The Cross Section of Over-the-Counter Equities

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Abstract

We analyze the cross section of stock returns of firms traded on the over-the-counter (OTC) bulletin board and pink sheets markets. We test whether well-known return patterns in stocks listed on the three major United States exchanges generalize to the less liquid stocks in OTC markets. We find that the illiquidity premium is much higher in OTC markets than in listed markets. The return premiums associated with small stocks and value stocks in listed markets also appear in OTC markets, but the premiums for return momentum and idiosyncratic volatility for OTC stocks are weak. There are modest correlations between systematic factors in returns and liquidity in OTC and listed markets, suggesting that these markets are partially segmented.

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Hundreds of studies analyze the cross section of returns for stocks traded on the New York Stock Exchange (NYSE), Nasdaq, and American Stock Exchange (AMEX), which we refer to as "listed" stocks. Because these listed markets are the largest and most liquid in the world, they merit special attention. In contrast, little is known about return patterns and the relation between firms' characteristics and average stock returns in illiquid stock markets. In this paper, we provide a unique, comprehensive comparison of the cross section of stock returns and liquidity in over-the-counter (OTC) markets to the cross section of listed markets.

Studying the OTC markets broadens our understanding of asset pricing in several important ways. First, we can measure liquidity premiums in US markets that are, in general, much less liquid than the listed markets. The OTC stocks that we examine are traded on the over-the-counter bulletin board (OTCBB) or pink sheets (PS) markets. At least one licensed broker-dealer agrees to make a market in each OTC stock, much like a listed stock. However, most OTC stocks are smaller and much less liquid than listed stocks, which makes OTC equity markets well suited to investigate return premiums for illiquidity.

Second, a comparison of similarities and differences across OTC and listed markets can shed light on the source of well-known cross-sectional return premiums in listed markets, such as the "momentum" premium for stocks with high returns during the past year. Whereas companies on listed stock markets must file regular financial disclosures, disclosure requirements for companies traded in OTC markets are minimal or non-existent. Because some theories designed to explain the cross-sectional return premiums in listed markets depend on how firms disclose and disseminate information, we can evaluate these theories using evidence from opaque markets without efficient news transmission. Similarly, some theories of asset pricing rely on the behavior of retail clientele. The clientele of OTC stocks is mostly individuals, as many

institutions shun OTC equity markets because of their poor disclosure requirements and low liquidity. If retail trading is the source of a cross-sectional return patterns, these patterns should be stronger in OTC markets.

Third, a cross-sectional return premium that exists in both OTC and listed markets is more likely to persist in the future. A return premium that appears only in listed markets must be sensitive to either specific features of the listed market environment or the particular return realizations in the listed historical data. Such a return premium is less likely due to a systematic risk or is sensitive to market structure or participants, which make the return premiums more fragile.

Our goal is to investigate the ability of firm characteristics to predict stock returns in OTC stock markets and contrast that predictability with the corresponding cross-sectional effects in comparable listed stocks. To control for the most obvious differences between the two markets, we study a subset of "comparable" listed stocks with market capitalizations that are similar to the typical OTC stock. We devote special attention to measuring illiquidity premiums in OTC markets because of the illiquid nature of the OTCBB and PS markets. We analyze the well-known return premiums for stocks with low market capitalizations ("size"), high ratios of book equity to market equity ("value"), low idiosyncratic volatility ("volatility"), and high momentum. We also examine contemporaneous and lagged correlations between OTC return factors and listed return factors to determine if OTC markets are partially segmented.

We find that the return premium for illiquid stocks is much higher in OTC markets than in listed markets, whether we measure liquidity using the fraction of days with no trading, Amihud's (2002) illiquidity ratio, or simply trading volume. Interestingly, the return premiums for size and value are similar in OTC markets and comparable listed markets. By contrast, the

return premiums for momentum and volatility are much smaller in OTC markets than in listed markets. Multifactor models augmented with additional listed and OTC factors cannot explain the large illiquidity, size, and value return premiums in OTC markets.

Of these findings, the large return premium for illiquid OTC stocks is particularly notable. Studies by Amihud and Mendelson (1986),Pastor and Stambaugh (2003), and Hasbrouck (2009) show that the least liquid listed stocks have higher returns than the most liquid listed stocks. Because some OTC stocks are extremely illiquid, we use the probability that a stock does not trade (*PNT*) as a key measure of liquidity. Sorting OTC and listed stocks into *PNT* quintiles, we find that an illiquidity factor for OTC stocks returns 21.5% per year, whereas the illiquidity premium for comparable listed stocks is just 1.7% per year. For this comparison and most others we scale the long and short positions in OTC portfolio to match the volatility of the listed factor. The annual Sharpe ratio of the OTC *PNT* factor at 1.16 is an order of magnitude higher than the Sharpe ratio of the listed *PNT* factor at 0.09. The average returns and Sharpe ratio of the listed Pastor-Stambaugh (2003) illiquidity factor—6.0% per year and 0.51, respectively—are more comparable to the corresponding OTC illiquidity factor returns but are still significantly lower than OTC illiquidity premiums.[1]

Our evidence on liquidity and expected returns complements the results in Bekaert, Harvey, and Lundblad's (2007) study of emerging markets. Using a model that assumes market segmentation, they find that local liquidity risk has a significantly positive return premium of 27 basis points (bps) per month or 3.2% per year. Although analyses of emerging markets are informative and interesting in their own right, there are several advantages to using data on OTC stocks. First, we do not rely on indirect measures of liquidity such as the proportion of days with

[1] Our results are similar using a liquidity factor based on the effective trading cost measure in Hasbrouck (2009). The average returns and Sharpe ratio of this factor are 8.1% per year and 0.52 in the comparable listed sample.

zero returns, introduced by Lesmond et al. (1999), because we have data on daily volume for most of our sample. Second, our time series is three times longer than the 11-year sample in Bekaert, Harvey, and Lundblad (2007), allowing for more precise inferences. Third, there is no geographical, currency, or investor segmentation in US OTC markets; we select common stocks incorporated in the US for both our OTC and listed equity samples. Furthermore, while companies can choose whether or not to list on the NYSE, Nasdaq, or Amex exchanges, companies typically cannot prevent their shares from being traded on OTC venues.

There are relatively few studies analyzing stock pricing in OTC markets and even fewer investigating the degree of segmentation between OTC and listed markets. Previous research on OTC markets can be grouped into two categories: those studying aspects of market quality and those analyzing market manipulation. An example of the former is Bollen and Christie (2009), who document interesting features of OTC stock microstructure such as transactions and quotes patterns of firms traded on the PS in 2004 and 2005. They classify PS stocks into four groups: distressed securities moving from listed markets to PS, microcap or penny stocks, tightly held and infrequently traded stocks, and American Depository Receipts (ADRs). They note that stocks can trade simultaneously on PS, OTCBB, and one of the listed exchanges. Our sample excludes ADRs, which Bollen and Christie show have the most similar trading characteristics to listed stocks, and stocks concurrently traded on listed markets. Thus, our OTC universe is as different from the listed stock universe as one can consider.

Two other recent studies on OTC stock liquidity examine how liquidity changes for stocks moving from listed stock markets to the OTC markets. Harris, Panchapagesan, and Werner (2008) show that volume falls by two-thirds, quoted bid-ask spreads double, and effective spreads triple for firms that are delisted from Nasdaq in 1999 to 2002 and subsequently

trade on OTC markets. Macey, O'Hara, and Pompilio (2008) also find higher spreads for most of the 58 NYSE stocks moving to OTC markets in 2002. Both studies either examine fewer than 100 firms or only a few years of data. In contrast, we analyze cross-sectional return predictability at the monthly horizon for 6,909 OTC firms from 1977 to 2008.

Because OTC markets are subject to few regulatory and information disclosure requirements, OTCBB and PS markets are good environments for studying price manipulation. Böhme and Holz (2006) and Frieder and Zittrain (2007) show that OTC stocks are more likely to be involved in pump and dump schemes. Aggarwal and Wu (2006) find that OTC stocks account for 78 of 142 cases of stock market manipulation pursued by the US Securities and Exchange Commission (SEC) between 1989 and 2001. Based on this evidence, many investors view OTC markets as the "wild west" of securities markets (Bollen and Christie, 2009). This low regulatory protection and poor information disclosure makes the question of which return predictability patterns generalize from listed markets to such environments very interesting.[2]

The study most similar to ours is the contemporaneous and complementary study by Eraker and Ready (2010), who investigate the aggregate returns of OTC stocks and find the OTC market return to be negative, on average. Although we use the OTC market return as a factor in some of our tests, our focus is on the cross section of OTC returns, which Eraker and Ready do not examine. We are especially interested in OTC versus listed liquidity premiums and also compare and contrast the OTC cross-sectional return patterns with listed stock markets.

We organize the rest of this paper as follows. Section I provides additional institutional background on OTC markets and describes our data on OTC firms. Section II defines the key variables, such as OTC stock liquidity, used in the statistical analyses. Section III presents our

[2] We use minimum size and volume filters to minimize the probability that pump and dump schemes affect stocks in our sample.

main cross-sectional regressions in which we use known predictors of returns in listed markets to predict returns in OTC markets. Section IV presents time series analyses of the returns on long-short calendar time portfolios formed based on characteristics of OTC firms, such as size and liquidity. Section V quantifies the degree of OTC and listed market segmentation. We discuss our results and conclude in Section VI.

I. OTC Market Data

A. Institutional Details

Our data consist of United States common stocks traded in the OTCBB and PS markets from 1975 through 2008. We obtain this data through MarketQA, which is a data analytics platform from Thomson-Reuters. The OTCBB and PS markets are regulated by the Financial Industry Regulatory Authority (FINRA), formerly the National Association of Securities Dealers (NASD), and the SEC to enhance market transparency, fairness, and integrity. For most of our sample, the defining requirement of an OTC stock is that at least one FINRA (formerly NASD) member must be willing to act as a market maker for the stock.

As of June 11, 2010, over 211 FINRA firms were market makers in OTCBB and PS stocks, facilitating daily trading activity of $395 million ($100 billion annualized). The most active firms, such as Archipelago Trading Services and Knight Equity Markets, are also market makers in stocks listed on the Nasdaq and are SEC-registered broker-dealers. FINRA requires market makers to trade at their publicly displayed quotations. Other FINRA rules guarantee best execution of customer orders, guard against front-running of customer orders, ensure accurate and timely trade reporting, and require disclosure of short interest positions.

Prior to 2000, there were almost no formal financial disclosure requirements for firms traded on the OTCBB and PS. FINRA and SEC regulation of these markets, however, has increased substantially in the past 10 years. After June 2000, firms listed on the OTCBB must have at least 100 shareholders, file annual reports, hold annual shareholder meetings, and meet other governance requirements. The disclosure requirements for PS firms are not as strict. After August 2007, the firm displaying quotations—Pink OTC Markets Inc.—began providing incentives for traded firms to provide timely financial information to the Pink Sheets News Service. A byproduct of the minimal formal requirements is that firms traded on the OTCBB and Pink Sheets are very heterogeneous. Some are large, liquid, and transparent firms, while others are small, thinly traded, and so-called "dark" firms that have not provided any financial information to the Pink Sheets News Service in the past six months.

