The Diminishing Liquidity Premium

By

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Abstract

Previous evidence suggests that less liquid stocks yield higher average returns. Using common-stock data, we present evidence that both the sensitivity of stock returns to liquidity and liquidity premia have significantly declined over the past four decades. Furthermore, the profitability of trading strategies, based on buying illiquid stocks and selling liquid stocks, has significantly declined over this time period. Our results are robust to several conventional liquidity proxies related to volume, are not driven by size effects, and apply strongly to NYSE and NASDAQ, and weakly to AMEX. We offer possible explanations for these results, related to the proliferation of index funds and exchange-traded funds, and to enhancements in markets that facilitate arbitrage activity. Consistent with this view, we find no trend in the liquidity premium for non-common stocks and for "penny stocks," and identify an increasing difference between the average holding periods of liquid vs. illiquid stocks.

1 Introduction

Liquidity is often defined as "the ability to trade large size quickly, at low cost, when you want to trade" (Harris (2003), p. 394). Starting from the work of Amihud and Mendelson (1986), it has been argued that liquidity has an important effect on the prices of financial assets. Amihud and Mendelson assume exogenous trading frequencies and conclude that less liquid securities yield higher expected returns which, in turn, benefit investors with long trading horizons. Furthermore, the price effects of liquidity may be first order, since the price reflects the present value of all future transaction costs. This idea has been subject to theoretical debate, as models that endogenize the trading frequency suggest that the price effect of liquidity is second order (Constantinides (1986) and Vayanos (1998)).[1]

The empirical presence of liquidity premia has been investigated extensively for various asset classes, using several different methodologies.[2] Amihud and Mendelson (1986, 1989), Brennan and Subrahmanyam (1996), Eleswarapu (1997), Brennan, Chordia and Subrahmanyam (1998), Amihud (2002), Chordia, Huh, and Subrahmanyam (2008), among others, find that different measures of illiquidity are associated with higher future stock returns.[3] Amihud and Mendelson (1991) find similar results in bond markets. Recent studies (e.g., Pastor and Stambaugh (2003), Acharya and Pedersen (2005), Sadka

[1] See additional related discussions in Jang, Koo, Liu, and Loewenstein (2007) and Levy and Swan (2008).
[2] For a comprehensive survey of this literature, see Amihud, Mendelson, and Pedersen (2006).
[3] Some exceptions should be noted. Hasbrouck (2009) finds only weak pricing effects using a proxy for the effective bid-ask spread. Spiegel and Wang (2005) find that much of the pricing effect of illiquidity is subsumed by the effect of idiosyncratic risk. Barclay, Kandel, and Marx (1998) do not find a significant price effect following a change in liquidity resulting from stocks moving between NASDAQ, NYSE, and AMEX.

(2006), Korajczyk and Sadka (2008), and Charoenrook and Conrad (2008)) have taken liquidity premia one step further and argue that liquidity is a priced risk factor.[4]

In this paper, we focus on liquidity as a characteristic, rather than as a risk factor. We argue that the sensitivity of expected returns of common stocks to conventional measures of liquidity, and the liquidity premium have significantly declined over the past 45 years. Obviously, liquidity itself has improved over the years following numerous regulatory reforms (such as decimalization) and technological improvements. Our key point, however, is different. Our main claim is not about liquidity itself; rather, we argue that the effect of each unit of liquidity on returns has declined over the years. In a practical sense, we hypothesize that if we put returns on the left-hand side of a regression and a measure of liquidity on the right-hand side, then the coefficient of liquidity declines over time (in absolute value), and the total effect (liquidity times the coefficient) declines over time. We further argue that the profitability of liquidity-based long-short trading strategies has decreased over the years. We test these hypotheses using CRSP common stock data between 1964 and 2008.

Our tests employ three popular volume-related proxies for liquidity. Our main liquidity measure is an inflation-adjusted version of Amihud's illiquidity measure (Amihud, 2002), defined as the absolute return per unit of one million dollar volume. This measure is easy to calculate from daily CRSP data, and has gained popularity in recent years (e.g., Acharya and Pedersen (2005), Korajczyk and Sadka (2008), and Kamara, Lou and Sadka (2008)). Adjusting for inflation is needed to facilitate comparisons over time, since the real value of dollar volume is changing. We provide

[4] Kamara, Lou, and Sadka (2008) show divergence over time between the systematic liquidity components of small-cap and large-cap firms. They attribute their findings to patterns of institutional ownership.

robustness tests using two other volume-related liquidity measures: annual turnover and annual dollar volume. These measures have been frequently used to proxy for liquidity (e.g., Brennan, Chordia, and Subrahmanyam (1998), Chordia, Subrahmanyam, and Anshuman (2001), Datar, Naik, and Radcliffe (1998), and Korajczyk and Sadka (2008)).

