

# Intraday REIT Liquidity

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**Abstract** This study measures and analyzes the liquidity differences between Real Estate Investment Trusts (REITs) and other common stocks. The intraday variations documented in this study have implications for the appropriate timing of trades to minimize transaction costs and the substitutability of investments if illiquidity is priced. The findings reveal intraday patterns indicating lower liquidity for REITs than for common stocks when the liquidity measure is friction-based. In contrast, activity measures exhibit higher liquidity levels for REITs than for common stocks but this difference is only statistically significant at the beginning of the trading day. The findings also indicate that the ability to trade without influencing prices is 15%–25% greater for non-REITS compared to REITs, and the price of immediacy is 7% higher for REITs.

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## Introduction

The unique characteristics of Real Estate Investment Trust (REIT) stocks have intrigued researchers because they are real estate investments, and yet they trade in the secondary market in the same manner as common stock. Since REITs are publicly traded, they are more liquid than a direct real estate investment; however, due to their institutional features, REITs may not be a perfect substitute for conventional equity. For example, REITs must pay out 90% of their earnings as dividends to avoid double taxation.<sup>1</sup> This requirement limits managerial discretion and suggests that REITs may have a lower level of asymmetric information and therefore different risk characteristics than common stocks. These different characteristics may provide additional diversification benefits and stability to common stock portfolios, thus increasing the attractiveness of REITs to general investors. Any diversification benefits, however, must be weighed against market microstructure differences (due to REIT characteristics) that translate into higher trading costs. Specifically, liquidity is one microstructure element where differences between REITs and common stocks may arise.

A detailed examination of liquidity differences between REITs and common stocks is important for two reasons. Real estate investors may be satisfied with the improved liquidity of their REIT investments compared to direct real estate

investments, but this contentment may be short-lived if REIT stocks are not as liquid as other common stocks. The asset-pricing literature indicates that illiquidity may be priced and REIT investors' returns may therefore be more related to microstructure characteristics than the real estate investment.<sup>2</sup> If REIT liquidity displays different patterns during the trading day compared to common stock liquidity patterns, then the identification of trading periods that minimize adverse liquidity effects would have important implications for REIT investors. Secondly, if REIT liquidity levels influence returns, common stock investors may not perceive REIT shares as investment substitutes. In this situation, the market for these shares may be segmented, resulting in a less efficient risk-return tradeoff than is possible in an otherwise integrated market.

The question of whether REITs provide as much liquidity as non-REIT common stocks remains unanswered. While Ghosh, Miles and Sirmans (1996) find that REIT liquidity may not be as large as comparably sized non-REIT stocks, Nelling, Mahoney, Hildebrand and Goldstein (1995) document REIT liquidity to be similar to other common stocks' liquidity. In addition, REIT liquidity may be more volatile than common stock liquidity partly due to a large dispersion both in terms of capitalization value among REITs and in their ownership concentration with some REITs being very widely held.<sup>3</sup>

The explosive growth in the REIT market in the 1990s led many researchers to test if the REIT microstructure environment changed accordingly. Bhasin, Cole and Kiely (1997) find that REIT percentage bid-ask spreads declined during the 1990-1994 period primarily due to higher share prices. Below, Kiely and MacIntosh (1996) confirm the liquidity decline between 1992 and 1994. Clayton and MacKinnon (2000), using a market depth approach, find no change in liquidity for externally advised/managed REITs in the 1993-1996 period. However, they do find that self-advised, self-managed REITs exhibited liquidity declines during that period. Danielsen and Harrison (2000) find that there are different determinants of REIT liquidity depending on the exchange where the security is listed and on the amount of direct real estate investments held within each REIT. The results of the existing literature suggest a need to further examine REIT liquidity to identify differences with common stock liquidity.

Market microstructure literature has identified several trading variables that measure different dimensions of liquidity, thus reflecting the difficulty of capturing all aspects of liquidity in one variable. The previous REIT studies' mixed results may be explained by the use of different liquidity proxies. For example, Below, Kiely and McIntosh (1995) examine intraday patterns for thirty-seven REITs using 1991 data and find that REIT liquidity is lower using volume, return and the raw bid-ask spread. Bhasin, Cole and Kiely (1997) using the percentage bid-ask spread recognize that the raw spread is a poor measure of liquidity from the perspective of an investor who wishes to execute a large trade quantity. Furthermore, the use of raw spreads fails to consider that many transactions take place inside the quoted spread. To update the prior literature by providing a comprehensive analysis of the liquidity differences, this study examines intraday

patterns using measures that span the various dimensions of liquidity. This study also uses more current data and a much larger sample of REITs than that used in previous studies.

The study estimates several liquidity proxies classified as either friction or activity measures to determine whether or not REIT liquidity is similar to common stock liquidity. The results document that the liquidity of REIT stocks exhibits the well-known intraday U-shaped pattern that is typically found for common stocks. From an economic perspective, these results hold strong implications for REIT investors seeking to minimize trading costs by using the information revealed by the intraday patterns. The findings also reveal that the liquidity of REITs is generally lower than that of similar common stocks, which suggests that the REIT market may not be viewed as a substitute by common stock investors. The research reveals that REIT liquidity is indeed complex and the use of any one measure may be too simplistic an approach to accurately portray REIT liquidity.

The structure of this paper is as follows. The next section reviews the relevant literature on intraday trading patterns in liquidity. The following sections describe the liquidity measures, data and methodology employed, and reports the results. The final section concludes the paper and highlights its contributions.

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## Intraday Patterns and Liquidity

The first comprehensive theory to explain intraday trading behavior was presented by Admati and Pfleiderer (1988) within the context of a strategic trader model that includes informed traders and both discretionary and non-discretionary liquidity traders. The informed and discretionary liquidity traders prefer to trade when they have the least effect on price, and this desire creates a strong incentive to trade when other traders are active. Their model suggests that the periods immediately after the open and before the close are unique for this purpose and will incur lower trading costs due to higher liquidity. Therefore traders may have a preference for trading during these high liquidity periods among non-discretionary traders, and this may result in other traders gravitating to these time periods as well. Based on this explanation, Brock and Kleidon (1992) model the bid-ask spread during the day and conclude that the intraday pattern should be U-shaped, if the intraday pattern in volume is also U-shaped.

Empirical investigations of common stock intraday patterns initially focused solely on trading volume. Jain and Joh (1988) find a U-shaped pattern in intraday volume for stocks of the S&P 500 Index with the hourly volume at the opening of the market 50% higher than the hourly volume at any other time during the trading day. In addition, Foster and Viswanathan (1993) report that stocks with relatively low volume exhibit a more pronounced U-shaped pattern than high volume stocks, although Wei (1992) finds that the lower activity stocks in his sample do not demonstrate a significant intraday pattern. Wood, McNish and Ord (1985) find unusually high standard deviations of returns at the beginning and at the end of

the trading day, as well as high average returns at the beginning and at the end of the trading day for NYSE stocks. These different perspectives of liquidity demonstrate that a more comprehensive approach may be necessary to fully understand the many dimensions of liquidity.

Real estate investment trust intraday pricing for 1991 was examined in Below, Kiely and McIntosh (1995), and they document lower levels of liquidity for REITs using a range of measures including returns, volume, trading activity and the bid–ask spread. They demonstrate that the level of institutional ownership can explain differences between REITs and common stocks in these four liquidity measures. However, Wang, Erickson, Gau and Chan (1995) demonstrate that institutional ownership levels are typically lower for REITs. However, this level is not constant over time and Chan, Leung and Wang (1998) report that institutional investors are becoming more active in the REIT market. Intertemporal changes in liquidity are also documented by Below, Kiely and McIntosh (1996) who find evidence of improved REIT pricing efficiency in a past REIT boom period (1994). More recently, the literature suggests some declines in liquidity, with Downs, Guner, Hartzell and Torres (2001) finding that volatility has increased for REITs. In fact, additional awareness of REITs may have negatively impacted on REITs since Downs and Guner (2000) find that liquidity worsens with increased analyst attention. These conflicting findings indicate the need for a comprehensive examination of REIT liquidity.