The majority of investors in the firms traded exclusively on OTC markets are individuals because SEC rules prevent most institutions from holding unlisted stocks. We define listed stocks as those meeting listing requirements of the NYSE, Nasdaq, or AMEX exchanges. The disclosures at the web site for Pink OTC Markets Inc. (www.otcmarkets.com) offer insights into the probable investor clientele in OTC stocks:

> "The OTC market presents investment opportunities for intelligent, informed investors, but also has a high degree of risk. ... Unsophisticated or passive investors should completely avoid the OTC markets."

Most full service and discount brokerages allow individual investors to trade in OTCBB and PS stocks, including Ameritrade, E-Trade, Fidelity, and Scottrade..

B. OTCBB and PS Data

For all common stocks traded in the OTCBB and PS from 1975 through 2008, we obtain daily trading volume, market capitalization, and closing, bid, and ask prices from MarketQA. Our analysis uses only OTCBB and PS stocks that are *not* concurrently listed on the NYSE, Nasdaq, or AMEX exchange because such firms have been analyzed in depth elsewhere. This restriction eliminates many Nasdaq firms with joint listings on the OTCBB. To ensure adequate data quality, we further restrict our attention to firms meeting the following requirements at any time in the previous month:

- Non-missing data on price, market capitalization, and returns
- Market capitalization exceeds $1 million in 2008 dollars
- Price exceeds $1
- At least one non-zero daily return
- Positive trading volume, after 1995 when volume data are reliable

Our final OTC sample includes an average of 500 firms per month and no fewer than 58 in each month.

C. Comparison to CRSP

We gauge the size and importance of the OTC stocks in our sample by comparing them to CRSP ("listed") common stocks. We define three groups to make these comparisons: active, eligible, and comparable stocks. *Active* stocks have at least one non-zero daily return in the past year. *Eligible* stocks meet the same data requirements listed in Section I.B. *Comparable* stocks in the listed sample consist of the 2N eligible listed firms with the lowest market capitalizations, where N is the number of listed firms with a market capitalization below the median market

capitalization in OTC markets in each month. That is, these listed firms are comparable to OTC firms in terms of size.

Table 1 provides a snapshot of the summary statistics for the OTC, comparable listed, and eligible listed samples in March of 2000—the peak of OTC trading activity in absolute terms. For this month, the median market capitalization of an OTC stock is $21.3 million, as compared to $169 million for the eligible listed sample.[3] The difference in total market capitalization is much larger ($91.3 billion versus $16.7 trillion) because the largest firms in the eligible listed sample are enormous and because there are five times fewer OTC stocks (1250 versus 6524). The annualized median OTC trading volume is only 3.6% ($9.9 million / $272 million) of the median eligible listed trading volume. The aggregate annualized transactions in OTC stocks exceed $141 billion, whereas trades in eligible listed stocks exceed $42 trillion.

[Insert Table 1 here.]

By design, the OTC sample is more similar to the comparable listed sample described in the second column of Table 1. As expected, the median size is identical in the two samples. In this particular month, the mean size and volume in the OTC markets are more than twice as large as the amounts in the comparable listed sample, but this relation changes over time. In fact, median trading volume is actually slightly higher for the comparable listed sample. The number of stocks in the OTC and comparable listed samples are similar at 1250 and 1700, respectively. The summary statistics in Table 3, which we discuss later, show that these similarities are even stronger in an average month.

Averaging across all months in our sample, the number of firms is 5,229 in the listed sample and is 5,708 in the active listed universe. The averages are 500 in our OTC sample and

[3] Table 1 uses rounding to three digits. Listed trading volume statistics do not adjust for possible double-counting of Nasdaq interdealer trades.

3,357 in the active OTC universe. The main reason that our OTC sample contains far fewer firms than the active OTC universe is that the majority of OTC firms are concurrently listed on the Nasdaq and therefore excluded from our sample. The listed sample, however, contains 92% of the active firms in CRSP, implying that none of our other sample restrictions is onerous. In an average month, the number of firms in the OTC sample is 9.6% of the number in the listed sample.

The average firm size and trading volume in the OTC sample are also an order of magnitude smaller than they are in the listed sample. The median market capitalization in the OTC sample is on average 14.0% of the median in the listed sample. The median dollar volume in the OTC sample is on average 4.1% of the median in the listed sample. Because many OTC firms' volume statistics are unreliable before 1995, we use the ratio of means before 1995 instead of the ratio of medians.

Figure 1 summarizes the relative size, trading volume, and number of firms in the OTC sample as a percentage of the corresponding amounts in the active listed sample. It demonstrates that the relative size of firms in the OTC markets has always been higher than the relative trading volume—except for October 1977, when there is an unusual spike in OTC volume. This gap between relative size and volume widens sharply after the Internet boom. Relative size and volume both peaked in the late 1980s, whereas the number of firms in the OTC sample has grown rapidly since that time. The transparency and disclosure reforms in the OTC markets after 2000 partly explain the increase in OTC firms in the past decade.

[Insert Figure 1 here.]

Figure 2 compares the distributions of firm size in the OTC and listed samples. The bottom blue, solid line shows the size percentile in the listed sample that corresponds to the

median size in the OTC sample. The median OTC firm usually corresponds to the bottom size decile in the listed sample. The other lines represent the size percentiles in the listed sample corresponding to the 75th, 90th, and 99th percentiles of size in the OTC sample. The firm at the 90th percentile of OTC size is often bigger than the median listed firm. The firm at the 99th percentile of OTC size is usually as big as the firm at the 80th percentile of listed size. That is, although the typical OTC firm is much smaller than its listed counterpart, there are a significant number of large OTC firms and these large OTC firms have market capitalizations similar to large listed firms.

[Insert Figure 2 here.]

Table 2 lists the firm size and month in which the 10 largest firms in our sample attain their peak size. These firms have market capitalizations well in the billions. The largest OTC firms typically come from the banking, retail, manufacturing, health care, and technology industries. The largest firm, Publix Supermarkets, reaches a market capitalization of $88 billion at the end of our sample in December 2008. It would rank 18th in size in the listed sample in that month, which exceeds the median of the top percentile. Some companies trade on PS after delisting from NYSE, Amex, or Nasdaq, a phenomenon that Harris, Panchapagesan, and Werner (2008) and Macey, O'Hara, and Pompilio (2008) study in detail. For example, Delphi Corporation filed for Chapter 11 bankruptcy in 2005 and traded on the PS while being reorganized. Its largest market capitalization is $13 billion in February 2008. Delphi stock ceased trading on PS after it became a private firm in October 2009.

[Insert Table 2 here.]

In summary, OTC firms are, on average, much smaller and trade far less often than listed stocks; however, there is large heterogeneity in the OTC sample with the largest 1% of OTC

stocks being larger than the median listed stock. The number of OTC firms is not negligible; in an average month, the number of OTC firms is approximately 10% of all listed stocks across our sample. This percentage increases dramatically after 2000.

II. Variable Definitions

This section summarizes the key variables used in our analyses. Our return predictability tests require estimates of stocks' monthly returns and betas. We also measure several firm characteristics known to predict returns in listed stocks, such as past returns, idiosyncratic volatility, and liquidity.

We compute a stock's return as the monthly percentage change in Market QA's "total return index" variable, which is a cumulative stock price that accounts for dividends and splits. We assign a monthly index value based on the last available daily index value. Because some OTC stocks are not traded frequently, the most recently available daily index value may be several months old. Our tests use two past returns variables: past one-month returns (*Ret*[-1]) which capture short-term serial correlation and past 12-month returns (*Ret*[-12,-2]), not including the past month, which capture stock momentum.

To estimate a stock's beta in month *t* on multiple risk factors, we use a time series regression of the stock's monthly return on the monthly risk factors from month $t - 24$ to month $t - 1$. In cases where a stock is not traded for one month or longer, we cumulate monthly factors during the entire non-trading period to align the stock and factor returns. We compute stocks' betas on the MKT, SMB, and HML factors using the three-factor Fama and French (1993) regression. We compute betas with respect to the UMD momentum factor in Carhart (1997) and liquidity factor (LIQ) in Pastor and Stambaugh (2003) using regressions of returns on MKT,

SMB and HML in addition to the respective factor. We require at least 10 observations in each regression. Because many OTC stocks do not trade every day, we correct stocks' raw betas for non-synchronous trading, extending the method in Lo and MacKinlay (1990). The Appendix details this procedure.

Idiosyncratic volatility is defined relative to the Fama-French (1993) three-factor model, as in Ang et al (2006). To estimate volatility in month *t*, we use time-series regressions of firms' daily returns on the daily MKT, SMB and HML factors from month *t – 12* to month *t – 1*. A firm's idiosyncratic volatility (*Volatility*) in month *t* is the log of the standard deviation of the residuals of observations in months *t – 1* and *t – 2* of its regression.

We use four measures of individual stock liquidity in our analyses. The variable *PNT* denotes the fraction of days with zero trading volume in each month.[4] The variable *Volume* is the log of one plus a stock's monthly dollar volume. Our third measure (*Amihud*) is the log of the monthly average of the absolute value of daily returns divided by daily dollar volume (Amihud , 2002). The variable *Spread* is the difference between a stock's ask quote and bid quote divided by the bid-ask midpoint from the last day when both quotes are available. The *Spread* and *Amihud* measures capture the price impact of trading different quantities of shares, whereas *PNT* and *Volume* reflect the ability even to trade stock at all.

Our return predictability tests use data on firm size and book-to-market ratios. Firm *Size* is the log of shares outstanding times the most recently available closing price, as computed by Market QA. The book-to-market variable (*B/M*) is the log of the ratio of book-to-market equity using book equity data from Compustat and Reuters Fundamentals. We Winsorize all independent variables at the 5% level to minimize the influence of outliers.

[4] Our main results on the illiquidity premium become slightly stronger if we redefine *PNT* as the fraction of days in which at least trading volume exceeds 100 shares.

[Insert Table 3 here.]

Table 3 reports summary statistics of returns and variables for OTC stocks and comparable listed stocks in Panels A and B, respectively. The mean return of OTC stocks is negative at -0.26% per month compared to 0.69% per month for comparable listed stocks. Eraker and Ready (2010) investigate this negative average return for OTC stocks in detail. The cross-section of OTC returns is also significantly more disperse than listed stocks, with cross-sectional standard deviations of 27.8% and 19.3%, respectively. By construction, the size of the OTC and comparable listed samples are similar as the comparable sample is chosen to be the smallest market capitalization listed stocks. This also results in both the OTC and comparable listed stocks having similar book-to-market ratios.

OTC stocks are noticeably more volatile than comparable listed stocks, with average monthly average volatilities of 6.80% and 4.25% for the OTC and listed samples, respectively. The average monthly volume (*Volume*), measured using a logarithmic scale, is an order of magnitude smaller for OTC stocks (9.0) than for listed stocks (10.8). OTC stocks also trade much less frequently: the fraction of days with no trading over a month, *PNT*, is on average 0.51 for OTC stocks compared to 0.19 for listed stocks. The most infrequently traded OTC stocks trade just one day per month, on average, with the 95th percentile *PNT* value being 0.94. Average OTC *Spreads* are also significantly higher at 0.13 versus 0.07 for listed comparable stocks.