The sample period for our main tests is 1964-2008. We start our investigation in 1964, due to the availability of Compustat data (needed to obtain the book-to-market variable). Similar to Hasbrouck (2009), we separate the analysis between the three stock exchanges NYSE, AMEX, and NASDAQ. This allows us to account for different institutional details associated with the measurement of volume, and the different attributes of the listings in these exchanges. Due to data availability, the results for NASDAQ are restricted to a period starting in the mid-1980s.

In our first set of tests, we use a Fama-MacBeth approach to estimate the effect of liquidity on returns and the liquidity premium during different sub-periods of our sample period. Both parametric and non-parametric tests show that over the sample period both the sensitivity of returns to liquidity and liquidity premia of common stocks have declined. This applies strongly for NYSE and NASDAQ and less strongly for AMEX. For example, using Amihud's measure, we find that for common stocks listed in NYSE, the average annual liquidity premium has declined from about 1.6% in the period 1964-1974 to 0.1% (statistically insignificant) in the period 1997-2008. A similar trend is observed for common stocks listed in NASDAQ starting from the mid-1980s. For example, the annual liquidity premium associated with Amihud's measure from 1986 to 1996 is about 2.5%. This premium declined to 0.7% (with marginal statistical significance) in the period 1997-2008. When examining AMEX stocks we find signs of a similar trend, but the result is less clear. On one hand, the recent period of 1997-2008 shows an insignificant liquidity premium associated with Amihud's measure on this exchange. On the other hand, the pattern of decline is less stark compared to the other two stock exchanges.

We further show that popular trading strategies, based on buying illiquid stocks and selling liquid stocks, have lost much of their profitability over the years. For example, in NYSE, the average monthly Fama-French four-factor alpha of a strategy long in illiquid stocks and short in liquid stocks between 1964 and 1985 was 0.48% (5.76% annually). By contrast, starting from the mid-1980s, the average alpha of such strategies is not significantly different from zero.

Naturally, firm size and liquidity are highly correlated. Importantly, our results regarding the decline in the effect of liquidity on returns are distinct from well-documented trends in the small-firm anomaly (e.g., Fama and French (1992), Dichev (1998), and Schwert (2003)). We verify this in three ways. First, in our regression analysis we control for size effects. Second, in our analysis of liquidity-based trading strategies we control for the sensitivity of the liquidity-based portfolios to common variations in small vs. large firms (the SMB factor). Finally, in our analysis of liquidity-based investment strategies we pre-sort the data by size, controlling for a non-linear relation between liquidity and size.

We also provide evidence from the pre-Compustat period. We repeat our analysis during the period 1927-1963 (without controlling for book-to-market), and show that liquidity was significantly priced during that period. Additionally, we analyze the profitability of liquidity-based portfolios during that period and show that they demonstrated very large abnormal returns. Apparently, the liquidity premium is not merely an anomaly of the recent past.

Overall, the results show a strong decline in the effect of volume-related liquidity on expected returns of common stocks in NYSE and NASDAQ. The results are less conclusive for AMEX stocks. These results are important for both valuation and asset management applications. The existence of liquidity premia plays a central role in the valuation of financial assets. A 1% decrease in the discount rate may translate into a 15%–20% increase in valuation.[5] Furthermore, liquidity-based long-short trading strategies have become common, especially for hedge funds. Our findings suggest that the profitability of such strategies in recent years may have declined for stocks listed on NYSE and NASDAQ.

Importantly, our main hypotheses and results relate to a *decline* in the liquidity premium. Our results suggest that the decline is robust among common stocks. A distinct question is whether liquidity is still priced among common stocks in the most recent period. That is, has the liquidity premium disappeared? Here the results vary and depend crucially on attributes, such as size and exchange. For example, liquidity appears priced for common stocks listed on NASDAQ even in the most recent period, despite a dramatic decline in the pricing over the years. In comparison, for NYSE stocks we also see a sharp decline in the pricing of liquidity among common stocks; and here we cannot reject the hypothesis that the liquidity premium in the most recent years is zero.

[5] For a typical calculation, see the spreadsheet posted on Aswath Damodaran's website: http://pages.stern.nyu.edu/~adamodar. For the data posted on the June 2010 version of the spreadsheet, a 1% change in the equity premium changes the value of the S&P 500 index by about 20%. This calculation assumes a constant and exogenous dividend yield and earnings growth. Obviously, a reduction in the discount rate may actually increase future earnings by making more projects profitable, thereby intensifying the effect.

We next present possible explanations for the decline in the liquidity premium. We conjecture that the presence of financial instruments that allow investors to indirectly buy and sell illiquid assets (such as index funds and ETFs) works to lower the sensitivity of returns to liquidity. Furthermore, as shown in Subrahmanyam (1991) and Gorton and Pennacchi (1993), these instruments enable investors to indirectly hold illiquid stocks for very low transaction costs. This should prolong the investment horizon of the marginal investor in illiquid stocks, and thereby reduce the sensitivity of returns to liquidity. Secondly, we suggest that intense competition from arbitragers on exploiting the liquidity premium may have contributed to its decline. For example, some hedge funds buy illiquid stocks and short-sell liquid stocks, in an attempt to pocket the liquidity premium. Intense activity of this kind would drive down the liquidity premium. Furthermore, changes in markets that facilitate arbitrage may have contributed to the decline in the liquidity premium by encouraging such long-short strategies. One example of such a change is the ability to synthetically short assets using options and futures, which have greatly developed over the recent decades.