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### Liquidity Measures, Data and Methodology

Choosing the optimal measure of liquidity has proven elusive even though the concept of liquidity is well understood.<sup>4</sup> In general, empirical liquidity proxies can be categorized as either measures of friction or activity, reflecting the two major dimensions of liquidity. Friction measure classifications follow Demsetz (1968), Grossman and Miller (1988) and Stoll (2000), where friction is identified as the price concession for immediacy. In contrast, activity measures reflect the extent of trading. These two dimensions have opposing directional impacts on liquidity. Specifically, an increase in a friction measure indicates reduced liquidity, while an increase in an activity measure indicates increased liquidity. Exhibit 1 identifies eleven liquidity measures and provides the method of calculation for each liquidity proxy. These measures improve on prior liquidity studies in the REIT literature since they provide a more comprehensive perspective of liquidity by recognizing different aspects of liquidity. For example, the volume of trading is a proxy for actual activity, while depth levels reveal the ability to trade.

Friction measures can be subcategorized into bid–ask spread measures, price measures or return measures. Bid–ask spread measures reflect the cost of transacting in the market, but these measures have many critics. For example, Grossman and Miller (1988) and Lee, Mucklow and Ready (1993) argue that the quoted bid–ask spread is a noisy and inadequate measure of liquidity, since a

**Exhibit 1** | Liquidity Proxies

| Liquidity Proxy                                                                                                                                                                  | Variable      | Calculation                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------------------------------------------|
| <b>Panel A: Friction Measure</b>                                                                                                                                                 |               |                                                                   |
| <b>Bid-Ask Spread Measure</b>                                                                                                                                                    |               |                                                                   |
| Percentage Bid-Ask Spread                                                                                                                                                        | %Spread       | Difference between the ask and bid price, divided by the midpoint |
| <b>Price Measure</b>                                                                                                                                                             |               |                                                                   |
| High-Low                                                                                                                                                                         | HiLo          | Difference between the high and low transaction price             |
| <b>Return Measure</b>                                                                                                                                                            |               |                                                                   |
| Variance (1,000)                                                                                                                                                                 | IntraVar      | Variance of the transaction return                                |
| <b>Panel B: Activity Measures</b>                                                                                                                                                |               |                                                                   |
| <b>Depth Measures</b>                                                                                                                                                            |               |                                                                   |
| Ask Depth                                                                                                                                                                        | AskDepth      | Quantity of shares offered at the ask price                       |
| Bid Depth                                                                                                                                                                        | BidDepth      | Quantity of shares offered at the bid price                       |
| <b>Volume Measures</b>                                                                                                                                                           |               |                                                                   |
| Volume (1,000)                                                                                                                                                                   | Volume        | Number of shares traded                                           |
| Dollar Volume (1,000)                                                                                                                                                            | \$Volume      | Dollar value of transactions                                      |
| Number of Quotes                                                                                                                                                                 | NumberQuotes  | Number of quotes                                                  |
| <b>Size Measures</b>                                                                                                                                                             |               |                                                                   |
| Average Transaction Size                                                                                                                                                         | Transaction   | Average number of shares per transaction                          |
| Average Transaction Size in Dollars (1,000)                                                                                                                                      | \$Transaction | Average dollar value of each transaction                          |
| Percentage of Trading Inside the Bid-Ask Spread                                                                                                                                  | %InsideSpread | Percentage of transactions that occur within the bid-ask spread   |
| <p><i>Note:</i> Friction and activity measures calculated for each day are identified along with the variable name used in subsequent tables as well as calculation details.</p> |               |                                                                   |

large number of transactions take place at prices other than the quotations. The percentage spread more accurately reflects the percentage cost of trading by relating the size of the spread to the share price. Thus, the current study focuses on the percentage bid-ask spread, rather than the bid-ask spread as in Below, Kiely and McIntosh (1995). The measure of the range of transaction prices (Hi-Lo) is also estimated since a larger range indicates changes in liquidity and this variability itself may be a concern to some investors. The third friction measure estimated is the variance of transaction returns since this measure can be used as

an indication of fluctuations in liquidity during the trading day. A higher variance of returns indicates that liquidity is low and prices adjust to trades rather than trades being absorbed in the current price structure.

The other broad category of liquidity measures involves activity measures that reflect the extent of trading. Measures of depth reflect the ability to trade at the given bid or ask quotation without altering the prices in the market. Explanations of changes in quoted liquidity may hinge on the amount of quoted depth used to fill the trade. Kavajecz (1999) suggests that for most securities, quotations convey public trading desires and as market orders deplete the quoted depth, specialists move quotations to the nearest price containing additional standing volume. If floor brokers provide standing volume, then trading will not have an impact on prior quotations, and there will be less of an effect on liquidity. The study includes separate proxies for the bid depth and the ask depth, since these buy and sell liquidity measures may not be symmetrical.

Barclay, Kandel and Marx (1998) emphasize volume measures as better indicators of liquidity than price discounts. Volume of trading has been measured in a variety of ways, including the number of shares traded, dollar volume of shares traded and the number of transactions.<sup>5</sup> All three of these measures are estimated in the current study with the exception of the number of transactions. Instead, the number of quotations is measured as this captures the activity of the specialist and reflects the activity in the market.

Size measures are another subcategory of activity measures. The average transaction size is included, as well as the dollar value of the average transaction size, and the extent of the trading that occurs within the bid–ask spread. Any trades inside the spread occur because the specialist or market maker is making a price concession in order to consummate a transaction.

These various measures of the friction and activity dimensions have been estimated to allow a comprehensive comparison of the patterns in liquidity for REIT and non-REIT stocks across the trading day. The differences between REIT and non-REIT stocks are tested in each subperiod to address the null hypothesis that the REIT and non-REIT liquidity levels are identical. The following discussion explains the data, matching procedures, and regression analysis used in the empirical analysis.

The data are derived from the Trades And Quotes (TAQ) database provided by the New York Stock Exchange. Trades And Quotes data includes time-stamped trade prices, trade sizes and bid and ask quotes and depths. This study considers REITs and non-REITs over the entire 1996 calendar year. The REITs are identified from the National Association of Real Estate Investment Trusts (NAREIT) listing and other sources to include only REITs traded on the New York Stock Exchange. The non-REITs are included on the basis of the following matching process.

Three separate samples are constructed of publicly traded REIT and non-REIT companies matched on friction and activity measures of liquidity during the entire

calendar year. The first matched sample, based on total trading volume in the year 1996, matches each REIT with a common stock that has a total volume that is within  $\pm 5\%$  of the average REIT volume. The second matched sample, based on the time-weighted average percentage bid–ask spread, uses the same matching procedure between REIT and non-REIT stock, including the same 5% proximity rule. The third matched sample considers both activity and friction measures by matching each REIT with a common non-REIT stock that has a corresponding volume *and* time-weighted bid–ask spread, both of which must be within  $\pm 5\%$  of the average REIT value. It is important to stress that the matching is done on an overall basis, so that any individual differences within the trading day are not held constant across the two samples. Each of the three matched samples includes 127 REIT and 127 non-REIT stocks. Differences between the REIT and non-REIT samples are analyzed on an overall basis and within each time period, using a non-parametric Wilcoxon rank sums test.

In addition to reporting the patterns of the liquidity measures, a multiple regression model is estimated that includes indicator variables for the different half-hour periods and an indicator variable that identifies if the stock is a REIT. To determine if the REIT and non-REIT stocks diverge at any point during the day, the cross product of each half-hour trading indicator variable is included with the REIT indicator variable.

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## Results

Exhibit 2 reports the friction liquidity measures of REIT and non-REIT firms that were matched using the total trading volume during the year as the activity measure of liquidity. The overall friction measures for the percentage bid–ask spread (%Spread) and price (HiLo) measures are significantly larger for the non-REIT common stocks. Furthermore, Panel A of Exhibit 3 reveals that the percentage bid–ask spread (%Spread) is also lower for REITs in each of the thirteen intraday trading intervals. For this measure, the difference between REITs and non-REITs is at its largest in the morning and then declines during the trading day. For common stocks, the pattern is a reverse-J-shape, while for REITs the pattern resembles a U-shape.