III. Cross-Sectional Regressions

In Table 4, we investigate the cross-sectional premiums of factor loadings and risk characteristics. Each cell reports the Fama and MacBeth (1973) coefficients, along with standard

errors in parentheses. The point estimate is the weighted-average of monthly coefficients, where each coefficient weight is the inverse of the squared monthly standard error as in Ferson and Harvey (1999). We compute standard errors for the time series of the monthly coefficients using the estimator in Newey and West (1987) with the number of lags equal to the recommendation in Newey and West (1994). We group the regressors into factor loadings, which are firms' betas on MKT, SMB, HML, and UMD, and firm characteristics, which include size, volatility, past returns, and liquidity characteristics.[5] Thus, our focus is on the cross-sectional determinants of returns commonly used in the enormous literature on listed stocks. Panel A reports the coefficients on the OTC stock sample, Panel B reports coefficients for the comparable listed stock universe (the listed firms most comparable to OTC firms in terms of size), and Panel C reports coefficients for the eligible listed sample (all listed firms meeting our sample restrictions).

[Insert Table 4 here.]

A. Cross-Sectional R^2s

The first striking point in Table 4 is that there is far more cross-sectional predictability in OTC stocks than there is in listed stocks. For most regressions (I to VI), the average R^2 is significantly higher in the Panel A regressions on OTC stocks than the corresponding Panels B and C regressions on listed stocks. For example, in Regression VI containing all factor loadings and coefficients, the average R^2 is 25.5% in the OTC sample compared to just 5.0% and 5.8% in the listed comparable and eligible samples, respectively. This is despite the higher volatility, on average, for OTC stocks (4.25% for comparable listed stocks vs. 6.80% for OTC stocks) .

[5] Although using estimated betas in these predictive regressions induces an attenuation bias in the beta coefficients, this bias cannot explain negative point estimates for these coefficients.

B. Factor Loadings

The cross-sectional regressions in Table 4 show that many of the same cross-sectional effects long documented in listed stocks are also manifest in OTC stocks. Regression I employs only factor betas. The market beta is significantly negatively priced in OTC stocks, which Fama and French (1992) and Jagannathan and Wang (1996) also find in the listed universe. The OTC sample also produces a negative risk premium for SMB betas, which is significant at the 1% level, and positive premiums for HML and UMD betas. However, when these factor loadings are used jointly with all predictive variables in Regression VI, the factor premiums all diminish and only the coefficient on market beta remains significant at the 5% level. This is similar to the findings of Daniel and Titman (1997), who show that characteristics often have greater ability to predict the cross section of stock returns than factor loadings.

Nevertheless, the factor premiums in Regression I are similar to those found in the literature for listed stocks. Panels B and C show that the coefficients on factor loadings in the listed samples are similar in magnitude to those in the OTC sample: the MKT and SMB beta premiums are negative, while the HML and UMD beta premiums are positive. In the comparable listed sample (Panel B) most similar in size to the OTC sample, all factor premiums are insignificant in the joint Regression VI specification. In the full eligible listed sample (Panel C), the SMB and HML factor premiums are significantly negative and positive, respectively. This implies that the factor risk premiums are strongest amongst the largest listed stocks.

C. Size, Volatility, and Past Returns

In Regression II, we augment the factor loadings with size and past return characteristics. In the OTC market, size has a coefficient of -0.506, which is significant at the 1% level. This is similar to the -0.479 coefficient for the comparable listed market in Panel B, but the size effect is non-existent in the eligible listed sample in Panel C. In comparison, the past return effects are much weaker in the OTC sample than in listed stocks. In Regression II, the coefficient on past one-month and 12-month returns are -0.018 and 0.000 in OTC stocks, respectively, as compared to -0.057 and 0.016 in comparable listed stocks (Panel B) and -0.042 and 0.010 in eligible listed stocks (Panel C). The coefficients in the OTC sample are thus an order of magnitude smaller than the listed samples. OTC stocks exhibit little, if any, evidence of any momentum effect.

Regression III reexamines the characteristic effects by including only the HML beta and adding the monthly volatility of daily returns and the log of book-to-market equity. Because we only have book equity data since 1993, this regression only includes data from 1993 to 2008. This specification also includes a dummy variable for firms with missing or negative book equity variable to keep these firms in the sample without affecting the coefficient on book-to-market equity. In all three panels, the coefficient on the HML beta is statistically insignificant. Regression III shows similar coefficients on size and past returns as Regression II, with the size effect becoming even more pronounced. The coefficients on volatility in Regression III are large, negative, and statistically significant in Panels A, B, and C: -0.220, -0.318, -0.381, respectively. The results in the listed sample are consistent with the results in Ang et al. (2006), which shows that stocks with high volatility have low returns in the cross section. We reexamine the OTC volatility effect in terms of portfolio returns in the next section.

D. Liquidity

Regression IV considers three liquidity variables: volume, the Amihud (2002) measure, and our measure of non-trading, *PNT*. In the OTC sample, all three measures are significantly priced and they explain almost as much cross-sectional variation as the four factor loadings in Regression I (R^2s of 5.4% versus 5.9%). The signs of some of these liquidity measures are notable. The coefficient of -0.548 on volume is economically reasonable: investors may require higher returns for holding stocks that are less liquid, as measured by lower volume. However, the negative volume coefficient is opposite to the finding in Gervais, Kaniel and Mingelgrin (2001) that stocks with higher (normalized) volume tend to have higher average returns. The coefficient on the Amihud measure of -0.612 is also the opposite to Amihud's (2002) and others' findings. Interestingly, the two Amihud coefficients in Regression IV in Panels B and C in the two listed stock samples are also significantly negative (-0.193 and -0.395, respectively). The joint regressions discussed below shed more light on this unexpected result.

In Regression IV, the coefficients on *PNT*, which measures the extent of non-trading, are significantly positive in the OTC sample (Panel A), the comparable listed sample (Panel B), and the eligible listed sample (Panel C), with coefficients of 5.114, 2.213, and 2.478, respectively. When we control for characteristics in Regression V in the OTC sample, the *PNT* coefficient is the only liquidity coefficient to maintain its sign and statistical significance. The other two liquidity variables become insignificant at even the 10% level. We further investigate the portfolio returns to *PNT* in Section 4. The size, volatility, and momentum coefficients retain their signs and statistical significance across Regressions II, III, and V in Panels A and B. The same comment generally applies to the eligible listed sample in Panel C.

E. Joint Effects

Regression VI in Table 4 includes all factor loadings and firm characteristics. The strongest cross-sectional predictors for OTC stocks are size, volatility, and *PNT*, which are all significant at the 1% level, with coefficients of -0.871, -0.199, and 6.016, respectively. The *PNT* liquidity measure is the only liquidity variable that has a significant return premium. By comparison, for the comparable listed markets in Panel B, all liquidity variables are statistically significant. In this specification, the volume coefficient has the same positive sign that Gervais, Kaniel, and Mingelgrin (2001) find.

For OTC stocks, the one-month return reversal (*Ret*[-1]) coefficient of -0.019 is significant at the 5% level, but the 12-month return momentum (*Ret*[-12,-2]) coefficient of 0.002 is insignificant. The one-month reversal coefficients of -0.058 and -0.041 and 12-month momentum coefficients of 0.016 and 0.010 are much larger in the listed samples in Panels B and C, respectively. Thus, return reversals seems to exist in OTC markets, but momentum in OTC stocks is much weaker than in listed stocks.

IV. OTC Portfolio Returns

We construct calendar-time portfolios of OTC stocks ranked on various characteristics. Our procedure mimics the portfolios commonly used in the large listed stock literature to estimate expected return premiums on investable portfolios. The risk-adjusted returns from these OTC portfolios provide an estimate of the magnitude of univariate return premiums and complement the multivariate regression results in the previous section. Our analysis focuses on the size, value, and liquidity portfolios because these characteristics exhibit the highest return

premiums in OTC markets. We also estimate portfolio returns for return momentum, idiosyncratic volatility, and several alternative liquidity measures.

The four liquidity measures that we consider are *PNT*, *Volume*, *Spread*, and *Amihud*. To construct portfolios, we sort firms into quintiles at the end of each month based on the firm characteristic of interest, such as a firm's *PNT* value in that month. The portfolio return in month *t* is the difference between the equal-weighted returns in month *t* of firms in the top and bottom quintiles, as ranked by their characteristics in month *t – 1* within the set of firms in our OTC sample in month *t – 1*. A portfolio's excess return is its monthly return minus the monthly risk-free rate prevailing at the end of the prior month. A portfolio's alpha is the intercept from a time-series regression of monthly excess portfolio returns on various monthly factor returns.

To measure factor loadings in portfolios that may be infrequently traded, we include six monthly lags of each factor and report the sum of the contemporaneous and six lagged coefficients as the factor loading following Dimson (1979). We analyze five factors based on listed market returns, including the MKT, SMB, HML, UMD, and LIQ factors. We create a sixth factor equal to the value-weighted OTC market return minus the 30-day Treasury Bill rate. Our three-factor model benchmarks are the OTC CAPM, Listed CAPM, and the Listed Five-Factor models. The OTC and Listed CAPM models use only the OTC and market return factors as benchmarks, respectively. The Listed Five-Factor model comprises the MKT, SMB, HML, UMD and LIQ factors.

We summarize the return premiums for each OTC return factor in Panel A in Table 5 and the factor loadings in Panel B. Panel A displays the average monthly returns and alphas of each OTC return factor relative to the three factor model benchmarks. This panel also shows the annualized Sharpe Ratio of the raw OTC factors alongside the Sharpe Ratios of the raw return

factors from the comparable listed sample. Panel B in Table 5 reports the factor loadings on each factor, where the OTC and listed market factor loadings come from the CAPM models. Panel B also reports the R^2 from each of the three factor models.

[Insert Table 5 here.]

Table 5 shows three interesting comparisons between factor premiums in OTC markets and those in comparable listed markets: (1) the illiquidity return premium is much larger in OTC markets; (2) the size and value premiums are similar in OTC and listed markets; and (3) the momentum and volatility premiums are much smaller in OTC markets.

A. Liquidity Premiums

The first four rows of Table 5, Panel A illustrate the first finding. The Sharpe Ratios of the OTC illiquidity factors based on *PNT*, *Volume*, and *Spread* are all very large: 1.16, -1.31, and 1.64, respectively. The Sharpe Ratio of 0.51 for the Amihud factor is qualitatively consistent, but quantitatively smaller. The very large Sharpe ratio for the *PNT* factor is consistent with the very large coefficient on the *PNT* characteristic from the multivariate cross-sectional regression reported in Table 4.

The first four columns of Panel A show that the average monthly returns of the illiquidity factors are similar to the monthly alphas computed using each of the multifactor models. Specifically, none of the multifactor models (the OTC CAPM, Listed CAPM and Listed Five-Factor model) can explain even half of any of these four illiquidity premiums. In particular, the Pastor-Stambaugh illiquidity factor from listed markets cannot explain the high returns to illiquid OTC stocks. Panel B shows that none of the exposures of the OTC illiquidity factors to the listed

illiquidity factor is positive and statistically significant. Thus, the high risk premiums for OTC illiquidity cannot be explained by exposure to listed stock market liquidity factors.

B. Size and Value Premiums

The second notable finding in Table 5 is that the annualized Sharpe Ratios for the size and value factors are high in both the OTC and comparable listed markets: -1.38 and -0.98 for the two size factors and 1.50 and 1.18 for the two value factors. The magnitudes of the size and value OTC monthly return premiums of -3.49% and 3.57% are higher than the comparable listed premiums of -0.90% and 1.33%. The OTC size and value factors are more volatile, at 8.74% and 8.24% per month, than their listed factor counterparts, which have monthly volatilities of 3.21% and 3.90%. Clearly, the size and value premiums pervasively found in listed markets also exist in OTC equity markets.