Our suggested explanations cannot be readily tested or refuted in the absence of a clear event study. For example, hedge funds, index funds and ETFs were gradually introduced and gained popularity slowly over time. We do, however, provide some evidence which appears consistent with our suggested explanations.

First, we identify asset classes which are typically excluded from index funds and ETFs, and thereby are expected to demonstrate a weaker (if any) decline in the liquidity premium. One such asset class is non-common stocks, such as Closed End Funds (CEFs), Real Estate Investment Trusts (REITs), and foreign incorporated companies (including

American Depositary Receipts - ADRs). Another such asset class is "penny stocks," which we define as stocks with a price of less than $2. Our baseline sample excludes both of these asset classes. When we examine these two asset classes, we do not find a decline in either the liquidity coefficient or the liquidity premium. Furthermore, liquidity is often priced for these asset classes, even in the most recent periods. This stands in contrast to our baseline findings, and is consistent with the view that inclusion in indices may contribute to a decline in the liquidity premium.

Second, our explanation, regarding the proliferation of index funds and ETFs, suggests that the investment horizon of the marginal investor in illiquid stocks has increased. Consequently, we should observe an increasing difference between the investment horizons of investors in illiquid vs. liquid stocks. Building on Atkins and Dyl (1997a), who measure the investment horizon using share-turnover, we show that this is indeed the case. In fact, the wedge between the share turnover of illiquid stocks and liquid stocks increased dramatically over our sample period. This is again consistent with our proposed explanations.

The rest of the paper is organized as follows. Section 2 describes the data and the main variables of interest. Section 3 presents the empirical results regarding the decline in liquidity premium, as well as the decline in the profitability of liquidity-based trading strategies using Amihud's measure. Section 4 discusses possible explanations for the results, and presents related evidence. In Section 5, we explore the robustness of the results using alternative measures of liquidity, and for the pre-Compustat period. We conclude in Section 6.

2 Data and Main Variables

The sample for our main analysis consists of all common stocks drawn from CRSP between January 1964 and December 2008 with share codes 10 or 11 (common shares). Due to data availability, for NASDAQ stocks we only consider the period January 1985 to December 2008. In Section 4, we also study separately non-common stocks such as Closed End Funds, REITs, and foreign companies (including ADRs).[6]

Our main liquidity measure is a modified version of the measure presented in Amihud (2002). This is an annual measure of illiquidity in the spirit of Kyle's (1985) lambda, calculated based on the annual averages of daily absolute price changes, adjusted for dollar volume and inflation. Hasbrouck (2009), and Goyenko, Holden, and Trzcinka (2009) find, using intraday data, that Amihud's measure is a good proxy for price impact. Formally, Amihud's measure for stock *i* in year *t* is denoted by $Amihud_{i,t}$ and is given by

$$Amihud_{i,t} = \frac{1}{D_{it}} \sum_{d=1}^{D_{it}} \frac{|R_{idt}|}{VOLD_{idt} \cdot \inf_{dt}},$$

where R_{idt} is the return of stock *i* on day *d* of year *t*, $VOLD_{idt}$ is the dollar volume (in millions) of stock *i* on day *d* of year *t*, D_{it} is the number of available trading days for stock *i* in year *t*, and inf_{dt} is an adjustment factor for inflation, which allows us to present Amihud's measure using end-of-2008 prices. Such an adjustment is necessary, since the real economic meaning of dollar volume has changed significantly over the years.[7] Two additional related liquidity proxies that we use are dollar volume, defined as the

[6] In 1964, common stocks accounted for about 97% of all NYSE stocks. By contrast, in 2008 common stocks accounted for just 55% of all stocks listed on NYSE. Similar trends are also observed in AMEX and NASDAQ. This reflects the vast proliferation in recent years of ETFs, REITs and other types of funds. Considering common and non-common stocks separately ensures that this change in composition does not affect our time comparisons. We discuss this issue in detail in Section 4.

[7] Days with zero volume are not included in the calculation of Amihud's measure, while days with zero returns associated with a non-zero volume are included.

logarithm of the annual dollar volume (in millions), and turnover, defined as annual share volume divided by the average number of outstanding shares throughout the year.

The literature has used a variety of different scaling methods for Amihud's measure. For example, Amihud (2002) scaled his measure by the sample average of the measure in each month. Acharya and Pedersen (2005) scaled Amihud's measure by the sample market cap in the earliest year of their sample period. Our results are robust to these two different scaling methods. First, our measure of "liquidity premium" is identical to Amihud's scaled liquidity measure (see discussion in Section 3.1). We also checked our results with Acharya and Pedersen's version, and found similar conclusions.