The same intraday pattern is not evident in the HiLo measure. Exhibit 2 reveals REIT stocks have a consistently smaller HiLo measure, but the only significant difference between the REIT and non-REIT stocks occurs at the beginning of the trading day and on an overall basis. The difference between REIT and non-REIT stocks appears to be constant throughout the day with both measures rising and falling in tandem.

The return measure in Exhibit 2, the intraday variance of transaction returns (IntraVar), is significantly different on an overall basis between REIT and non-REIT stocks. During the first hour of trading, REIT stocks have a significantly smaller estimate, and this difference is statistically significant at a 5% level. The

**Exhibit 2** | Intraday Friction Measure Liquidity Estimates Matched on Activity

|                                 |          | 10:00   | 10:30   | 11:00   | 11:30   | 12:00   | 12:30   | 1:00    | 1:30    | 2:00    | 2:30    | 3:00    | 3:30    | 4:00    | Overall  |
|---------------------------------|----------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|
| Panel A: Bid-Ask Spread Measure |          |         |         |         |         |         |         |         |         |         |         |         |         |         |          |
| %Spread                         | REIT     | 1.86    | 1.62    | 1.55    | 1.54    | 1.49    | 1.41    | 1.35    | 1.33    | 1.40    | 1.44    | 1.52    | 1.63    | 1.83    | 1.57     |
|                                 | Non-REIT | 2.60*** | 2.11*** | 2.03*** | 1.96*** | 1.93*** | 1.78*** | 1.69*** | 1.69*** | 1.64*** | 1.71*** | 1.85*** | 1.97*** | 2.25*** | 1.97***  |
| Panel B: Price Measure          |          |         |         |         |         |         |         |         |         |         |         |         |         |         |          |
| HiLo                            | REIT     | 0.067   | 0.063   | 0.048   | 0.048   | 0.046   | 0.040   | 0.038   | 0.036   | 0.039   | 0.042   | 0.045   | 0.051   | 0.062   | 0.048    |
|                                 | Non-REIT | 0.098*  | 0.071*  | 0.068   | 0.059   | 0.058   | 0.053   | 0.048   | 0.049   | 0.046   | 0.051   | 0.055   | 0.060   | 0.073   | 0.061**  |
| Panel C: Return Measure         |          |         |         |         |         |         |         |         |         |         |         |         |         |         |          |
| IntraVar                        | REIT     | 0.075   | 0.041   | 0.139   | 0.131   | 0.169   | 0.114   | 0.095   | 0.188   | 0.138   | 0.058   | 0.097   | 0.177   | 0.115   | 0.116    |
|                                 | Non-REIT | 0.112** | 0.145   | 0.102   | 0.120   | 0.135   | 0.102   | 0.097*  | 0.108   | 0.096   | 0.124** | 0.111   | 0.135   | 0.117   | 0.113*** |

Note: Estimates of the three friction liquidity measures defined in Exhibit 1 for REIT and non-REIT stocks during 1996. Estimates based on quotes are averaged across time, while estimates based on transactions are averaged across transaction size. Tests of difference are based on a non-parametric Wilcoxon Rank Sums test.

\*Significant at  $\alpha = 10\%$ .

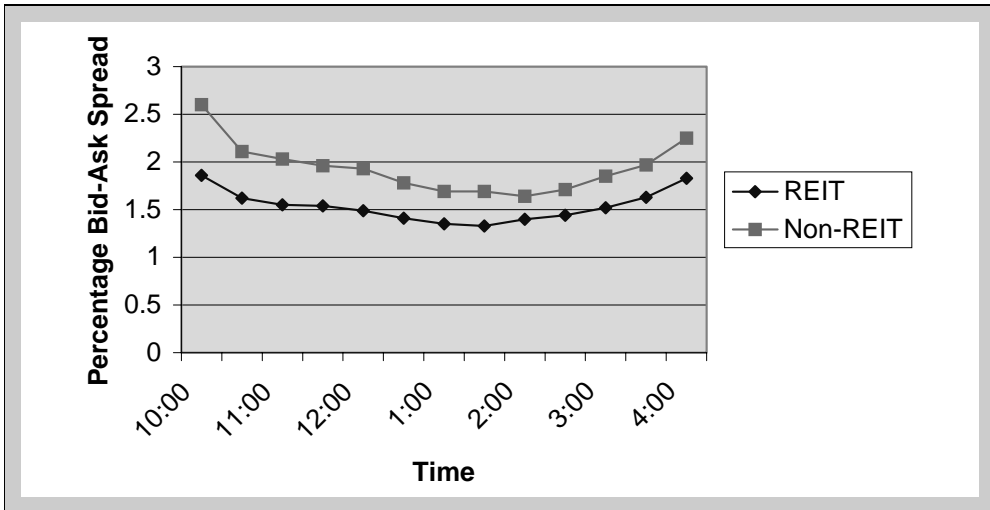
\*\*Significant at  $\alpha = 5\%$ .

\*\*\*Significant at  $\alpha = 1\%$ .

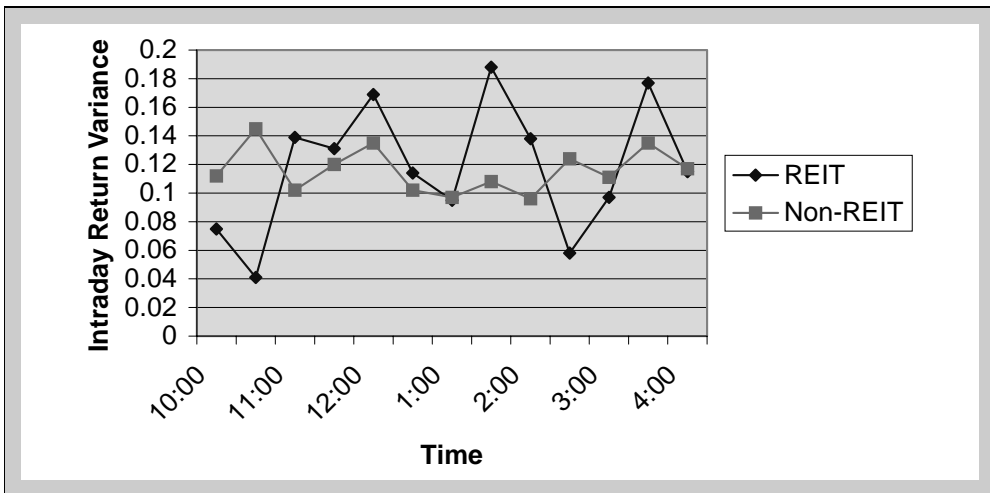


**Exhibit 3** | Friction Measures During the Day for REIT and Non-REIT Firms Matched on Total Trading Volume

**Panel A: Time-Weighted Percentage Bid-Ask Spread**



**Panel B: Intraday Return Variance**



*Note:* The 127 REIT firms are matched with non-REIT common stocks based on the total trading volume in 1996. The time-weighted percentage bid-ask spread and intraday return variance are measured over half-hour intervals during the trading day and reported across all stocks in each category.

estimate for REIT stocks is larger for most of the remainder of the day, but there are only two statistically significant differences between REIT and non-REIT stocks. Exhibit 3, Panel B, demonstrates the intertemporal relationship between REIT and non-REIT stocks, which is much more erratic for this liquidity measure than for the bid–ask spread measure, and the difference may be attributable to the REITs return volatility.

Next, a friction-based, matched sample is considered using the mean time-weighted percentage bid–ask spread as the matching variable. Exhibit 4 reports the activity measure estimates for each of the thirteen half-hour periods in the trading day. The depth measures are consistently larger for REIT stocks, except at the beginning of the trading day. Exhibit 5, Panel A, shows the bid depth levels for both REIT and non-REIT stocks during the trading day. The pattern reveals that REIT stocks exhibit more liquidity except for the first half hour when there is no significant difference between REIT and non-REIT stocks.