Interestingly, the factor loadings in Panel B show that neither the listed size nor the listed value factor explains much of the variation in the OTC size and value factors. The alpha of the OTC size factor is -3.64% per month after controlling for its loading on the listed size factor and the other four listed factors. These listed factors explain just 11.8% of the variance in the OTC size factor. The alpha of the OTC value factor is 4.39% per month after controlling for its loading on the five listed factors, which explain only 33.7% of the variance in the OTC value factor. Thus, there are large, independent size and value effects in the OTC market that are not captured by listed size and value effects.

To compare the magnitude of the size premiums in the OTC and comparable listed markets, we scale down the long-short portfolio positions in the OTC size portfolio so that it has the same volatility as the comparable listed size factor. The size premium between size quintiles

in the comparable listed sample is 10.8% per year, while the OTC size premium with the same volatility is 15.4% per year. The size premium in OTC markets is partly driven by the negative average returns (-9.5% per year) of the OTC firms in the top size quintile. In fact, the value-weighted OTC market return is -11.5% per year, whereas the equal-weighted OTC market return is -3.1% per year. This is consistent with the negative average returns for the aggregate OTC market reported in contemporaneous work by Eraker and Ready (2010).

C. Momentum and Idiosyncratic Volatility

The third key result is that the return premiums for momentum and volatility in OTC markets are surprisingly small. Whereas the Sharpe ratio of 1.25 for momentum is the largest among all listed factors in Table 5, Panel A, the Sharpe ratio of 0.26 for momentum in OTC markets is the smallest of all OTC factors considered and is also statistically insignificant. In contrast to some of the other factors, the OTC and listed momentum factors are significantly positively correlated. This explains why the alpha of the OTC momentum factor against the Listed Five-Factor model—which includes listed momentum—is actually negative, but insignificant.

Panel A reports some evidence that highly volatile OTC stocks have lower average returns than less volatile stocks. However, this result is not robust to controlling for the OTC CAPM factor. That is, the highly negative average market return of OTC stocks seems to be closely related to the low average returns of highly volatile OTC stocks. Panel B shows that the OTC market beta of the long-short OTC volatility factor exceeds 1.0 and that OTC market exposure explains 21.7% of the variance in the volatility factor. This is interesting also because the standard listed factor loadings and characteristics do not alter the negative cross-sectional

coefficient on volatility for OTC stocks in Table 4; only the OTC market factor makes the volatility effect insignificant.

Our OTC evidence on the momentum and volatility effects differs from the results in evidence on momentum and volatility in listed stocks reported in studies by Jegadeesh and Titman (1993) and Ang et al. (2006), respectively. Both the OTC momentum and volatility premiums are directionally consistent with the comparable listed return premiums, but the magnitudes are much smaller. In particular, the listed momentum premium is several times larger than the OTC momentum premium and the OTC premium for volatility has an unexpected positive sign after controlling for the OTC market.

D. Portfolio Returns Over Time

In Figures 3A and 3B, we graph the cumulative returns for the illiquidity, size, and value factors in the OTC and comparable listed samples. Figure 3A uses a logarithmic scale to represent the evolution of the value of a $1 investment from December 1976 to December 2008 for the illiquidity factors based on *PNT* in both markets. As additional benchmarks, we include two liquidity factors from the eligible listed sample: the factor based on *PNT* quintiles and the Pastor-Stambaugh liquidity factor. Figure 3B depicts the size and value factors in the OTC and comparable listed markets. Both figures assume that an investor begins with $1 long and $1 short and faces no margin or other funding requirements. To facilitate comparison, we scale the long-short portfolio positions in the OTC and eligible listed factors so that the volatility of these portfolios is equal to the volatility of the long-short portfolio based on the comparable listed factor.

[Insert Figures 3A and 3B here.]

Figure 3A shows that the OTC illiquidity factor based on *PNT* quintiles has extremely high cumulative returns. This factor performs relatively poorly in the first few years of data when the OTC volume data is likely to be of poorer quality. The only other time in which the illiquidity factor declines substantially is just prior to the March 2000 peak of the Nasdaq stock market. One possible reason is that the short side of this portfolio contains highly liquid technology stocks, which would also explain the rapid rebound of the illiquidity factor after March 2000.

The magnitude of the OTC *PNT* factor dwarfs the magnitude of all the liquidity factors based on the listed samples. Although the Pastor-Stambaugh factor is the most successful listed factor, a one-dollar investment in this factor produces "only" $11.56 by the end of the sample. By contrast, a dollar invested the OTC *PNT* factor yields over $504 at the end of the sample. Moreover, as Panel A in Table 5 shows, there are actually two OTC factors based on other liquidity measures—*Volume* and *Spread*—that provide even higher Sharpe ratios than the OTC *PNT* factor. In summary, liquidity premiums in OTC markets dwarf those in listed markets.

Figure 3B shows that both the size and value factors in the OTC and listed samples exhibit high cumulative returns, though not as high as the OTC illiquidity factor. For example, a $1 long-short investment in the OTC size factor grows to more than $104 across the 32-year sample. Although the returns on the OTC size factor are barely positive in the first decade of the sample, the returns during the second half of the sample are extremely high. The value factor also has lower returns in the first few years when book equity data become available. Again, the OTC data coverage or quality may be poor in these earlier years. Despite this limitation, we find robust evidence of illiquidity, size, and value premiums in the OTC markets.

V. OTC and Listed Market Segmentation

Motivated by the discrepancies in the pricing patterns in OTC and listed markets, we investigate the degree of segmentation between the two markets. This section analyzes the time-series relations between systematic return and liquidity factors in OTC and listed markets. We first assess the contemporaneous correlations between returns and liquidity in both markets and then estimate vector auto-regressions (VARs) to examine predictive relationships.

A. OTC and Listed Return Factors

Before we examine aggregate market returns in OTC and listed markets, we briefly revisit the earlier evidence in Table 5 on the relationship between systematic return factors in OTC and listed markets. These results suggest that most of the systematic return variation in size, value, momentum, volatility, and liquidity factors in OTC markets is unrelated to activity in listed markets. The last column in Panel B in Table 5 shows that the listed market, size, value, momentum, and liquidity factors jointly explain between 12% and 42% of the variance in the four OTC liquidity factors.[6]

Table 6 performs the same time-series regression as in Table 5, using the excess return on the value-weighted OTC market as the dependent variable. For each contemporaneous listed factor included as a regressor, we include six monthly lags of the listed factor to correct for non-synchronous trading following Dimson (1979). The key finding is that the listed CAPM explains only 35.2% of the variation in the OTC market, while the five-factor model explains 50.8%. Thus, nearly half of the variance in OTC market returns remains unexplained by the five-factor

[6] The listed market beta of the value-weighted OTC market return is 0.93 with an R^2 of 35%. Adding the listed size and value factors to this regression increases the R^2 to 48%.

model. This is broadly consistent with the inability of the other systematic listed factors to explain much of the variation in the OTC size, value, momentum, and volatility factors.

[Insert Table 6 here.]

We do not analyze the predictive relationships between OTC and listed return factors in depth because these tests are difficult to interpret in light of the non-synchronous trading issues that affect OTC portfolio returns and, to a lesser extent, listed portfolio returns. For example, a positive coefficient on the listed return factor in predicting next month's OTC factor returns is consistent with both non-synchronous trading and the slow diffusion of information from listed to OTC markets. Not surprisingly, we obtain several positive and significant coefficients on the first-order lags of listed factor returns in our specifications in Tables 5 and 6.

B. OTC and Listed Stock Liquidity

To assess the contemporaneous co-movement between aggregate liquidity in OTC and listed markets we compute correlations of aggregate liquidity in the OTC, comparable listed, and eligible listed markets, where we define liquidity as the equal-weighted average of *PNT* across stocks at each point in time. In each case, we compute an abnormal or detrended version of *PNT* (*APNT*) that is equal to *PNT* in the current month minus the average *PNT* value in the previous three months. This procedure removes the time trend effects in liquidity.[7] We define the value of *APNT X* months ago as LagX(*APNT*).

Figure 4 depicts the equal-weighted average of *PNT* for the OTC market and the two listed samples. The figure incorporates corrections for four possible structural breaks in the OTC and listed liquidity measures. The first break occurs in 1982 and corresponds to the month in which volume data on listed Nasdaq firms becomes available. The other three breaks occur in

[7] The results are qualitatively similar for the raw version of *PNT*.

1987, 1990, and 1995, and correspond to possible changes in market structure and volume data availability for OTC stocks. We define five subperiods based on these four breakpoints. Under the assumption that the data from the last subperiod is the most reliable, the figure splices together each of the three average *PNT* measures from these five subperiods so that each liquidity measure is continuous at the four breakpoints.

[Insert Figure 4.]

The average value of *PNT* in the OTC market is similar to the average *PNT* value in the comparable listed market from 1977 through 1990, where both measures of non-trading are approximately 20%. From 1990 to 2008, however, non-trading in OTC markets gradually increases to over 50%, while non-trading in comparable listed markets decreases to just 10%. Despite these differences in long-term trends, the two liquidity measures appear to be positively correlated at the monthly horizon. The average liquidity in the full eligible listed sample, which constitutes almost all listed traded stocks, is much higher than liquidity in both of the OTC and comparable listed samples; non-trading in eligible listed stocks gradually decreases from roughly 10% in 1977 to 3% by 2008. Thus, while liquidity has generally improved for the large listed stocks and smaller listed stocks over the last 30 years, OTC liquidity has, on average, become worse, especially over the past 15 years.

[Insert Table 7 here.]

Table 7 reports the correlations between aggregate liquidity (*APNT*) in the OTC and listed markets for the full sample and for the five subperiods described above. The first row in Table 7 reports that the correlation between aggregate liquidity in OTC and comparable listed markets is 0.39 for the full sample. Even in the recent data from 1995 to 2008 when the correlation reaches 0.69, the aggregate listed liquidity measure cannot explain the majority

(52.4% = 1 – 0.69^2) of the variance in OTC liquidity. The correlations in the second column of Table 7 between aggregate liquidity in the OTC and the eligible listed markets are, in most cases, slightly lower than the corresponding correlations between OTC and comparable listed liquidity. For example, the correlation for the full sample is just 0.25. One interpretation of these findings is that OTC and listed markets are highly segmented. This is consistent with the different return premiums across OTC and listed stocks.

[Insert Table 8 here.]

Finally, we scrutinize the predictive relationships between aggregate liquidity in the OTC and listed markets using a VAR with three monthly lags of the *APNT* measure in both markets. Panels A and B in Table 8 report the results from two VARs in which we separately compare OTC liquidity to liquidity in the comparable and eligible listed samples, respectively. The main result in both VARs is that there are no positive, and statistically significant at the 5% level, predictive relationships between liquidity in OTC markets and listed markets. That is, listed liquidity does not positively predict OTC liquidity and vice versa. In the regression predicting OTC liquidity ($APNT_{OTC}$) in Panel A, there is a marginally significant negative coefficient on the first lag of comparable listed liquidity. This could arise if OTC investors trade more in OTC markets after periods of relative illiquidity in listed markets. The lack of a strong predictive relationship is consistent with the partial segmentation interpretation of OTC and listed markets.