To ensure the reliability of of our estimates, in our main analysis we calculate the liquidity measure only for stocks that satisfy the following two requirements: (i) the stock must have return data for at least 60 trading days during the year; and (ii) the stock must be listed at the end of the year and have a year-end price that is higher than $2.[8] Similar to Amihud (2002), for each year, we also censored the upper and lower 1% of the distribution of Amihud's illiquidity measures to avoid outliers.

Table 1 presents summary statistics for the stocks in our sample broken down by the exchange in which they are listed. The number of stocks in our sample ranges from 1,078 to 1,681 in NYSE, 239 to 1012 in AMEX, and 2,109 to 4,010 in NASDAQ. As can be observed, the three exchanges differ substantially in the composition of their listed stocks. The median market cap of stocks in NYSE during our sample period is $594 million, as opposed to just $33 million in AMEX, and $107 million in NASDAQ. Since

[8] This type of filters is common. See for example Amihud (2002), Acharya and Pedersen (2005), and Kamara, Liu, and Sadka (2008), who use similar or more restrictive filters. When we apply the stricter filters used in Amihud (2002), the decline in the liquidity premium becomes even more pronounced, as fewer small and illiquid stocks are included in the sample.

size and liquidity are highly correlated, Amihud's measure is more than 10 times smaller in NYSE as compared to NASDAQ and AMEX. Similar results apply to the other liquidity measures. This fact, in itself, suggests that an analysis of liquidity effects should distinguish between the different exchanges. The three exchanges differ in several other important dimensions that may affect a longtitudal analysis:

1. NASDAQ data on CRSP until the mid-1980s does not include volume information. This prevents us from examining liquidity measures in NASDAQ until that time.
2. It is well known that volume in NASDAQ is inflated (see Atkins and Dyl (1997b)), and the amount of inflation has varied over the years because of market reforms. Thus, the economic meaning of Amihud's measure (and other volume-related measures) in NASDAQ is different compared to NYSE and AMEX, and is not comparable over time.
3. Over the years, the different exchanges have experienced different market reforms that have affected the liquidity of their listings. For example, during the early to mid-1990s, AMEX introduced the "Emerging Company Market Place," which attracted smaller and less liquid listings. In 1997, NASDAQ implemented reforms that permitted the public to compete with dealers through limit orders. And, decimalization applied to the different exchanges at different points in time.
4. Finally, the three exchanges have experienced somewhat different trends in terms of the composition of their listings (in particular common vs. non-common stocks). We discuss this issue in detail in Section 4.2.1. For now it is important to note that common stocks have become less prevalent in all three exchanges, and

the situation is quite extreme in AMEX, where recently only about 35% of the listings are common stocks.

Due to the significant differences in characteristics and the additional reasons above, in all of our analyses we distinguish between the different exchanges (similar to Hasbrouck (2009)). This helps us prevent mixing the trends in the liquidity premium with trends in the types of stocks listed on a particular exchange, or with differences in the way volume is recorded.

Figure 1 plots the evolvement over time of Amihud's measure in the three exchanges. For each year, we plot the equal-weighted average of the liquidity measures across the firms available for analysis during that year. The picture is quite similar: while liquidity seemed to fluctuate during the 1970s and 1980s, it appears to have improved (expect perhaps in AMEX) since the early 1990s. This is consistent with the several market reforms (such as decimalization) and technological changes that took effect during these years. Chordia, Roll, and Subrahmanyam (2008) study the determinants of this trend. They find that the increased turnover is associated with more frequent smaller orders and with a higher level of institutional holdings. It is important to distinguish between this gradual improvement in liquidity and the effect of liquidity on returns, which is the focus of this paper. The fact that liquidity has improved does not, in itself, mean that the sensitivity of returns to illiquidity has changed or that liquidity premia have gone down.

Table 2 reports the averages of the monthly cross-sectional correlations among the three liquidity variables, as well as the market cap (Lnsize), and the daily standard deviation of returns (sdret). It is important to keep in mind that Amihud's measure is a measure of illiquidity, whereas dollar volume and turnover are measures of liquidity. Given this, the three measures are correlated as expected. However, the correlations are not extremely high. Apparently, the three measures reflect somewhat different aspects of liquidity.

Beyond the liquidity measures, our analysis uses several other variables. The main dependent variable is the stock return. We use monthly returns from CRSP and adjust the returns to account for delisting bias.[9] To account for the sensitivity of stock returns to risk factors, we use the Fama-French factor-loadings calculated by regressing daily excess returns on Fama-French four-factors (MKTRF, SMB, HML, and UMD), obtained from CRSP during each year in our sample period. This approach is similar to that of Ang, Hodrick, Xing, and Zhang (2009).

