seppi (1997), who provide theoretical work that suggests that the limit order book affects the quotes of specialists.

¹⁰ Chung, Van Ness, and Van Ness (1999) show that the cumulative volume and number of limit orders exhibit an inverted intraday U-shaped pattern, and show that this has a significant bearing upon the intraday quoted spread (and use this to explain the U-shaped pattern of spreads).

Table 2—Intraday Depth

Intraday depth for various quote classes (the specialist or limit order book) are provided. Quote class S,S is a quote where both the ask and bid quotes are from the specialist. Quote class S,L is a quote in which one side is from the specialist and one side is from the limit order book. Quote class S, M is a quote where the specialist has one side of the quote (either ask or bid) and both the specialist and limit order book are determining the other side of the quote. Quote class L,L is where the limit order book is determining both the ask and bid prices. Quote class L,M is a situation where the limit order book has one side of the quote and the specialist and limit order book are jointly determining the other side of the quote. Quote class M,M is the situation in which both the specialist and limit order book are determining the quote (both have depth at the current quote). The table reports the average quoted depth for each of these quote classes. Panel A reports aggregate statistics (for the entire trading day) while panel B shows the averages over 13 consecutive 30-minute intervals. F-statistics are provided to examine whether the intraday differences are the same for each 30 minute period during the trading day

Panel A: Aggregate

	Quote Class					
	(S,S)	(S,L)	(S,M)	(L,L)	(L,M)	(M,M)
Depth	7,400	9,078	19,046	16,493	26,143	46,293

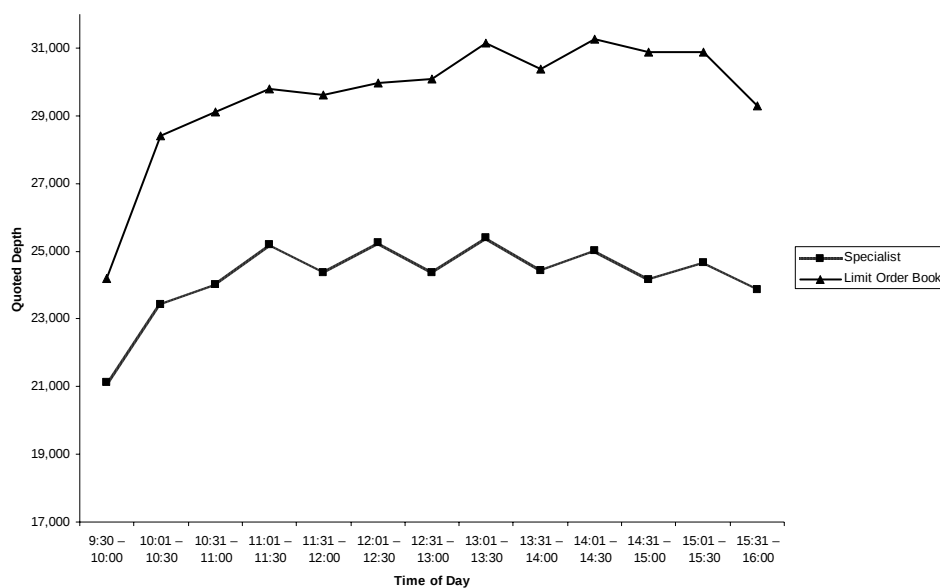
Panel B: Time of Day

	(S,S)	(S,L)	(S,M)	(L,L)	(L,M)	(M,M)
9:30 – 10:00	7,014	8,648	19,379	13,189	22,439	36,976
10:01 – 10:30	8,158	8,943	18,861	16,142	25,789	43,292
10:31 – 11:00	8,277	9,156	19,016	16,692	25,861	44,783
11:01 – 11:30	8,846	9,604	20,002	16,576	26,052	46,746
11:31 – 12:00	8,128	9,888	19,383	16,749	26,503	45,593
12:01 – 12:30	7,771	9,153	20,927	16,938	25,908	47,050
12:31 – 13:00	8,048	9,618	19,518	18,125	26,626	45,540
13:01 – 13:30	8,274	9,160	18,340	17,162	27,270	49,050
13:31 – 14:00	7,927	10,054	18,406	17,309	26,855	46,934
14:01 – 14:30	6,594	9,176	18,330	17,522	26,879	50,117
14:31 – 15:00	6,103	9,154	18,144	17,457	26,962	48,252
15:01 – 15:30	5,737	8,713	19,458	17,346	26,460	48,827
15:31 – 16:00	5,282	6,692	17,811	13,114	26,189	48,529
F-stat	1.2485	3.2650*	0.5247	6.5830*	2.0943*	4.0676*

*statistically different at the 5 percent level

place limit orders when the spread is large and the limit order book is thin,¹¹ while Chung, Van Ness, and Van Ness (1999) find that the spread narrows as the accumulated limit order book grows. Hence, we expect to find that quoted depth is largest for the limit order book in the middle of the day since Chung, et al. find that the accumulated limit order book is greatest in the middle of the day and declines toward the close of trading. Our results in Table 3 confirm this expectation. The specialist and limit order book all exhibit a rough intraday inverted U-shaped pattern in depth (this finding is depicted in Figure 1). The specialist appears to be providing more depth in the middle of the trading day at the same time that the limit order book is

¹¹ Similarly, Bae, Jang, and Park (2003) find that there are more limit orders placed (relative to market orders) when the spread is large, the order size is large, and there is an expectation of high transitory price volatility.