For the volume-based liquidity measures, Exhibit 4 reports that REIT stocks have a lower level of liquidity, but this difference is not statistically significant. The U-shaped patterns during the trading day are similar across REITs and non-REITs, but the non-REIT stocks appear to have a larger variation. Exhibit 5, Panel B, reveals that the volume for REIT stocks is consistently below the volume for non-REIT stocks in each half-hour period. Both REITs and non-REITs exhibit a U-shaped volume pattern. As shown in Exhibit 5 Panel C, the dollar volume pattern across the trading day is consistent with volume indicating that the differences in the volume patterns are not caused by differences in the price levels of the two samples of stocks.

The size-based liquidity measures have the largest number of statistically significant differences between REIT and non-REIT stocks, as reported in Exhibit 4. In particular, throughout the trading day, both the dollar value of transactions and the percentage of transactions inside the quoted bid–ask spread are significantly higher for non-REITs than for REITs. As shown in Exhibit 5, Panel D, the percentage of transactions inside the quoted spread for both REITs and non-REITs begins the trading day below 10%. Then non-REIT stocks increase and then remain at a level of approximately 23%, while REIT stocks increase and then remain at a level of 18%. This finding suggests that the lower percentage bid–ask spread (%Spread) of REIT stocks may not be as significant since additional price improvement beyond the quoted spread occurs for non-REIT stocks.

The third matched sample is based on the annual average percentage bid–ask spread and the volume of shares traded. Exhibit 6 reports intraday estimates of liquidity measures. By simultaneously matching on a friction and an activity measure, this procedure ensures that the overall liquidity is similar, but the interest here is in the intraday fluctuation of liquidity. Exhibit 6, Panel A, reveals that even after matching, the REIT stocks have a statistically significant higher percentage bid–ask spread (%Spread) estimate on an overall basis, but no

**Exhibit 4** | Intraday Activity Measure Liquidity Estimates Matched on Friction

|                          |          | 10:00  | 10:30   | 11:00   | 11:30   | 12:00   | 12:30   | 1:00    | 1:30    | 2:00    | 2:30    | 3:00    | 3:30    | 4:00    | Overall |
|--------------------------|----------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Panel A: Depth Measures  |          |        |         |         |         |         |         |         |         |         |         |         |         |         |         |
| AskDepth                 | REIT     | 78.1   | 78.9    | 80.8    | 81.9    | 83.1    | 84.1    | 84.8    | 85.2    | 85.8    | 86.1    | 86.0    | 86.5    | 85.2    | 83.6    |
|                          | Non-REIT | 84.1   | 77.0**  | 77.4*** | 78.3*** | 78.1*** | 79.2*** | 80.0*** | 80.5*** | 81.3*** | 81.7*** | 81.2*** | 81.4*** | 80.9*** | 80.1*** |
| BidDepth                 | REIT     | 78.3   | 79.3    | 82.4    | 83.9    | 85.9    | 86.6    | 87.3    | 87.9    | 88.1    | 88.3    | 88.7    | 87.4    | 86.6    | 85.4    |
|                          | Non-REIT | 84.3   | 79.4*   | 79.8**  | 81.8**  | 82.7**  | 83.2**  | 84.1**  | 85.2**  | 85.6**  | 85.6**  | 86.4**  | 86.1**  | 84.7**  | 83.8*** |
| Panel B: Volume Measures |          |        |         |         |         |         |         |         |         |         |         |         |         |         |         |
| Volume                   | REIT     | 7575   | 5415    | 4984    | 4802    | 4440    | 4026    | 3850    | 3654    | 3713    | 3816    | 4039    | 4422    | 5870    | 4662    |
|                          | Non-REIT | 8987   | 7863    | 7628    | 6666    | 5736    | 5807    | 5241    | 4916    | 4975    | 5469    | 5832    | 6249    | 7870    | 6404    |
| \$Volume                 | REIT     | 160    | 116     | 106     | 100     | 93      | 83      | 80      | 75      | 76      | 77      | 84      | 93      | 128     | 97      |
|                          | Non-REIT | 231    | 210     | 208     | 179     | 151     | 152     | 139*    | 131     | 131     | 146     | 154     | 164     | 208     | 170***  |
| NumberQuote              | REIT     | 4.07   | 3.88    | 3.66    | 3.58    | 4.01    | 3.11    | 2.94    | 2.89    | 3.02    | 3.14    | 3.30    | 3.55    | 3.97    | 3.42    |
|                          | Non-REIT | 4.82   | 5.02    | 4.54    | 4.28    | 4.01    | 3.78    | 3.61    | 3.48    | 3.60    | 3.85    | 4.04    | 4.42    | 4.97    | 4.19    |
| Panel C: Size Measures   |          |        |         |         |         |         |         |         |         |         |         |         |         |         |         |
| Transaction              | REIT     | 1610   | 1551    | 1591    | 1558    | 1511    | 1443    | 1463    | 1456    | 1399    | 1419    | 1374    | 1392    | 1540    | 1485    |
|                          | Non-REIT | 1803   | 1826    | 1668    | 1584    | 1594    | 1707*   | 1709    | 1570    | 1507    | 1529    | 1577    | 1657*   | 1690    | 1648*** |
| \$Transaction            | REIT     | 31     | 30      | 31      | 30      | 39      | 28      | 28      | 27      | 26      | 26      | 26      | 27      | 30      | 28      |
|                          | Non-REIT | 43     | 41*     | 40*     | 38      | 38*     | 40***   | 40**    | 38**    | 36      | 37**    | 38**    | 38***   | 40*     | 39***   |
| %InsideSprd              | REIT     | 6.7    | 17.4    | 17.9    | 18.0    | 17.9    | 17.5    | 18.0    | 17.8    | 17.6    | 17.8    | 18.2    | 18.1    | 18.1    | 17.0    |
|                          | Non-REIT | 9.4*** | 22.1*** | 22.7*** | 22.3*** | 21.9*** | 21.7*** | 21.9*** | 22.4*** | 23.6*** | 22.4*** | 23.1*** | 22.4*** | 22.7*** | 21.4*** |

Notes: Estimates of the eight activity liquidity measures defined in Exhibit 1 are made for REIT and non-REIT stocks during 1996. The non-REIT stocks are matched based on the time weighted average bid-ask spread for the year. Estimates based on quotes are averaged across time, while estimates based on transactions are averaged across transaction size. Tests of difference between REIT and non-REIT means are based on a non-parametric Wilcoxon Rank Sums test.

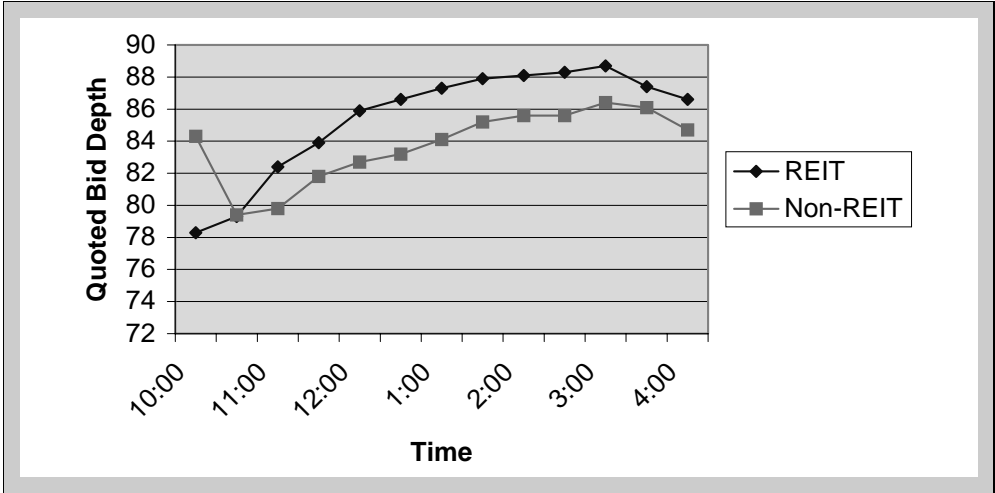
\*Significant at  $\alpha = 10\%$ .