As for other control variables, we mostly follow Amihud (2002). These are: (i) End of year market capitalization - to capture the size effect. (ii) Daily standard deviation during the year - to capture the effects of idiosyncratic risk on stock returns. (iii) Dividend yield calculated as the sum of cash dividends (per share) during the year divided by the end of the year price. This variable helps capture the value premium and possible tax effects on returns. (iv) Two variables that account for past returns in an attempt to capture short-term momentum. The first is mom4, equal to the cumulative return during the last four months of the previous year; and the second is mom8, equal to the cumulative return during the first 8 months of the previous year. Note that including controls for both risk characteristics and factor loadings is now common (see for example Ang, Hodrick, Xing, and Zhang (2009)).

Finally, we control for book-to-market to account for the value premium. We

[9] Our approach here follows Shumway (1997) and is similar to that of Amihud (2002). The last return used is either the last return available on CRSP, or the delisting return, if available. Shumway finds an average delisting return of –30% using OTC returns of delisted stocks. We thus assign a return of –30% if a delisting is coded as 500 (reason unavailable), 520 (went to OTC), 551–573 and 580 (various reasons), 574 (bankruptcy) and 584 (does not meet exchange financial guidelines).

estimate book-to-market as in Fama and French (1992). That is, we use the firm's market value of equity at the end of December of year t-1, and the book value of equity (from Compustat) with fiscal year end in calendar year t-1. The book-to-market variable of year t-1 is then used in the regressions as an explanatory variable, whenever the dependent variable is the monthly return between July of year t until June of year t+1. This ensures that the balance-sheet information is public by the time we use it.

A well known problem is that book-to-market information is missing in many cases, especially in early Compustat years. To maintain statistical power and avoid creating any bias in the sample by dropping firms with no book-to-market information, we follow the approach of Pontiff and Woodgate (2008). That is, we define a dummy variable (BMdum) that takes the value of 1, whenever the book-to-market exists and is positive, and the value of 0 otherwise. Furthermore, we define a modified book-to-market variable, equal to the true book-to-market if it is available and positive, and to 0 otherwise. Then, in the regressions we include both the dummy and the modified log(book-to-market) variable. The latter is essentially an interaction variable between the dummy and the true log(book-to-market) variable. The coefficient on this interaction is an estimate of the loading on the original book-to-market variable on the sub-sample, where it is available and non-negative.

3 Analysis of Time Trends

Our main hypotheses are that (i) the sensitivity of returns to liquidity has declined over the period 1964–2008; (ii) liquidity premia have declined over this time period; and (iii) the profitability of liquidity-based portfolios has declined over this time period. We test the first two hypotheses by employing the Fama-MacBeth (1973) cross-sectional methodology to estimate the sensitivity of returns to illiquidity from monthly cross-sections of stocks. We then turn to testing the third hypothesis, using a time series analysis of liquidity-based portfolios.

To conserve space, we present our main results using Amihud's measure. We emphasize, however, that the results are robust to other volume-related measures of liquidity: dollar-volume and turnover. We provide a representative sample of results using the other measures in Section 5.1.

3.1 Cross-Sectional Analysis

For each month *m* in year *t* between January 1964 and December 2008 (540 months), we estimate a cross-sectional regression of the form:

$$R_{imt} = \alpha_{mt} + \sum_{j=1}^{J} \beta_{jmt} X_{ij,t-1} + \varepsilon_{imt} \,. \qquad (1)$$

That is, we regress the returns of stock *i* in month *m* of year *t* on a set of *J* explanatory variables calculated using data from year *t*–1. This ensures that the explanatory variables are known to investors at the time that monthly returns are realized. The main explanatory variable is Amihud's liquidity measure. We also include additional explanatory variables that have been shown (or are suspected) to be determinants of returns. These are the Fama-French four-factor loadings, as well as several characteristics: size (*market capitalization*), momentum, book-to-market, standard deviation of returns, and dividend yield. Given the discussion above, we run the regressions separately for each one of the three exchanges.

For the purpose of our analysis, the main output from these regressions is twofold. First, we obtain 540 monthly estimates of the sensitivity of returns to Amihud's illiquidity measure – one for each month in the sample period. Second, multiplying these monthly coefficients by the average liquidity measure of the relevant month, we obtain an estimate of the monthly liquidity premium. Essentially, this is an estimate of the expected return difference between a firm with perfect liquidity and a firm with average liquidity. Importantly, this liquidity premium is exactly equal to the regression coefficient in Amihud (2002), where he scales his measure by the market-wide average of the measure.[10] Thus, we propose a new interpretation for the liquidity coefficient given in Amihud (2002) – it is an estimate of the average liquidity premium.

In a second set of tests, we normalize the explanatory variables by their standard deviation, and run Fama-MacBeth regressions on the standardized variables. These tests are needed, since the variability of the liquidity measures has changed over the years. These tests allow us to estimate the effect of one standard deviation of liquidity on stock returns, and how this effect changes over time.