VI. Concluding Discussion

While some listed cross-sectional return patterns generalize to OTC markets, such as size and value, other cross-sectional premiums are strikingly different. The return premium for illiquidity in OTC markets is an order of magnitude larger than in listed markets, perhaps

reflecting the fact that the stocks traded on OTC markets are traded less frequently, with lower volume, and have larger bid-ask spreads. In contrast, the momentum and volatility effects that are quite pronounced in listed markets are economically small or non-existent in OTC markets. Listed return factors cannot explain the majority of the variation in OTC return factors. This suggests that the two markets are partially segmented and that OTC markets provide independent evidence on return patterns.

The differing return premiums for illiquidity, momentum, and idiosyncratic volatility across OTC and listed markets shed light on which explanations of these return premiums are most promising. First and foremost, the return premium for illiquidity in OTC markets may be much larger precisely because OTC markets are less liquid than listed markets. That is, liquidity premiums for very illiquid stocks are high. It is economically sensible that the equilibrium price of a resource, namely liquidity, is higher in a market where the resource is scarce.

Second, the momentum effect in OTC markets may be weak or non-existent because the transmission of information about OTC stocks is very different from the transmission of news about listed stocks. Because OTC stocks have low or no information disclosure requirements, investors may view information about OTC stocks as less credible than information about listed stocks. Thus, OTC investors may not include a group of "newswatchers," in the sense of Hong and Stein (1999), who mainly pay attention to firms' fundamentals and disregard stock price movements. In the absence of gradual information diffusion across newswatchers, the model in Hong and Stein (1999) would not predict any momentum, which is what we observe for the OTC markets. By contrast, the alternative models of momentum proposed in Barberis, Sheifer, and Vishny (1998) and Daniel, Hirshleifer, and Subrahmanyam (1998) rely on a representative investor with innate behavioral biases. If we suppose that retail traders are more likely to exhibit

these behavioral biases, representative agent models of return momentum make the incorrect prediction that momentum would be larger in OTC markets than in listed markets.

The weak idiosyncratic volatility effect in OTC markets after controlling for OTC market returns could also be related to the low information disclosure in these markets. In the presence of short-sale constraints, Miller (1977) and Kim and Verrecchia (1991) show that stocks on which investors have large differences of opinion tend to become over-priced and have low average future returns. Diether, Malloy, and Scherbina (2002) provide suggestive empirical evidence of this effect in listed markets. If information disclosures tend to increase both differences of opinion among investors and return volatility, highly volatile stocks would exhibit low future returns in listed markets, where disclosures are abundant. Furthermore, differences of opinion may be greater in listed markets because the investor population is more heterogeneous, consisting of both institutions and individuals. Again, this could produce a larger volatility effect in listed markets. The weak volatility effect in OTC markets, where information is scarce and disclosures are infrequent, casts doubt on the hypothesis in Jiang, Xue, and Yao (2009) that selective corporate disclosure can explain the volatility effect in listed markets.

While the similarities in the size and value premiums in OTC and listed markets are striking, they do not necessarily help us differentiate between risk-based and behavioral mechanisms for return predictability. For example, the Barberis, Shleifer, and Vishny (1998) argument that investors excessively extrapolate the past growth rates of stocks could apply equally to listed and OTC stocks. Similarly, the Zhang (2005) risk-based explanation that value stocks have more assets in place, which are harder to reduce in downturns and therefore riskier, applies universally to OTC and listed stocks. However, the finding that size and value premiums exist in OTC markets provides more evidence that size and value effects are pervasive and

systematic (see also Asness, Moskowitz and Pedersen, 2009). This suggests that size and value premiums are robust to differences in market structure and liquidity, and therefore may persist in the future.

Finally, the return premiums we find that exist in OTC markets may offer insights into the future of listed markets, particularly for liquidity premiums and for momentum and volatility—the cross-sectional effects not observed in OTC stocks. Although listed markets are typically far more liquid than OTC markets, they occasionally succumb to a liquidity crisis. During these times, stock prices in listed markets may reflect an illiquidity premium much like we observe in the highly illiquid OTC markets. On the opposite side of the spectrum, if the differences in information disclosure across listed and OTC markets partially explain the differences in the momentum and volatility premiums, the tendency toward greater disclosure in listed markets could actually exacerbate these two effects.

Appendix: Correcting Observed Betas for Non-synchronous Trading

We correct stocks' observed betas for non-synchronous trading using the model presented in Lo and Mackinlay (1990). Suppose that the unobservable, "true" return process for stock *i* is

$$R_{it} = \alpha_i + F_t \beta_i + \varepsilon_{it} \tag{1}$$

where F_t is a $1 \times m$ vector of factor returns. The econometrician only observes prices and returns in periods when trading occurs. We denote the probability that stock *i* does not trade by p_i and assume this probability is constant and independent across periods. If a security does not trade for several periods, the observed return when it eventually does trade is the sum of all unobserved true returns per period. Formally, we define a variable $X_{it}(k)$ as follows:

$$X_{it}(k) = \begin{cases} 1 & \text{if stock } i \text{ traded in period t but did not trade in all } k \text{ period prior to } t \\ 0 & \text{otherwise.} \end{cases} \tag{2}$$

This definition implies that $X_{it}(k) = 1$ with probability $(1 - p_i)p_i^k$. Now we can write the observed return process (R_{it}^o) as

$$R_{it}^o = \sum_{k=0}^{\infty} X_{it}(k) R_{it-k}. \tag{3}$$

We assume that factor returns (F_t) are independent and identically distributed over time with $E(F_t) = \mu_F$ and

$$Var(F_t) = \Sigma_f = \begin{pmatrix} \sigma_1^2 & . & . & . & \sigma_{1m} \\ . & . & & & . \\ . & & . & & . \\ . & & & . & . \\ \sigma_{m1} & . & . & . & \sigma_m^2 \end{pmatrix}. \tag{4}$$

We estimate regressions of observed monthly returns on observed monthly factors. The observed beta vectors that we estimate are

$$\beta_i^o = [E(F_t^{o'}F_t^o) - E(F_t^{o'})E(F_t^o)]^{-1}[E(F_t^{o'}R_{it}^o) - E(F_t^{o'})E(R_{it}^o)]. \quad (5)$$

After extensive algebra, available upon request, we obtain the following relation between a stock *i*'s true beta and its observed beta and alpha:

$$\beta_i = \beta_i^o - \frac{2p_i}{1-p_i}\alpha_i^o[1 - \frac{2p_i}{1-p_i}\mu_f(\Sigma_f + \frac{2p_i}{1-p_i}\mu_f'\mu_f)^{-1}\mu_f']^{-1}(\Sigma_f + \frac{2p_i}{1-p_i}\mu_f'\mu_f)^{-1}\mu_f'. \quad (6)$$

When F_t is a scalar, such as an intercept in a factor regression, this formula simplifies to

$$\beta_i = \beta_i^o - \frac{2p_i}{1-p_i}\alpha_i^o\frac{\mu_F}{\sigma_F^2}. \quad (7)$$

We obtain the parameters required for computing β_i as follows. First, we estimate the observed betas and alphas (β_i^o and α_i^o) for each firm for each month with regressions using the 24 previous months. Next, we estimate the factor means and covariances (μ_F and Σ_f) for each regression during the same 24 months. Lastly, we estimate the probability of a stock not trading in a given month p_i using the proportion of months in which the stock did not trade during the regression period. We then substitute these parameter estimates into Equation (7) to obtain an estimate of stock *i*'s true beta.

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Table 1: Summary Statistics for the OTC and the Two Listed Samples in March 2000

We report statistics for size, volume, and the number of firms in the OTC, comparable listed, and eligible listed samples in March of 2000, which is the peak month for OTC trading volume. By design, the comparable listed sample has the same median size as the OTC sample. The eligible listed sample consists of all listed stocks that satisfy the same data requirements as the OTC stocks in our sample, as described in Section I.B.

	OTC	Comparable Listed	Eligible Listed
Total Market Capitalization (Billions)	91.3	37.7	16,691
Median Market Capitalization (Millions)	21.3	21.3	169
Mean Market Capitalization (Millions)	73.0	22.2	2,558
Trading Volume (Annualized Billions)	141.6	95.0	42,027
Median Trading Volume (Annualized Millions)	9.9	15.0	272
Mean Trading Volume (Annualized Millions)	113.4	55.9	6,444
Number of Firms	1,250	1,700	6,524

Table 2: The Peak Sizes of the Largest 10 OTC Firms

We list the ten largest OTC firms in our sample from 1977 to 2008. The first column shows the month in which each firm attains its peak size. The third column shows its size in that month. The two rightmost columns show each OTC firm's size rank and percentile within the eligible listed sample. The eligible listed sample consists of all listed stocks that satisfy the same data requirements as the OTC stocks in our sample, as described in Section I.B.

Company Name	Peak Month	Trading Venue	Peak Size in Billions	Size Rank in Listed Sample	Size Percentile in Listed Sample
PUBLIX SUPER MARKETS INC	Dec-08	OTCBB	88.5	18th	99.5%
SECURITY NATL CORP IOWA	Jan-01	OTCBB	62.0	50th	99.2%
KISH BANCORP INC	Sep-08	Pink Sheets	44.1	48th	98.8%
HARFORD BANK	Apr-02	OTCBB	27.2	83rd	98.4%
UMEMBER.COM INC	Mar-00	OTCBB	25.4	116th	98.2%
DELAWARE BANCSHARES INC	Aug-08	Pink Sheets	18.9	159th	96.2%
DELPHI CORP	Feb-08	Pink Sheets	13.0	232nd	94.7%
COMDISCO HLDG CO INC	Dec-02	OTCBB	11.7	144th	96.9%
ASB FINL CORP	Aug-05	Pink Sheets	11.5	251st	94.6%
SKYTOP LODGE CORP	Sep-08	Pink Sheets	9.3	253rd	93.9%

Table 3: Cross-Sectional Summary Statistics for Key Variables

We summarize the distributions of monthly returns and the main firm characteristics for the OTC and comparable listed samples in Panels A and B, respectively. The comparable sample consists of stocks that are comparable to stocks in the OTC sample in terms of size, as described in Section I.C. We measure all firms characteristics other than *PNT* using logarithms. We Winsorize all firm characteristics at the 5% level, but we do not winsorize returns. The first seven columns report monthly averages of means, standard deviations, and various percentiles. We compute these statistics separately for each month and then average across all months. The second to last column presents the average number of firms with non-missing values of each variable in each month. The last column presents the total number of months for which we have any non-missing data values of each variable in each month.