Figure 1—Intraday Depth of the Specialist and Limit Order Book**Table 3—Aggregate and Intraday Depth**

Average depth over the entire trading day (panel A) and intraday depth (panel B) are shown below. The statistics are shown for the specialist, and quotes from the limit order book. The trading day is segmented into 13 consecutive 30-minute intervals. F-statistics are provided to examine whether the intraday differences are the same for each of the 30 minute intervals

Panel A: Average Depth

	Specialist Depth	Limit Order Depth
Depth	24,262	29,626

Panel B: Time of Day

Time Interval	Specialist Depth	Limit Order Depth
9:30 – 10:00	21,123	24,201
10:01 – 10:30	23,437	28,408
10:31 – 11:00	24,025	29,112
11:01 – 11:30	25,198	29,791
11:31 – 12:00	24,368	29,615
12:01 – 12:30	25,249	29,965
12:31 – 13:00	24,369	30,097
13:01 – 13:30	25,402	31,160
13:31 – 14:00	24,422	30,366
14:01 – 14:30	25,016	31,267
14:31 – 15:00	24,166	30,890
15:01 – 15:30	24,674	30,878
15:31 – 16:00	23,874	29,278
F-statistic	1.9953*	5.9132*

*statistically different at the 5 percent level

providing a substantial amount of liquidity. This finding is consistent with Bondarenko and Sung (2003), who present a model of specialist participation and limit order book depth.

Depth Differences for Specialist and Limit Orders

Table 4 examines differences in depth for specialists and the limit order book. We find that the average depth for the specialist is significantly smaller than that of the limit order book at the 5 percent level. The findings of Table 4, that the differences in average quoted depth of the limit order book are greater than that of the specialist, cause us to question whether these relationships are consistent throughout the trading day. Table 5 presents the intraday differences in depth.

Table 4—Differences in Depth

This table examines differences in quoted depth for the specialist and limit order book. Panel A presents the average quoted depth, and panel B presents t-tests tests for differences in average quoted depth

Panel A: Average Quoted Depth		
	Specialist	Limit Orders
Depth	24,262	29,626
Panel B: Differences in Quoted Depth		
	Difference	t-statistic
Specialist versus Limit Orders	-5364	28.454*

*statistically different at the 5 percent level

Consistent relations emerge when examining the intraday differences. The limit order book maintains a larger quoted depth than the specialist throughout the trading day, and this difference is generally increasing throughout the day until the last hour of trading. This difference also shows an inverted U-shaped intraday pattern.

Day of the Week Depth for Specialist and Limit Orders

In Table 1 we show that depth on Tuesday is different from the other days of the week. We expand upon this finding by analyzing the intraday quoted depth for the specialist (Table 6). The F-statistics show no significant differences in the days of the week or intraday intervals for the specialist.

Table 7 expands on the Table 6 by looking at the intraday depth of the limit order book. The F-statistics for quoted depth from the limit order book show that the greater overall depth observed on Tuesday can be attributed to larger limit order depth in the latter part of the trading day.

Conclusions

We examine weekday and intraday relations of spreads and depth for both the specialist and limit order book. We find that the limit order book plays an important role in providing liquidity by posting orders with higher depth than the specialist.

Table 5—Intraday Depth Difference

This table shows differences in quoted depth on an intraday basis. The trading/quoting day is divided into 13 consecutive 30-minute increments. Differences in quoted depth between the specialist and limit order book are presented for each of the 13 intervals of the trading. Additionally, F-statistics are used to determine if the differences in quoted depth are the same for each of the 30 minute time intervals

Specialist – Limit Orders		
Time Interval	Difference	t-stat
9:30 – 10:00	-3,078	4.55*
10:01 – 10:30	-4,971	7.28*
10:31 – 11:00	-5,087	7.45*
11:01 – 11:30	-4,593	6.84*
11:31 – 12:00	-5,247	7.81*
12:01 – 12:30	-4,716	7.02*
12:31 – 13:00	-5,728	8.53*
13:01 – 13:30	-5,759	8.57*
13:31 – 14:00	-5,944	8.85*
14:01 – 14:30	-6,252	9.31*
14:31 – 15:00	-6,724	9.93*
15:01 – 15:30	-6,204	9.16*
15:31 – 16:00	-5,404	7.98*
F-statistic	1.9059*	