To begin, Table 3 presents a standard Fama-MacBeth analysis (broken down by stock exchange) for the entire sample period with non-normalized explanatory variables. For each explanatory variable, the table reports the average of the coefficient based on all of the monthly observations, as well as a t-statistic testing against the null hypothesis that this average is zero. The results are quite typical for this kind of test. Both a univariate and a multivariate analysis including all relevant control variables show that Amihud's measure is significantly priced. For example, the coefficient of Amihud's measure for

[10] In a linear regression, when one divides the explanatory variable by some number, the coefficient will be multiplied by the same number. Note that adjusting Amihud's measure for inflation has no effect in this case.

NYSE (Column (2)) is 0.60, with a t-stat of 2.38. This means that an increase of one standard deviation in Amihud's measure (0.21; see Table 1) would decrease monthly returns by 0.60*0.21=0.126% (1.5% annually). As another example, the coefficient of Amihud's measure for NASDAQ is 0.08 (Column (6)). Thus, an increase of one standard deviation in Amihud's measure (3.53; see Table 1) would decrease monthly returns by 0.28% (3.4% annually).

It seems that on average, over the entire sample period, liquidity is priced in an economically and statistically significant way. We argue that this result reflects a mixture of highly significant liquidity coefficients at the beginning of our sample period, and low and sometimes even insignificant liquidity coefficients more recently.

To get a first impression of the plausibility of this assertion, in Figure 2 we plot the liquidity regression coefficients obtained from Eq. (1), using Amihud's measure over time for NYSE, AMEX, and NASDAQ. The figure depicts the 10-year moving average of monthly point estimates of the liquidity coefficients, as well as a two standard-deviation confidence interval.[11] In all three exchanges, one can observe high liquidity coefficients early on, as opposed to lower coefficients in the later periods. In NYSE and AMEX, the decline in the liquidity coefficient seems quite dramatic during the 1970s to mid-1980s. As regards to NASDAQ, the decline in the coefficient seems gradual.

To attempt to statistically identify trends in the liquidity coefficients, we divide the 45 years in our sample period into four sub-periods: three 11-year periods and one 12-year period. The idea behind slicing the entire sample period into sub-periods is to neutralize some of the noise in the monthly coefficients by averaging them over several

[11] The confidence intervals for this graph were calculated separately for each rolling interval of 120 months, based on the standard errors associated with the average liquidity coefficient for that period.

years of data. Using 11(12) years of data gives us 132 (144) monthly observations per sub-period, which is likely to alleviate some of the inevitable noise.

We consider the following sub-periods: Period 1 is 1964–1974, Period 2 is 1975–1985, Period 3 is 1986–1996, and Period 4 is 1997–2008. We then apply the Fama-MacBeth analysis (as above) separately to each of the sub-periods and compare the resulting coefficients. We perform this analysis twice, once with non-standardized explanatory variables and once with standardized ones. We also calculate the average liquidity premium for each sub-period. To compare the sub-periods we use both a t-test, and the non-parametric Wilcoxon test. The latter helps prevent inferences driven by outliers.

Table 4 presents the results. For each exchange, we present three columns showing the average liquidity coefficient, the average standardized liquidity coefficient, and the estimated liquidity premium. Panel A depicts the results from a univariate analysis, whereas in Panel B we include (but do not report to conserve space) all of the control variables from Table 3.

First, consider the results for NYSE reported in Columns (1)-(3). Recall that in Table 3, we observed a significant coefficient for the entire period. Here we observe that in the multivariate analysis (Panel B) the coefficients for the first sub-period (1964-1974) are positive and significant. For example, considering the non-standardized case (Column (1)), the average liquidity coefficient in Periods 1 is 2.01, with a t-stat of 2.69. By contrast, the coefficients in Periods 2, 3, and 4 are much smaller, and are not significantly different from zero. A similar result is observed for the standardized coefficients (Column (2)). Additionally, the average monthly liquidity premium (Column (3) of

Panel B) in Period 1 is 0.13% or approximately 1.6% in annual terms. In Periods 2, 3, and 4, the monthly liquidity premium declines dramatically, and is not significantly different from zero. Furthermore, the differences between the first and the last period, and the differences between the coefficients in the first and last halves of the sample period (1965-1985 vs. 1986-2008) in Columns (1)-(3) of Panel B are mostly significant, suggesting that the pricing effect of liquidity in NYSE has declined. The univariate analysis for NYSE (Panel A) shows a similar trend only with the coefficients becoming insignificant starting with the third period.

When looking at AMEX data (Columns (4)-(6)) the trend is similar, but weaker (see Figure 2). As a result, the coefficients (in both the univariate and multivariate cases) become insignificant only in the most recent period; yet, the difference between the first and last period is highly significant. Note that the liquidity premium in AMEX remains relatively high, even throughout the 1990s. Hence, when splitting our sample period into two sub-periods, the coefficients for the sub-periods do not show a significant difference.