Panel A: OTC Stocks

	Monthly Averages								Total months
Variable	Mean	SD	P5	P25	P50	P75	P95	Firms	
Return (%)	-0.26	27.78	-34.59	-10.11	-1.25	4.84	37.55	500	384
Size	2.45	1.31	0.25	1.47	2.38	3.38	4.86	500	384
B/M	1.01	3.71	0.07	0.23	0.54	1.05	2.81	173	384
Volatility	6.80	6.02	0.80	2.39	4.98	8.99	23.11	467	384
Volume	9.00	3.85	4.47	5.70	8.21	12.11	15.21	500	384
Amihud	1.85	1.49	0.09	0.57	1.49	2.88	4.91	461	384
PNT	0.51	0.36	0.00	0.17	0.57	0.82	0.94	500	384
Spread	0.13	0.11	0.02	0.04	0.09	0.18	0.42	388	192

Panel B: Comparable Listed Sample

	Monthly Averages								Total months
Variable	Mean	SD	P5	P25	P50	P75	P95	Firms	
Return (%)	0.69	19.30	-24.20	-8.90	-1.18	7.27	31.94	1130	384
Size	2.27	0.55	1.11	1.90	2.38	2.74	2.98	1130	384
B/M	1.27	1.62	0.18	0.53	0.95	1.55	3.23	865	384
Volatility	4.25	2.10	1.22	2.63	3.93	5.53	8.88	1114	384
Volume	10.84	2.01	8.15	9.53	10.32	12.44	14.35	1130	384
Amihud	1.89	1.03	0.41	1.04	1.74	2.62	3.98	958	384
PNT	0.19	0.21	0.00	0.02	0.11	0.31	0.66	1130	384
Spread	0.07	0.04	0.02	0.04	0.06	0.10	0.17	602	303

Table 4: Cross-Sectional Regressions of Monthly Returns on Firm Characteristics

This table displays estimates of cross-sectional regressions of monthly stock returns on several firm characteristics and factor loadings. We compute Fama and Macbeth (1973) coefficients by estimating monthly cross-sectional regressions and weighting the monthly coefficients by the inverse of their squared standard errors as in Ferson and Harvey (1999). We compute standard errors using the estimator in Newey and West (1987) with the number of lags equal to the recommendation in Newey and West (1994). This number of lags is four for Regression III and five for all other regressions. The R^2 in the bottom row is the average from the monthly regressions. We denote statistical significance at the 5% and 1% levels using * and ** symbols, respectively. The ‡ symbol denotes the regression that only uses data from 1993 to 2008. All other regressions include data from 1977 through 2008.

Panel A: OTC Sample

	I	II	III‡	IV	V	VI
β_{MKT}	-0.163**	-0.163**				-0.075*
	(0.043)	(0.042)				(0.037)
β_{SMB}	-0.133**	-0.135**				-0.033
	(0.029)	(0.027)				(0.022)
β_{HML}	0.072*	0.087*	0.005			0.029
	(0.034)	(0.034)	(0.022)			(0.025)
β_{UMD}	0.047	0.045				0.033
	(0.027)	(0.027)				(0.029)
Size		-0.506**	-1.121**		-0.825**	-0.871**
		(0.108)	(0.133)		(0.111)	(0.109)
B/M			0.755**			
			(0.150)			
Volatility			-0.220**		-0.207**	-0.199**
			(0.023)		(0.020)	(0.020)
Ret[-1]		-0.018**	-0.010		-0.020**	-0.019**
		(0.006)	(0.006)		(0.006)	(0.006)
Ret[-12,-2]		0.0000	0.001		0.002	0.002
		(0.001)	(0.001)		(0.001)	(0.001)
Volume				-0.548**	-0.156	-0.080
				(0.100)	(0.100)	(0.096)
Amihud				-0.612**	-0.179	-0.160
				(0.105)	(0.109)	(0.111)
PNT				5.114**	6.046**	6.016**
				(0.810)	(0.827)	(0.805)
Average R^2	0.059	0.104	0.035	0.054	0.166	0.255
Avg Stocks	399	379	708	461	346	345

Table 4 Continued

Panel B: Comparable Listed Sample

	I	II	III‡	IV	V	VI
β_{MKT}	-0.175**	-0.124				-0.049
	(0.068)	(0.070)				(0.053)
β_{SMB}	-0.103**	-0.089*				-0.040
	(0.036)	(0.038)				(0.029)
β_{HML}	0.042	0.033	0.005			0.011
	(0.037)	(0.035)	(0.038)			(0.029)
β_{UMD}	0.004	-0.028				-0.009
	(0.027)	(0.026)				(0.030)
Size		-0.479**	-0.819**		-0.819**	-0.812**
		(0.079)	(0.178)		(0.105)	(0.104)
B/M			0.837**			
			(0.130)			
Volatility			-0.318**		-0.399**	-0.391**
			(0.089)		(0.042)	(0.039)
Ret[-1]		-0.057**	-0.054**		-0.057**	-0.058**
		(0.006)	(0.008)		(0.006)	(0.006)
Ret[-12,-2]		0.016**	0.019**		0.016**	0.016**
		(0.002)	(0.002)		(0.001)	(0.001)
Volume				0.096	0.397**	0.399**
				(0.091)	(0.078)	(0.077)
Amihud				-0.193**	0.354**	0.344**
				(0.051)	(0.062)	(0.062)
PNT				2.213**	0.966*	0.936**
				(0.487)	(0.382)	(0.359)
Average R^2	0.014	0.030	0.037	0.017	0.039	0.050
Avg Stocks	1013	998	759	958	853	854

Table 4 Continued

Panel C: Eligible Listed Sample

	I	II	III‡	IV	V	VI
β_{MKT}	-0.272**	-0.223**				-0.103
	(0.086)	(0.080)				(0.057)
β_{SMB}	-0.165**	-0.148**				-0.068*
	(0.052)	(0.043)				(0.031)
β_{HML}	0.188**	0.158**	0.066			0.089*
	(0.061)	(0.052)	(0.039)			(0.038)
β_{UMD}	0.044	0.014				0.020
	(0.028)	(0.025)				(0.025)
Size		-0.031	-0.115*		-0.199**	-0.229**
		(0.039)	(0.046)		(0.061)	(0.055)
B/M			0.539**			
			(0.109)			
Volatility			-0.381**		-0.517**	-0.483**
			(0.105)		(0.062)	(0.048)
Ret[-1]		-0.042**	-0.025**		-0.038**	-0.041**
		(0.005)	(0.007)		(0.005)	(0.005)
Ret[-12,-2]		0.010**	0.011**		0.010**	0.010**
		(0.001)	(0.002)		(0.002)	(0.001)
Volume				0.000	0.070	0.103**
				(0.031)	(0.043)	(0.036)
Amihud				-0.395**	0.303**	0.283**
				(0.072)	(0.059)	(0.059)
PNT				2.478**	0.055	0.031
				(0.536)	(0.300)	(0.266)
Average R^2	0.024	0.043	0.049	0.017	0.049	0.058
Avg Stocks	4809	4762	5140	4826	4407	4412

Table 5: Time Series Analysis of OTC Factor Portfolios

This table summarizes the returns and risk of several long-short factor portfolios constructed using OTC stocks. To construct each factor, we sort OTC firms into quintiles at the end of each month based on the firm characteristics in the OTC Factor column. A factor return for month *t* is the difference between the equal-weighted returns of firms in the top and bottom quintiles for that factor, as ranked in month *t-1*. We require at least 10 firms in each quintile. We estimate time series regressions of the monthly OTC factor returns on various contemporaneous return factors and six lags of these factors to account for non-synchronous trading as in Dimson (1979). We compute standard errors using the estimator in Newey and West (1987) with the number of lags equal to the recommendation in Newey and West (1994). We denote statistical significance at the 5% and 1% levels using * and ** symbols, respectively.

The first column in Panel A reports average monthly returns on the OTC factors. The next three columns report intercepts (alphas) from three time series regressions with different regressors. In the OTC CAPM and Listed CAPM columns, the only regressors are the value-weighted OTC market excess return and the listed MKT factor, respectively. In the Listed 5-Factor column, the regressors include the listed MKT, SMB, HML, and UMD factors from Carhart (1997) and the liquidity factor in Pastor and Stambaugh (2003). The last two columns in Panel A report annualized Sharpe ratios for OTC factors and for analogous factors based on the comparable listed sample, which consists of stocks that are comparable to stocks in the OTC sample in terms of size, as described in Section I.C.

Table 5 Continued

Panel A: Evaluating OTC Factor Returns

	Average	Alphas by Model			Annualized Sharpe Ratios	
	Monthly	OTC	Listed	Listed		Comparable
OTC factor	Returns	CAPM	CAPM	5-Factor	OTC	Listed
PNT	3.070**	2.168**	3.735**	3.444**	1.160**	0.090
	(0.560)	(0.540)	(0.528)	(0.729)	(0.211)	(0.191)
Volume	-3.203**	-2.635**	-3.657**	-3.439**	-1.308**	0.059
	(0.507)	(0.473)	(0.530)	(0.744)	(0.207)	(0.178)
Spread	3.382**	4.060**	3.090**	3.114**	1.641**	-0.751**
	(0.673)	(0.647)	(0.704)	(1.042)	(0.327)	(0.201)
Amihud	1.426*	1.954**	0.890	1.223	0.506*	-0.104
	(0.559)	(0.604)	(0.539)	(0.762)	(0.198)	(0.181)
Size	-3.491**	-3.447**	-3.427**	-3.637**	-1.384**	-0.975**
	(0.547)	(0.680)	(0.513)	(0.587)	(0.217)	(0.208)
Value	3.570**	2.050**	4.112**	4.389**	1.500**	1.183**
	(0.716)	(0.686)	(0.620)	(0.962)	(0.301)	(0.209)
Momentum	0.694	0.705	0.951*	-0.727	0.264	1.247**
	(0.448)	(0.495)	(0.453)	(0.668)	(0.170)	(0.154)
Volatility	-0.928	0.127	-1.541**	-0.438	-0.320	-0.527**
	(0.581)	(0.596)	(0.530)	(0.706)	(0.200)	(0.199)

Table 5 Continued

Panel B: Systematic Variation in OTC Return Factors

The first six columns of Panel B report beta coefficients on factors from the three time series regressions described in Panel A. The first and second columns reports the univariate coefficients of each OTC factor on the OTC value-weighted market excess return and on the listed MKT factor, respectively. The next four columns report beta coefficients of each OTC factor on the listed SMB, HML, and UMD factors and the Pastor-Stambaugh liquidity factor from the five-factor regression. Each beta coefficients on a factor is the sum of estimated regression coefficients on the contemporaneous factor and its six lags. The last three columns in Panel B report the R^2 statistics from the three time series regressions.

	Factor Loadings						R^2 by Model		
OTC Factor	β_{OMKT}	β_{MKT}	β_{SMB}	β_{HML}	β_{UMD}	β_{LIQ}	OTC CAPM	Listed CAPM	Listed 5-Factor
PNT	-1.009**	-1.249**	-0.877*	0.854*	-0.095	0.340	0.242	0.203	0.421
	(0.221)	(0.276)	(0.418)	(0.427)	(0.379)	(0.353)			
Volume	0.691**	0.759*	0.642	-0.665	0.095	-0.280	0.153	0.127	0.315
	(0.222)	(0.303)	(0.418)	(0.426)	(0.333)	(0.328)			
Spread	0.492	0.647	0.806	0.416	0.181	-0.715	0.056	0.053	0.167
	(0.307)	(0.333)	(0.486)	(0.45)	(0.418)	(0.471)			
Amihud	0.469*	1.033**	1.127*	-0.342	-0.135	-0.015	0.069	0.080	0.165
	(0.238)	(0.328)	(0.474)	(0.495)	(0.356)	(0.425)			
Size	0.112	-0.223	-0.547	0.527	-0.129	0.117	0.049	0.028	0.118
	(0.243)	(0.327)	(0.551)	(0.540)	(0.430)	(0.386)			
Value	-0.969**	-1.396**	-0.070	0.613	-0.547	0.131	0.194	0.139	0.337
	(0.235)	(0.353)	(0.428)	(0.375)	(0.390)	(0.721)			
Momentum	-0.079	-0.330	0.090	0.735	1.075**	0.480	0.011	0.038	0.164
	(0.178)	(0.263)	(0.362)	(0.410)	(0.349)	(0.374)			
Volatility	1.017**	1.392**	0.537	-0.964*	0.145	-1.322**	0.217	0.112	0.293
	(0.207)	(0.330)	(0.424)	(0.414)	(0.369)	(0.363)			

Table 6: Time Series Regression of the OTC Market on Listed Return Factors

This table reports the estimates from three time series regressions of the monthly OTC factor returns on various listed return factors. The next three columns report intercepts (alphas) from three time series regressions with different regressors. In the Raw Return column, there are no regressors. In the Listed CAPM column, the only regressor is the listed MKT factor. In the Listed 5-Factor column, the regressors include the listed MKT, SMB, HML, and UMD factors from Carhart (1997) and the liquidity factor in Pastor and Stambaugh (2003). The first row reports the intercepts (alpha) from each regression, while the next five rows report the beta coefficients on each of the five listed factors. Each beta coefficients on a factor is the sum of estimated regression coefficients on the contemporaneous factor and its six lags. The last row reports the R^2 statistics from the three time series regressions. We compute standard errors using the estimator in Newey and West (1987) with the number of lags equal to the recommendation in Newey and West (1994). We denote statistical significance at the 5% and 1% levels using * and ** symbols, respectively.