\*\*Significant at  $\alpha = 5\%$ .

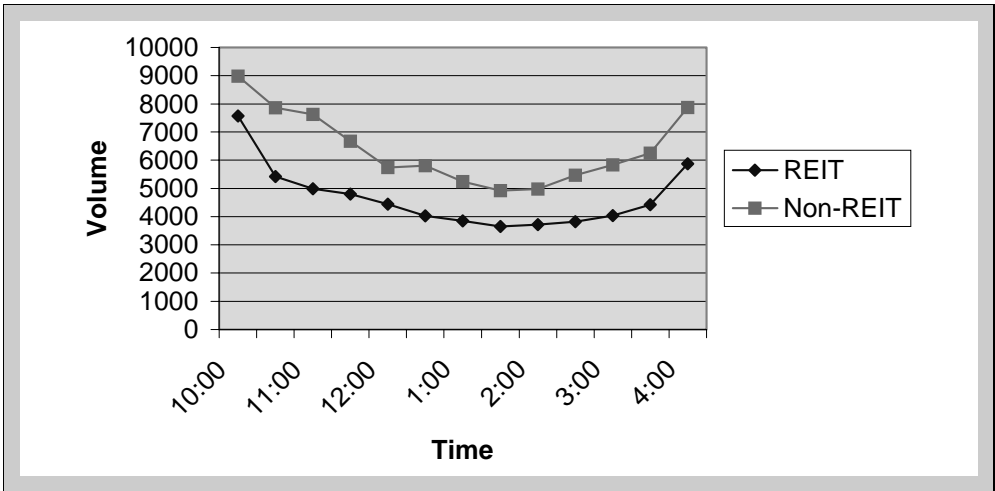
\*\*\*Significant at  $\alpha = 1\%$ .

**Exhibit 5** | Activity Measures During the Day for REIT and Non-REIT Firms Matched on Percentage Bid-Ask Spread

**Panel A: Quoted Bid Depth**



**Panel B: Volume**

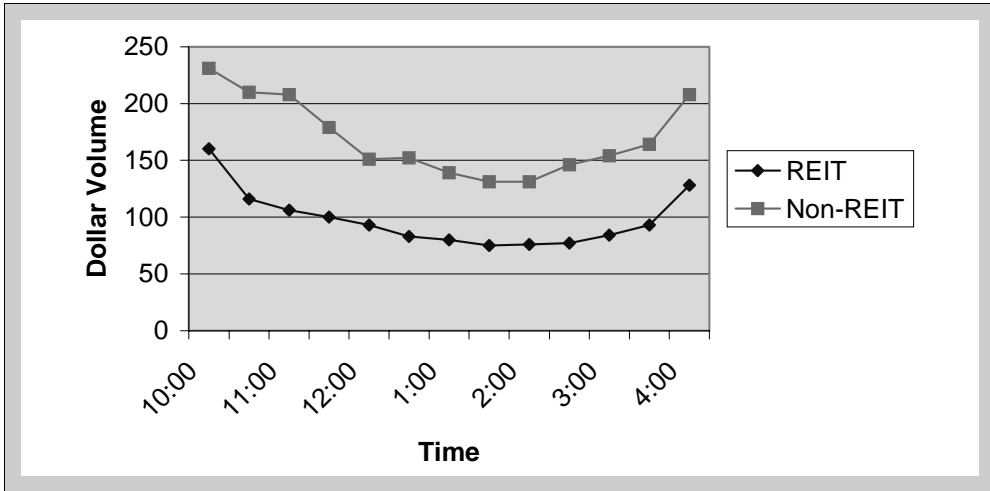


statistical difference exists in any of the half-hour sub-periods. Exhibit 7, Panel A, illustrates the similarity of the U-shaped pattern for both REIT and non-REIT stocks. Further inspection of Exhibit 6, Panel A, indicates that with a single exception, no statistical differences exist in the sub-periods for the other two friction measures. The price measure (HiLo), and the return measure (IntraVar), are both marginally higher for non-REIT firms on an overall basis.

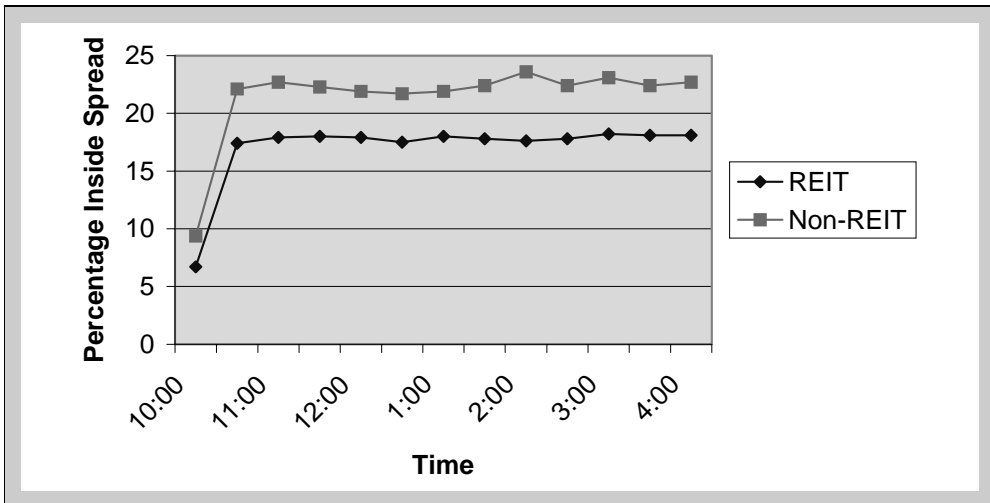
**Exhibit 5** | (continued)

Activity Measures During the Day for REIT and Non-REIT Firms Matched on Percentage Bid-Ask Spread

**Panel C: Dollar Volume**



**Panel D: Percentage Inside Spread**



*Note:* The 127 REIT firms are matched with non-REIT common stocks based on the time-weighted percentage bid-ask spread in 1996. The dollar volume and percentage of trades inside the quoted bid-ask spread are measured over half-hour intervals during the trading day and reported across all stocks in each category.