As regards to NASDAQ data (Columns (7)-(9)), we can only look at the two most recent sub-periods. Here again we see a similar trend. For example, the standardized coefficient of Amihud's measure in the multivariate analysis (Column 8) during 1986-1996 is 0.39 and highly significant. By contrast, the coefficient during 1997-2008 is just 0.14 and marginally significant. The difference between the two is highly significant. The monthly liquidity premium in NASDAQ falls from 0.21% (with a t-stat of 5.61) to just 0.06% (with a t-stat of 1.60). Overall, unlike in NYSE and AMEX, where we cannot identify a premium in the most recent 12-year period, there seems to be evidence of a smaller - but still somewhat significant - liquidity premium in NASDAQ. The univariate results for NASDAQ (Panel A) are quite consistent. They demonstrate significant coefficients and liquidity premium in the period 1986-1996, becoming statistically not different from zero in the period 1997-2008. However, the difference between the two sub-periods is not statistically significant. Thus, the significant difference in Columns (7)-(9) of Panel B should be attributed to the addition of the control variables.

Overall, the parametric and non-parametric tests seem consistent. They both support the hypotheses that liquidity coefficients and liquidity premia have been trending down. These results are strong for NYSE and NASDAQ, and weaker for AMEX.

3.2 Liquidity-Based Trading Strategies

The higher expected returns of illiquid stocks have long attracted long-term investors, who tried to reap the higher gains, not having to liquidate early. Anecdotal evidence suggests that some hedge funds use long-short strategies, buying illiquid stocks and short-selling liquid stocks of the same class. Given our results on the decline in the liquidity premium, it is important to know whether the profitability of these trading strategies declined as well.

It is also crucial to more closely examine the relation between liquidity and firm size. Prior research has pointed out that the effect of firm size on expected returns has declined since the early 1980s (e.g., Fama and French (1992), Dichev (1998), and Schwert (2003)). Our Fama-MacBeth regressions control for firm size, already taking any trends in this variable into account. Still, a concern is that the results obtained so far somehow reflect a size effect in a non-linear fashion.

To answer these questions, we construct portfolios double sorted on both size and liquidity. That is, we sort the stocks in our sample into three size groups, based on the previous end-of-year size. Within each size group, we sort the stocks into five illiquidity quintiles, based on the previous year's Amihud's illiquidity measure. By assigning equal weight to all firms, we obtain 15 portfolios for each and every month during our sample period. For each size tercile and each month, we then construct long-short liquidity-based portfolios. These portfolios are long in the least liquid quintile and short in the most liquid quintile within a certain size tercile. By examining time trends in the abnormal returns of these long-short portfolios, we can (i) examine whether the profitability of liquidity-based portfolios has changed over the years; and (ii) better isolate liquidity effects from size effects, which are captured through sorting first by size.

To evaluate the profitability of these portfolios, we estimate out-of-sample alphas, relative to the four Fama-French factors (MKTRF, HML, SMB, and UMD). Our approach here is similar to that of Brennan, Chordia, and Subrahmanyam (1998) and Chordia, Subrahmanyam, and Anshuman (2001). For each month m between 1964 and 2008, we regress the monthly excess returns of a portfolio on the returns of the Fama-French four factors during the preceding 60 months: m–60 to m–1. Thus, for each month m in our sample period, we obtain an estimate of the four-factor loadings as of that month. Denote these factor loadings by $\beta_{MKT,p,m}$, $\beta_{HML,p,m}$, $\beta_{SMB,p,m}$, and $\beta_{UMD,p,m}$, where, for example, $\beta_{MKT,p,m}$ stands for the loading on the market factor related to month m and portfolio p (one of the three liquidity portfolios). Now, for each month m we calculate the out-of-sample four-factor alpha of portfolio p (denote $Alpha_{m,p}$) as the realized excess return of the portfolio less the expected excess return calculated from the realized returns on the factors and the estimated factor loadings:

$$Alpha_{m,p} = \left(RET_{p,m} - Rf_m\right) - \beta_{MKT,p,m}\left(RET_{MKT,m} - Rf_m\right) - \beta_{SMB,p,m}SMB_m - \beta_{HML,p,m}HML_m - \beta_{UMD,p,m}UMD_m, \qquad (2)$$

where $RET_{p,m}$, $RET_{MKT,m}$, and Rf_m are the realized returns on portfolio p, the CRSP value-weighted index, and the risk-free rate, respectively, during month m; and SMB_m, HML_m, *and* UMD_m are the appropriate realized returns on the factor portfolios in month m. For each portfolio, we thus obtain a time series of 132 (or 144) out-of-sample alpha estimates for each of the sub-periods defined above.