Coefficient	Raw Return	Listed CAPM	Listed 5-Factor
α	-0.962**	-1.415**	-1.356**
	(0.319)	(0.235)	(0.313)
β_{MKT}		0.933**	0.859**
		(0.117)	(0.156)
β_{SMB}			0.410*
			(0.182)
β_{HML}			-0.008
			(0.197)
β_{UMD}			-0.033
			(0.160)
β_{LIQ}			-0.162
			(0.159)
R^2		0.352	0.508

Table 7: Contemporaneous Correlations between Detrended OTC and Listed Liquidity

This table displays correlations between detrended average liquidity in the OTC sample and detrended average liquidity in the two listed samples. We define detrended average liquidity in each month as the equal-weighted average *PNT* value in that month minus the mean equal-weighted average *PNT* in the previous three months. A stock's monthly *PNT* value is the fraction of non-trading days in that month. We compute correlations for five subperiods and for the entire sample period. We select cutoff points for the subperiods to coincide with four possible structural breaks in the listed and OTC average liquidity measures. Before detrending the average liquidity time series, we remove these breaks as described in Section V.B. The comparable listed sample consists of stocks that are comparable to stocks in the OTC sample in terms of size, as described in Section I.C. The eligible listed sample consists of all listed stocks that satisfy the same data requirements as the OTC sample described in Section I.B.

Time Period	OTC versus Comparable Listed	OTC versus Eligible Listed
Full Sample	0.39	0.25
1/77-10/82	0.22	0.18
11/82-5/87	0.39	-0.14
6/87-9/90	0.73	0.79
10/90-7/95	0.13	0.21
8/95-12/08	0.69	0.69

Table 8: VAR with OTC and Listed Liquidity

We estimate VARs of detrended average liquidity in the OTC, comparable listed, and eligible listed samples. We define detrended average liquidity in each month as the equal-weighted average *PNT* value in that month minus the mean equal-weighted average *PNT* in the previous three months. A stock's monthly *PNT* value is the fraction of non-trading days in that month. Before detrending liquidity, we remove four possible structural breaks from the time series of average *PNT* values as described in Section V.B. The comparable listed sample consists of stocks that are comparable to stocks in the OTC sample in terms of size, as described in Section I.C. The eligible listed sample consists of all listed stocks that satisfy the same data requirements as the OTC sample described in Section I.B.

Panel A presents results from a VAR of detrended average liquidity measures in the OTC and comparable listed samples. Panel B presents results from an identical VAR with liquidity in the OTC and the eligible listed samples. Both VARs include three monthly lags for each variable. The six columns report the three coefficients on each of these two sets of lagged variables. The last column reports the R^2 statistics from the three time series regressions. We compute standard errors using the estimator in Newey and West (1987) with the number of lags equal to the recommendation in Newey and West (1994). We denote statistical significance at the 5% and 1% levels using * and ** symbols, respectively.

Panel A: Average Detrended PNT in the OTC and the Comparable Listed Sample (CLS)

Dependent	Independent Variables						
Variable	Lag1($APNT_{OTC}$)	Lag2($APNT_{OTC}$)	Lag3($APNT_{OTC}$)	Lag1($APNT_{CLS}$)	Lag2($APNT_{CLS}$)	Lag3($APNT_{CLS}$)	R^2
$APNT_{OTC}$	0.296**	0.052	-0.185**	-0.146*	0.039	0.029	0.102
	(0.092)	(0.094)	(0.067)	(0.074)	(0.060)	(0.079)	
$APNT_{CLS}$	0.037	-0.017	-0.020	0.114	0.073	-0.203**	0.064
	(0.061)	(0.076)	(0.058)	(0.093)	(0.076)	(0.067)	

Table 8 Continued

Panel B: Average Detrended PNT in the OTC and the Eligible Listed Sample (ELS)

Dependent Variable	Independent Variables						R^2
	Lag1($APNT_{OTC}$)	Lag2($APNT_{OTC}$)	Lag3($APNT_{OTC}$)	Lag1($APNT_{ELS}$)	Lag2($APNT_{ELS}$)	Lag3($APNT_{ELS}$)	
$APNT_{OTC}$	0.279**	0.058	-0.191**	-0.444	0.161	0.120	0.103
	(0.092)	(0.097)	(0.063)	(0.237)	(0.208)	(0.167)	
$APNT_{ELS}$	-0.001	-0.017	0.000	0.330**	0.009	-0.214**	0.152
	(0.017)	(0.020)	(0.014)	(0.097)	(0.101)	(0.074)	

Figure 1: OTC Sample Characteristics as a Percentage of Listed Sample Characteristics

For each month, we plot the median size, median trading volume, and number of stocks in the OTC sample as a percentage of the corresponding statistics in the eligible listed sample. We plot the ratio of means rather than ratio of medians for volume prior to July 1995 because volume data are less reliable before 1995. The eligible listed sample consists of the CRSP stocks satisfying the same data requirements as the OTC sample described in Section I.B.

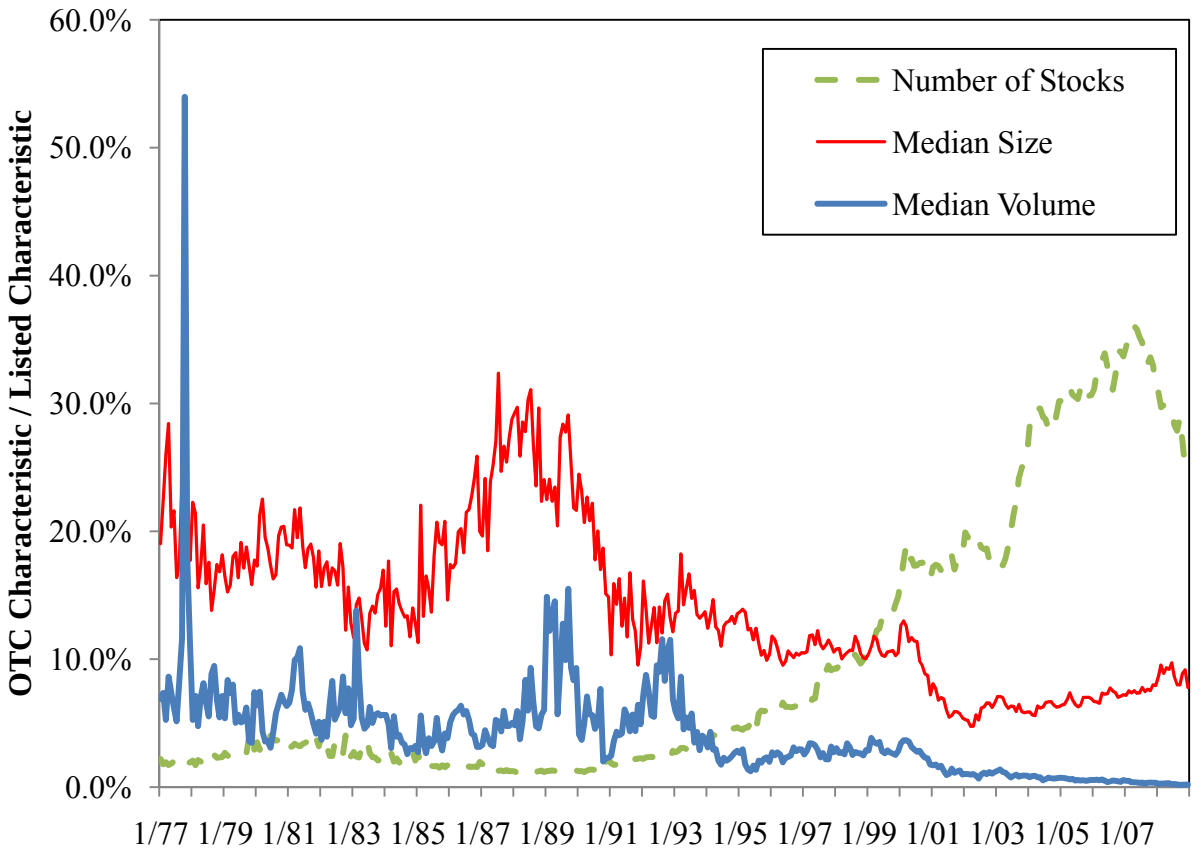

Figure 2: Listed Percentiles Corresponding to the 50th, 75th, 90th, and 99th OTC Percentiles

This figure compares the size of firms in the eligible listed and OTC samples in each month from 1977 to 2008. The four lines represent the four size percentiles in the eligible listed sample that correspond to the firms ranked at the 50th, 75th, 90th and 99th percentiles of size in the OTC sample in each month. The eligible listed sample consists of all listed stocks that satisfy the same data requirements as the OTC sample described in Section I.B.