*statistically different at the 5 percent level

Table 6—Average Quoted Depth by Day of the Week for the Specialist

This table presents average quoted depth on an intraday basis for the specialist for each day of the week. The trading day is separated in 13 consecutive 30-minute intervals. F-statistics are used to determine if there are differences between the average quoted depth for the 13 intervals. Also, we use F-tests to compare each interval across the days of the week (F_s) and to determine if each interval on Tuesday is significantly different from the corresponding interval on the other days of the week (F_{TUE})

Time Interval	Mon	Tue	Wed	Thu	Fri	F-statistic	
						F_s	F_{TUE}
9:30 – 10:00	19,522	21,116	21,734	21,955	21,351	1.1325	0.0005
10:01 – 10:30	23,341	22,947	24,261	23,313	23,221	0.1909	0.1925
10:31 – 11:00	22,191	23,776	23,618	25,269	25,439	0.7564	0.0383
11:01 – 11:30	26,806	25,408	23,774	24,896	25,137	0.3255	0.0124
11:31 – 12:00	21,521	25,601	25,141	26,560	23,207	1.3108	0.5063
12:01 – 12:30	26,104	27,285	24,619	25,031	23,521	0.5292	1.1724
12:31 – 13:00	24,109	23,989	24,349	26,278	23,059	0.5986	0.0636
13:01 – 13:30	23,112	27,474	26,946	24,682	25,114	0.8795	1.3055
13:31 – 14:00	23,082	26,639	26,915	23,887	21,930	1.4009	1.5122
14:01 – 14:30	25,995	26,754	23,972	26,011	22,614	0.5736	0.6253
14:31 – 15:00	23,715	25,907	24,989	23,712	22,741	0.3916	0.8624
15:01 – 15:30	24,763	23,526	24,037	26,560	24,313	0.4165	0.4309
15:31 – 16:00	22,710	25,247	21,359	26,498	23,677	1.2056	0.5925
F-statistic	1.1236	0.8317	1.0412	0.7893	0.5374		

*statistically different at the 5 percent level

On an intraday basis, we find that the average depth exhibits an inverted U-shaped pattern for both the specialist and limit order book. Our finding reinforce those of Lee, Mucklow, and Ready (1993) who find that wide spreads are accompanied by low depth—intraday spreads exhibit a U-shaped pattern; hence, intraday

Table 7—Average Quoted Depth by Day of the Week for the Limit Order Book

This table presents average quoted depth on an intraday basis for the entire the limit order book for each day of the week. The trading day is separated in 13 consecutive 30-minute intervals. F-statistics are used to determine if there are differences between the average quoted depth for the 13 intervals. Also, we use F-tests to compare each interval across the days of the week (F_5) and to determine if each interval on Tuesday is significantly different from the corresponding interval on the other days of the week (F_{TUE})

Time Interval	Mon	Tue	Wed	Thu	Fri	F-statistic	
						F_5	F_{TUE}
9:30 – 10:00	22355	24063	23604	26782	24379	2.4468*	0.0324
10:01 – 10:30	26923	28966	27212	30648	28559	1.3305	0.1713
10:31 – 11:00	27647	30539	27927	30960	28828	1.1329	1.0664
11:01 – 11:30	29547	31879	28478	30694	28678	0.8978	2.1325
11:31 – 12:00	28257	31261	28684	32501	27626	2.2548*	1.4496
12:01 – 12:30	30064	32638	29239	30331	27966	1.1242	3.0738*
12:31 – 13:00	30179	32560	29108	31412	27604	1.1701	2.0696
13:01 – 13:30	30758	32887	32033	30734	29656	0.4274	0.8866
13:31 – 14:00	29794	33231	30188	31421	27635	1.2773	2.7091*
14:01 – 14:30	32010	35095	29378	32702	27740	1.7716	3.4318*
14:31 – 15:00	30575	34456	30885	30695	28364	1.3997	4.2222*
15:01 – 15:30	31852	31942	28946	32672	29216	0.8553	0.3327
15:31 – 16:00	28491	32580	26273	31032	284459	1.6900	3.3616*
F-statistic	2.2302	1.6926	1.7048	1.0189	0.7753		

*statistically different at the 5 percent level

depth exhibits an inverted U-shaped pattern. The difference in quoted depth from the specialist and limit order book is significant, and this difference is significant on an intraday basis.

We also find that spreads are lower and depth is higher on Tuesdays. We attribute the higher quoted depth to the limit order book posting larger cumulative depth toward the end of the trading day on Tuesdays.

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