**Exhibit 6** | Intraday Liquidity Estimates Matched on Friction and Activity

|                            |          | 10:00   | 10:30 | 11:00 | 11:30 | 12:00 | 12:30 | 1:00  | 1:30  | 2:00  | 2:30  | 3:00  | 3:30  | 4:00  | Overall  |
|----------------------------|----------|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----------|
| Panel A: Friction Measures |          |         |       |       |       |       |       |       |       |       |       |       |       |       |          |
| Bid-Ask Spread Measure     |          |         |       |       |       |       |       |       |       |       |       |       |       |       |          |
| %Spread                    | REIT     | 1.86    | 1.62  | 1.55  | 1.54  | 1.49  | 1.41  | 1.35  | 1.33  | 1.40  | 1.44  | 1.52  | 1.63  | 1.83  | 1.54     |
|                            | Non-REIT | 1.77    | 1.62  | 1.51  | 1.42  | 1.37  | 1.30  | 1.26  | 1.24  | 1.26* | 1.33  | 1.39  | 1.51  | 1.78  | 1.44***  |
| Price Measure              |          |         |       |       |       |       |       |       |       |       |       |       |       |       |          |
| HiLo                       | REIT     | 0.067   | 0.051 | 0.048 | 0.048 | 0.046 | 0.040 | 0.038 | 0.036 | 0.039 | 0.042 | 0.045 | 0.051 | 0.062 | 0.047    |
|                            | Non-REIT | 0.086** | 0.064 | 0.057 | 0.054 | 0.052 | 0.047 | 0.042 | 0.040 | 0.043 | 0.047 | 0.052 | 0.053 | 0.065 | 0.054*   |
| Return Measure             |          |         |       |       |       |       |       |       |       |       |       |       |       |       |          |
| IntraVar                   | REIT     | 0.075   | 0.069 | 0.139 | 0.131 | 0.169 | 0.114 | 0.095 | 0.188 | 0.138 | 0.058 | 0.097 | 0.177 | 0.115 | 0.120    |
|                            | Non-REIT | 0.224   | 0.113 | 0.122 | 0.150 | 0.154 | 0.122 | 0.130 | 0.134 | 0.096 | 0.131 | 0.112 | 0.128 | 0.116 | 0.122*** |
| Panel B: Activity Measures |          |         |       |       |       |       |       |       |       |       |       |       |       |       |          |
| Depth Measures             |          |         |       |       |       |       |       |       |       |       |       |       |       |       |          |
| AskDepth                   | REIT     | 78.1    | 78.9  | 80.8  | 81.9  | 83.1  | 84.1  | 84.8  | 85.2  | 85.8  | 86.1  | 86.0  | 86.5  | 85.2  | 83.6     |
|                            | Non-REIT | 92.5    | 97.6  | 102.4 | 104.8 | 106.4 | 107.6 | 108.6 | 108.4 | 108.5 | 109.4 | 109.7 | 109.7 | 109.5 | 105.8*** |
| BidDepth                   | REIT     | 78.3    | 79.3  | 82.4  | 83.9  | 85.9  | 86.6  | 87.3  | 87.9  | 88.1  | 88.3  | 88.7  | 87.4  | 86.6  | 85.4     |
|                            | Non-REIT | 98.7    | 104.1 | 108.9 | 112.1 | 114.4 | 116.3 | 117.4 | 118.8 | 119.6 | 120.1 | 119.9 | 120.5 | 119.7 | 114.7**  |
| Volume Measures            |          |         |       |       |       |       |       |       |       |       |       |       |       |       |          |
| Volume                     | REIT     | 7575    | 5415  | 4984  | 4802  | 4440  | 4026  | 3850  | 3654  | 3713  | 3816  | 4039  | 4422  | 5870  | 4662     |
|                            | Non-REIT | 7797    | 6970  | 6069  | 5304  | 5186  | 4898* | 4400* | 4406* | 4469  | 4607  | 4610  | 5169  | 5725  | 5341***  |
| \$Volume                   | REIT     | 160     | 116   | 106   | 100   | 93    | 83    | 80    | 75    | 76    | 77    | 84    | 93    | 128   | 97       |
|                            | Non-REIT | 205     | 190   | 165   | 149   | 141*  | 134*  | 126** | 127** | 125*  | 131*  | 139*  | 149   | 163   | 150***   |

**Exhibit 6** | (continued)

Intraday Liquidity Estimates Matched on Friction and Activity

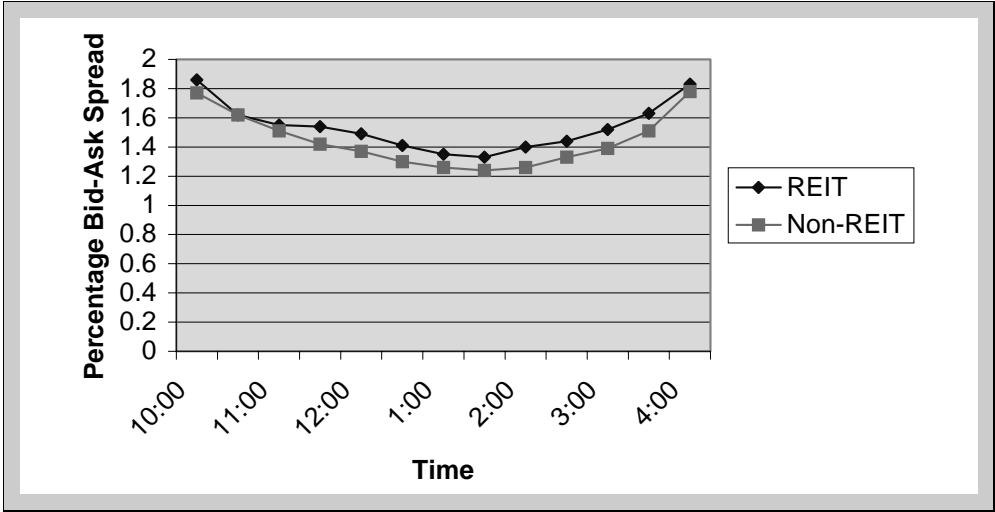
|                                        |          | 10:00  | 10:30  | 11:00  | 11:30  | 12:00   | 12:30   | 1:00    | 1:30    | 2:00   | 2:30   | 3:00    | 3:30    | 4:00    | Overall |
|----------------------------------------|----------|--------|--------|--------|--------|---------|---------|---------|---------|--------|--------|---------|---------|---------|---------|
| Panel B: Activity Measures (continued) |          |        |        |        |        |         |         |         |         |        |        |         |         |         |         |
| NumberQuote                            | REIT     | 4.07   | 3.88   | 3.66   | 3.58   | 4.01    | 3.11    | 2.94    | 2.89    | 3.02   | 3.14   | 3.30    | 3.55    | 3.97    | 3.42    |
|                                        | Non-REIT | 4.10   | 4.21   | 3.88   | 3.64   | 3.45    | 3.22    | 3.06    | 3.00    | 3.09   | 3.27   | 3.43    | 3.69    | 4.15    | 3.55**  |
| Size Measures                          |          |        |        |        |        |         |         |         |         |        |        |         |         |         |         |
| Transaction                            | REIT     | 1610   | 1551   | 1591   | 1558   | 1511    | 1443    | 1463    | 1456    | 1399   | 1419   | 1374    | 1392    | 1540    | 1485    |
|                                        | Non-REIT | 1992** | 1834*  | 1815*  | 1704   | 1796*   | 1676*** | 1778*** | 1785**  | 1738** | 1696** | 1607*** | 1727*** | 1718**  | 1759*** |
| \$Transaction                          | REIT     | 31     | 30     | 31     | 30     | 39      | 28      | 28      | 27      | 26     | 26     | 26      | 27      | 30      | 28      |
|                                        | Non-REIT | 46***  | 43***  | 42**   | 40**   | 42***   | 40***   | 44***   | 42***   | 41***  | 40***  | 40***   | 41***   | 40***   | 42***   |
| %InsideSprd                            | REIT     | 6.7    | 17.4   | 17.9   | 18.0   | 17.9    | 17.5    | 18.0    | 17.8    | 17.6   | 17.8   | 18.2    | 18.1    | 18.1    | 17.0    |
|                                        | Non-REIT | 8.2*   | 20.1** | 20.9** | 21.4** | 21.3*** | 20.7**  | 21.4**  | 21.6*** | 21.0** | 20.8** | 21.0**  | 22.1*** | 21.8*** | 20.2*** |

Notes: Estimates of the 11 liquidity measures defined in Exhibit 1 are made for REIT and non-REIT stocks during 1996. The non-REIT stocks are matched based on total volume for the year and the time-weighted average bid-ask spread for the year. Estimates based on quotes are averaged across time, while estimates based on transactions are averaged across transaction size. Panel A reports estimates for friction measures, while Panel B reports estimates for Activity Measures. Tests of difference between REIT and non-REIT means are based on a non-parametric Wilcoxon Rank Sums test.

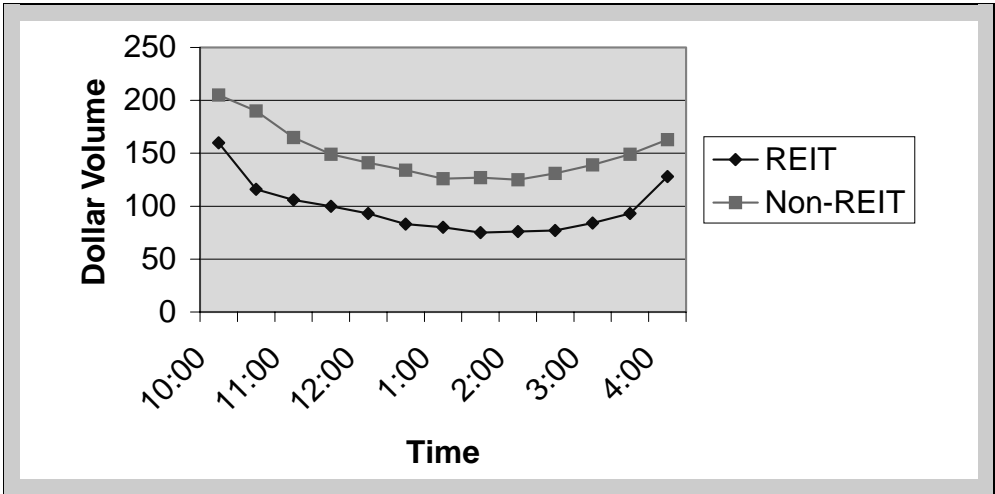
- \* Significant at  $\alpha = 10\%$ .
- \*\* Significant at  $\alpha = 5\%$ .
- \*\*\* Significant at  $\alpha = 1\%$ .