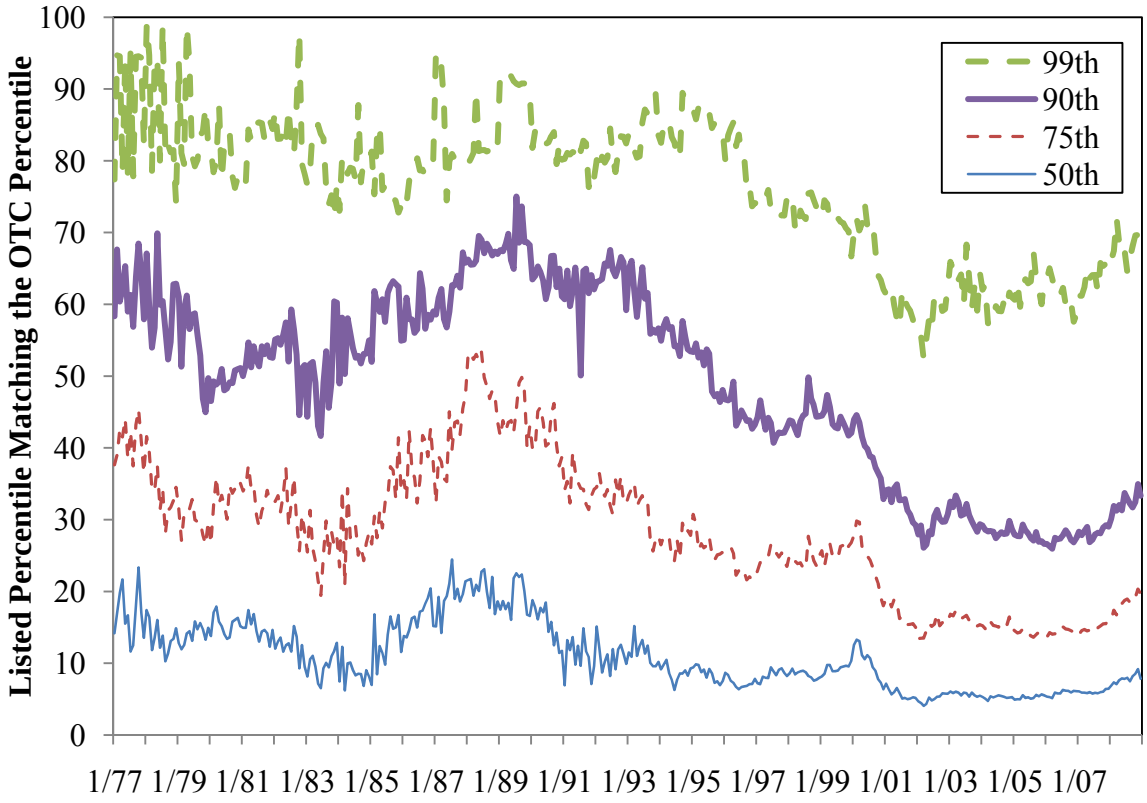

Figure 3A: The Value of $1 Invested in Illiquidity Factors

We graph the cumulative returns for illiquidity factors in the OTC, comparable listed, and eligible listed samples. We use a logarithmic scale to represent the evolution of the value of a $1 investment from December 1976 to December 2008 for the illiquidity factors from each market. For all three markets, we construct factors by sorting stocks into quintiles according to their monthly *PNT* values, where *PNT* is the fraction of non-trading days in a month. Each *PNT* factor return is the difference between the equal-weighted returns of firms in the top and bottom *PNT* quintiles. We also plot the cumulative return on the Pastor-Stambaugh liquidity factor from the eligible listed sample. We assume that an investor begins with $1 long and $1 short and faces no margin or other funding requirements. To facilitate comparison, we scale the long-short portfolio positions in the OTC and eligible listed factors so that the volatility of these portfolios is equal to the volatility of the long-short portfolio based on the comparable listed factor. The comparable listed sample consists of stocks that are comparable to stocks in the OTC sample in terms of size, as described in Section I.C. The eligible listed sample consists of all listed stocks that satisfy the same data requirements as the OTC sample described in Section I.B.

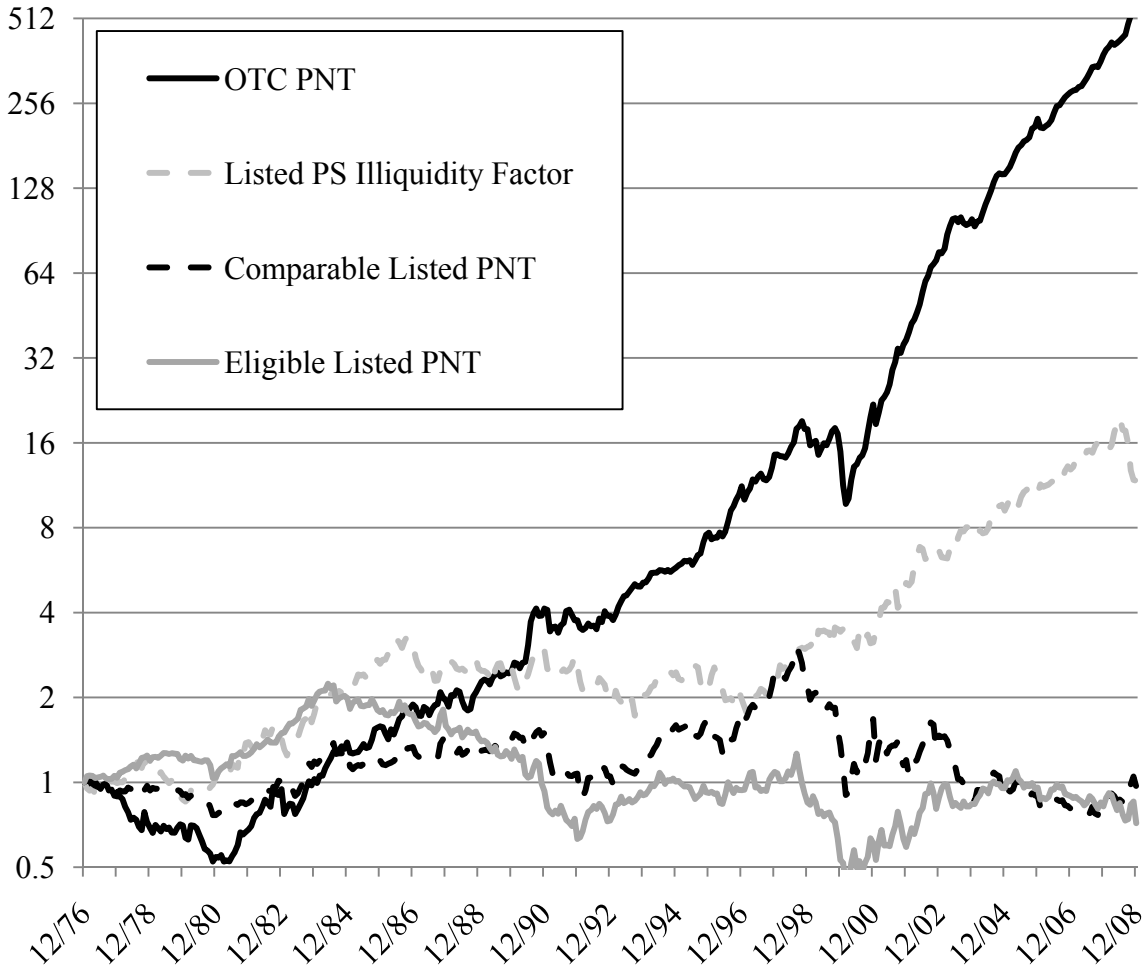

Figure 3B: The Value of $1 Invested in Size and Value Factors

We plot the cumulative returns for size and value (*B/M*) factors in the OTC and comparable listed samples. We use a logarithmic scale to represent the evolution of the value of a $1 investment from December 1976 to December 2008 for the size and value factors from both markets. We construct factors by sorting stocks into quintiles according to either their monthly size or *B/M* values, where the *B/M* variable representing value is the ratio of a firm's book equity to its market equity. Each factor return is the difference between the equal-weighted returns of firms in the top and bottom quintiles. We assume that an investor begins with $1 long and $1 short and faces no margin or other funding requirements. To facilitate comparison, we scale the long-short portfolio positions in the OTC and eligible listed factors so that the volatility of these portfolios is equal to the volatility of the long-short portfolio based on the comparable listed factor. The comparable listed sample consists of stocks that are comparable to stocks in the OTC sample in terms of size, as described in Section I.C. The eligible listed sample consists of all listed stocks that satisfy the same data requirements as the OTC sample described in Section I.B. We only compute the return on the value factors after 1993 because there are an insufficient number of OTC firms with book equity data before 1993.

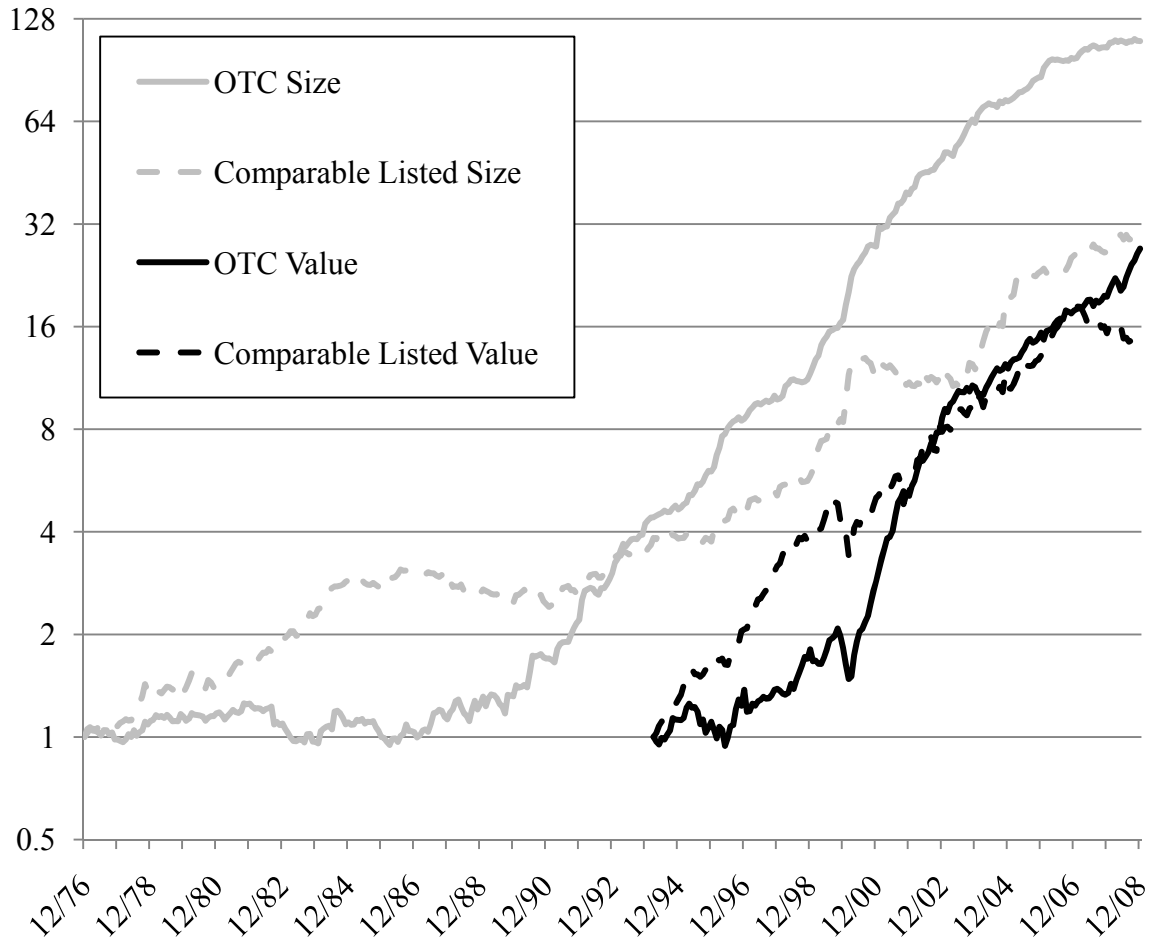

Figure 4: Average Fraction of Non-Trading Days for the OTC and Listed Samples

We plot average *PNT* values for the OTC , comparable listed, and eligible listed samples, where a stock's monthly *PNT* value is the fraction of non-trading days in that month. We remove four possible structural breaks in the time series of average *PNT* values for the OTC and listed samples, as described in Section V.B. The comparable listed sample consists of stocks that are comparable to stocks in the OTC sample in terms of size, as described in Section I.C. The eligible listed sample consists of all listed stocks that satisfy the same data requirements as the OTC sample described in Section I.B.