**Exhibit 7** | Friction and Activity Measures During the Day for REIT and Non-REIT Firms  
Matched on Two Dimensions

**Panel A: Percentage Bid-Ask Spread**



**Panel B: Dollar Volume**



Note: The 127 REIT firms are matched with non-REIT common stocks based on the mean percentage bid-ask spread in 1996 and the volume of trading during the year. The percentage bid-ask spread and volume are measured over half-hour intervals during the trading day and reported across all stocks in each category.



Exhibit 6, Panel B, reports the estimates for the activity measures and reveals more statistically significant differences between REIT and non-REIT firms, especially for the size-based liquidity measure. Differences between the depth measures are only significant on an overall basis with the non-REIT stocks having a much higher depth measure. Volume-based measures exhibit some statistical differences during the middle of the trading day, where the dollar volume traded is significantly larger for non-REIT firms. As shown in Exhibit 7, Panel B, the dollar-volume pattern throughout the trading day is U-shaped for both REIT and non-REIT stocks with the pattern for REIT stocks consistently below that for the non-REIT stocks.

The size measures indicate the most significant differences between REIT and non-REIT stocks across the intraday sub-periods and on an overall basis. The transaction size (Transaction) and transaction value (\$Transaction) are consistently larger for non-REIT firms, while the percentage of transactions inside the quoted bid-ask spread is larger for non-REIT firms throughout the trading day. This indicates that individual trades are smaller for REITs and therefore similarly sized transactions may have a larger impact on REIT stocks, implying less liquidity.

From an economic perspective, these differences suggest that it is easier to trade non-REITs without further influencing prices. To further quantify these differences, non-REIT purchase transactions could be 27% larger (105.8 vs. 83.6 ask depth), while non-REIT sale transactions could be 34.3% larger (114.7 vs. 85.4 bid depth) before the depth is exhausted and prices move beyond the quoted spreads. If the volume measures are used, then non-REITs' volume is 15% larger (5,341 vs. 4,662 volume) on average, consistent with the larger depths for non-REITs.

Transactions in REITs are more costly to implement as well. On an overall basis, the price for immediacy is 7% higher for REITs than for non-REITs (1.54% vs. 1.44%). In addition, the intraday pattern varies during the trading day. For REITs, immediacy costs at the beginning of the trading day are 40% higher than at the lowest point in the trading day (1.86% vs. 1.33%). This finding suggests that choosing the time of day to transact in REITs is important to minimize trading costs. Consistent with these economic findings, the trade size for REITs is smaller than the trade size for non-REITs.

To confirm the simple statistics, multivariate regression tests are also performed on each of the three matched samples using the liquidity measures individually as the dependent variable. The analysis employs a series of indicator variables for each half-hour period, as well as an indicator variable to identify the REIT stocks. The cross product of the REIT indicator variable and the individual half-hour trading period indicator variables are also used to capture intraday variation in the data. Exhibit 8 reports the coefficient estimates for the REIT indicator variable in each of the regressions, where the matching of the samples is based on volume, percentage bid-ask spread, and both spread and volume, respectively.

**Exhibit 8** | Multivariate Regression Tests

| Liquidity Measure | Matched on Volume     | Matched on Percentage Bid-Ask Spread | Matched on Percentage Bid-Ask Spread and Volume |
|-------------------|-----------------------|--------------------------------------|-------------------------------------------------|
| %Spread           | -0.1676**<br>(0.07)   | 0.0030<br>(0.06)                     | 0.0668<br>(0.06)                                |
| HiLo              | -1041.7<br>(661.98)   | -782.50*<br>(457.23)                 | -465.59<br>(427.57)                             |
| IntraVar          | -0.0199<br>(0.66)     | 0.5616<br>(0.52)                     | -0.3490<br>(0.74)                               |
| AskDepth          | -6.881<br>(14.42)     | 4.403<br>(13.50)                     | -23.713<br>(16.57)                              |
| BidDepth          | -3.413<br>(14.43)     | 2.858<br>(14.33)                     | -30.114*<br>(17.67)                             |
| Volume            | -1013.4<br>(1115.1)   | -1390.7<br>(1133.6)                  | -550.2<br>(996.5)                               |
| \$Volume          | -1932.7<br>(26720)    | -59705*<br>(30988)                   | -46552<br>(30915)                               |
| NumberQuote       | -0.4728<br>(0.30)     | -0.6855*<br>(0.38)                   | -0.1206<br>(0.30)                               |
| Transaction       | -268.55**<br>(136.05) | -246.17*<br>(135.32)                 | -315.12**<br>(131.74)                           |
| \$Transaction     | -5013<br>(3207)       | -12249***<br>(3445)                  | -16811***<br>(3951)                             |
| %InsideSpread     | -0.0276**<br>(0.01)   | -0.0390***<br>(0.01)                 | -0.0336**<br>(0.01)                             |

Notes: Each of the liquidity measures in Exhibit 1, column 1, is used as the dependent variable in a separate regression (11 in all). Each regression includes indicator variables for 12 of the 13 different 30 minute periods, an indicator variable that is 1 if the stock is a REIT and an interactive indicator variable for each 30 minute time period that is 1 if the stock is a REIT. The coefficient for the REIT indicator variable is reported along with the standard deviation (below it in parentheses) and the *t*-Stat significance as a superscript. The regressions are calculated using each of the three different matched samples.

\*Significant at  $\alpha = 10\%$ .  
\*\*Significant at  $\alpha = 5\%$ .  
\*\*\*Significant at  $\alpha = 1\%$ .

As revealed in Exhibit 8, first column, the first series of regressions (matched on volume) result in statistical significance for the REIT indicator variable in three of the eleven regressions. When the percentage bid-ask spread (%Spread) is the dependent variable, REIT firms have a significantly smaller percentage bid-ask spread. With both mean transaction size and the percentage of transactions that

occur inside the quoted bid–ask spread (%InsideSpread) as the dependent variable, the REIT indicator coefficient estimate is negative, indicating that REIT stocks typically have smaller transaction sizes and a lower percentage of trades inside the spread. These regression results confirm the earlier statistical findings that REIT stocks exhibit lower levels of liquidity.

For the second series of regressions (second column matched on the percentage bid–ask spread), two regressions (out of eleven) reveal statistical significance on the REIT indicator variable. Exhibit 8 reports that the average dollar value of each transaction (\$Transaction) and the percentage of trades within the quoted bid–ask spread (%InsideSpread) are lower for REIT stocks. Marginally significant differences between REIT and non-REIT stocks are present in four other regressions as well. The range of the transaction prices (HiLo) is smaller for REIT stocks, while three activity measures, the dollar volume (\$Volume), the number of quotes (NumberQuote) and the transaction size (Transaction) all indicate that REIT stocks have lower levels of liquidity.

Finally, the third series of regressions (third column, matched on friction and activity) indicates four regressions out of eleven, where the coefficient estimate of the REIT indicator variable is statistically significant. The depth of the bid quotes (BidDepth), transaction size (Transaction), dollar value of average transaction (\$Transaction) and percentage of transactions inside the bid–ask spread (%InsideSpread) all have negative coefficients indicating that the REIT stocks have lower liquidity. These findings once more confirm the earlier results. Overall, the results are generally consistent with Below, Kiely and McIntosh (1995) and Downs, Guner and Patterson (2001) that report decreased liquidity for REIT stocks. Interestingly, the lower level of transactions inside the quoted spread (%InsideSpread) for REITs suggests that proxies that use quotes may be more overstated for non-REITs, making comparisons difficult.

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## Conclusion

This study documents differences in the intraday pattern in liquidity between publicly traded REIT and non-REIT stocks. The findings indicate that REIT stocks with similar activity measures as non-REIT stocks have higher friction measures (lower liquidity). The REIT stocks with similar friction measures as the non-REIT stocks have mixed results with mostly lower activity levels (lower liquidity). The exception is depth levels with some higher estimates for REITs, most notably after the beginning of the trading day.

The pattern in activity measures indicates that the first half hour of trading is especially important for liquidity purposes confirming theoretical arguments that the period around the open of trading may encourage trading because of higher volume. REIT stocks have much lower return measures during the first hour of trading, before increasing during the rest of the trading day. In contrast, non-REIT return measures are much higher during the first hour and then decline during the

rest of the trading day. A decline in the friction measure for non-REITs is consistent with market makers/specialists trying to encourage trading during this low volume period.

On an economic basis, the findings have strong implications for traders. First, if a large amount of REIT stock is going to be traded, then the order should be split up to ensure that the large transaction sizes do not change prices. This price impact problem is more severe for REITs than for common non-REIT stocks due to the lower liquidity in the former. Second, if the trader has flexibility in the timing of the transaction, then it is preferable to trade REIT stocks during the first hour after the open. A higher level of liquidity will then accommodate the trader without a commensurate increase in friction costs. Non-REIT traders may be better off waiting until the friction costs decline later in the day.

Traders more frequently improve prices beyond the quoted bid–ask spread when trading non-REITs compared with REITs. This difference in the percentage of transactions within the bid–ask spread is due to less aggressive traders in REITs or less responsive specialists in these stocks. Thus, any comparisons using quotes may not capture the better prices that are obtained especially in non-REIT stocks. This lower level of price improvement suggests that REIT traders have to be more responsive to liquidity changes during the day. Friction costs (immediacy costs) are observed that vary by 40% throughout the trading day.

The results indicate that liquidity differences exist between REITs and non-REITs, and investors' concerns about liquidity may hamper the substitutability of REITs and non-REITs. While the asset pricing literature indicates liquidity may be priced, the method of incorporation has not yet been discovered. The findings are still important as the specific aspect of liquidity that is relevant for each investor can be used to determine the suitability and attraction of REIT investments.

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## Endnotes

- <sup>1</sup> This figure was 95% during the year when the data for this study was generated.
- <sup>2</sup> See Brennan and Subrahmanyam (1996).
- <sup>3</sup> A recent *Wall Street Journal* article refers to a Morgan Stanley study that finds those REITs included in the Standard and Poor's 500 Index are more volatile and more highly correlated with the overall market than before they were included in the Index.
- <sup>4</sup> O'Hara (1997:217) defines common stock liquidity as the "accommodation of trading with the least effect on price."
- <sup>5</sup> Jones, Kaul and Lipson (1994) suggest information asymmetry is better measured by number of transactions. Barclay and Warner's (1993) stealth trading explanation also suggests that volume alone is not sufficient as a gauge of activity since informed traders will hide large trades by splitting them up.

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## References

- Admati, A. R. and P. Pfleiderer, A Theory of Intraday Patterns: Volume and Price Variability, *Review of Financial Studies*, 1988, 1, 3–40.
- Barclay, M. J., E. Kandel and L. Marx, The Effects of Transaction Costs on Stock Prices and Trading Volume, *Journal of Financial Intermediation*, 1998, 7, 130–50.
- Barclay, M. J. and J. B. Warner, Stealth Trading and Volatility: Which Trades Move Prices?, *Journal of Financial Economics*, 1993, 34, 281–305.
- Below, S. D., J. K. Kiely and W. McIntosh, An Examination of Informed Traders and the Market Microstructure of Real Estate Investment Trusts, *Journal of Real Estate Research*, 1995, 10, 335–61.
- Below, S. D., J. K. Kiely and W. McIntosh, REIT Pricing Efficiency; Should Investors Still Be Concerned?, *Journal of Real Estate Research*, 1996, 12, 397–412.
- Bhasin, V., R. A. Cole and J. K. Kiely, Changes in REIT Liquidity 1990–1994: Evidence from Intra-day Transactions, *Real Estate Economics*, 1997, 25, 615–30.
- Brennan, M. J. and A. Subrahmanyam, Market Microstructure and Asset Pricing: On the Compensation For Illiquidity in Stock Returns, *Journal of Financial Economics*, 1996, 41, 441–64.
- Brock, W. A. and A. W. Kleidon, Periodic Market Closure and Trading Volume: A Model of Intraday Bids and Asks, *Journal of Economic Dynamics and Control*, 1992, 16, 451–89.
- Chan, S. H., W. K. Leung and K. Wang, Institutional Investment in REITs: Evidence and Implications, *Journal of Real Estate Research*, 1998, 16, 357–74.
- Clayton, J. and G. MacKinnon, Measuring Changes in REIT Liquidity: Moving Beyond the Bid/Ask Spread, *Real Estate Economics*, 2000, 28, 89–115.
- Danielsen, B. R. and D. M. Harrison, The Impact of Potential Private Information on REIT Liquidity, *Journal of Real Estate Research*, 2000, 19, 49–71.
- Demsetz, H., The Cost of Transacting, *Quarterly Journal of Economics*, 1968, 82, 33–53.
- Downs, D. H., Z. N. Guner, D. J. Hartzell and M. A. Torres, Why Do REIT Prices Change? The Information Content of Barron's 'The Ground Floor,' *Journal of Real Estate Finance and Economics*, 2001, 22, 63–80.
- Downs, D. H. and Z. N. Guner, Investment Analysis, Price Formation and Neglected Firms: Does Real Estate Make A Difference?, *Real Estate Economics*, 2000, 28, 549–79.
- Foster, F. D. and S. Viswanathan, Variations in Trading Volume, Return Volatility, and Trading Costs, *Journal of Finance*, 1993, 48, 187–211.
- Ghosh, C., M. Miles and C. F. Sirmans, Are REITs Stocks?, *Real Estate Finance*, 1996, 13, 46–53.
- Grossman, S. J. and M. H. Miller, Liquidity and Market Structure, *Journal of Finance*, 1988, 43, 617–33.
- Jain, P. C. and G-H. Joh, The Dependence Between Hourly Prices and Trading Volume, *Journal of Financial and Quantitative Analysis*, 1988, 33, 269–83.
- Jones, C. M., G. Kaul and M. L. Lipson, Information, Trading, and Volatility, *Journal of Financial Economics*, 1994, 36, 127–54.
- Kavajecz, K. A., The Specialist's Quoted Depth and the Limit Order Book, *Journal of Finance*, 1999, 54, 747–71.

Lee, C. M. C., B. Mucklow and M. J. Ready, Spreads, Depths and the Impact of Earnings Information: An Intraday Analysis, *Review of Financial Studies*, 1993, 6, 345–74.

Nelling, E. F., J. M. Mahoney, T. L. Hildebrand and M. A. Goldstein, Real Estate Investment Trusts, Small Stocks and Bid–Ask Spreads, *Real Estate Economics*, 1995, 23, 45–64.

O’Hara, M., *Market Microstructure Theory*, Blackwell Publishers, 1997.

Stoll, H., Friction, *Journal of Finance*, 2000, 55, 1479–1514.

Wang, K., J. Erickson, G. Gau and S. H. Chan, Market Microstructure and Real Estate Returns, *Real Estate Economics*, 1995, 23, 85–100.

Wei, P. H., Intraday Variations in Trading Activity, Price Variability, and the Bid–Ask Spread, *Journal of Financial Research*, 1992, 15, 265–76.

Wood, R. A., T. H. McNish and J. K. Ord, An Investigation of Transactions Data for NYSE Stocks, *Journal of Finance*, 1985, 40, 723–39.

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