Figure 3A plots a 10-year moving average of the alphas for NYSE stocks according to size tercile. It can be observed that the profitability of liquidity-based trading strategies declines, and that this trend applies to all sizes. A similar trend is observed for NASDAQ stocks in Figure 3B. We did not calculate double-sorted alphas for AMEX, since in the most recent periods the number of common stocks listed on AMEX is just about 250, and they are typically very small, allowing for little variation in size. We did, however, calculate one-way sorted alphas for AMEX data, based on liquidity only. The results show a declining trend quite similar to that observed in Figure 3A.

To formalize the analysis, the alphas of the liquidity-based long-short portfolios for each size tercile related to NYSE and NASDAQ are presented in Table 5 by sub-period. Let us begin by considering the results for NYSE presented in Panel A of Table 5. First, for the entire sample period the average alphas are significant for all three size terciles. For example, the average alpha associated with small stocks during the entire sample period is 0.44% per month (about 5% annually). The corresponding average alpha for large stocks is 0.14% per month. As in the Fama-MacBeth regressions, results for the entire period reflect a combination of high and significant alphas in the early period, and low and often insignificant alphas in the recent period. Indeed, in the first two sub-periods the alpha of the long-short portfolio is positive and significant for all three size terciles. For example, the alpha in Size 3 (largest stocks) is 0.44% and 0.31% per month in the first and second periods, respectively. In annual terms, these represent an abnormal return of about 4% to 5%. An even larger abnormal return is observed among the smaller stocks, where during the first and second sub-periods we have an alpha of 0.84% (0.41%) per month (about 10% (5%) annually), respectively. In sharp contrast, the alphas of the long-short portfolios are not statistically different from zero in the last two periods. To perform a formal test that incorporates all size terciles, we construct a "balanced portfolio" that has equal weights in each of the three long-short portfolios. This portfolio is forced to include stocks from all size terciles, allowing us to control for size. We then estimate the average alphas on the balanced portfolio during the different sub-periods. The results (rightmost column of Table 5) again show positive alphas in the first two sub-periods and statistically insignificant alphas in the last two sub-periods; the difference between the two is significant. Overall, the results in Panel A of Table 5 suggest a decline in the profitability of liquidity-based trading strategies on the NYSE.

Next, consider the results for NASDAQ, presented in Panel B of Table 5. Here, we only have two sub-periods, and the overall picture seems similar. However, the trend patterns are a bit different across the different size groups. First, for the small stocks tercile (Size 1) we see a significant alpha in both periods. However, the magnitude of the alphas has declined from 1.74% to 0.72%, and the difference is significant. In the intermediate size tercile (Size 2), the average alpha in the first sub-period is 1.07% per month. In the second sub-period, the average alpha drops and becomes insignificant. Finally, for the larger stocks (Size 3), the average alphas are insignificant for both time periods. The balanced portfolio, which provides an overall test for trend across all size terciles, shows a decline from an average alpha of 0.98% in the first sub-period to an insignificant alpha in the second sub-period, where the difference is statistically significant (t-stat of 2.49).

Overall, the results using liquidity-based portfolios reinforce the cross-sectional results that the liquidity premium has been trending down. Furthermore, this conclusion is intact, even accounting for time trends in the size effect. The decline applies to all three size terciles.

4 Possible Explanations

The empirical results presented so far call for an explanation. Why would the sensitivity of returns to liquidity and liquidity premia decline over the years? We first suggest two *possible* explanations related to changes and innovations in financial markets in recent decades. Then, to explore the plausibility of these explanations, we extend the sample of our analysis to non-common stocks and "penny stocks," and consider trends in the investment horizon of investors.

4.1 Two Possible Explanations

4.1.1 Index Funds and Exchange Traded Funds

Index funds and exchange-traded funds (ETFs) allow investors to buy and sell illiquid assets indirectly for low transaction costs (see a similar argument in Cherkes, Sagi and

Stanton (2008), within the context of closed end funds). For example, direct investment in Russell 2000 stocks is quite expensive in terms of illiquidity costs. However, Russell 2000 ETFs (e.g., IWM) are highly liquid, presumably because there is very little information trading in ETFs.[12] Furthermore, as shown in Subrahmanyam (1991) and Gorton and Pennacchi (1993), liquidity traders are more protected from informed trading by trading in baskets. The idea is that informed traders cannot exploit their security-specific information efficiently using baskets, since they must take essentially the same position in all securities in the basket. The ETFs and index funds themselves are long-term holders of the illiquid stocks, and thus incur only low transaction costs over the long run. They employ a passive trading strategy, and trade primarily following index changes.[13] Index funds also trade as a result of significant mismatches between inflows and outflows. While these instruments charge management fees that can be avoided by direct investment in the underlying stocks, these management fees are typically very low.[14]

Index funds and ETFs enable short-term investors to invest indirectly in illiquid stocks at low cost. As a result, in the presence of index funds and ETFs, direct investors in illiquid stocks are more likely to be long-term investors. In other words, it is possible that with the proliferation of these instruments, the holding horizon of direct investors in illiquid stocks has increased. Therefore, we expect that investors' compensation for investing in illiquid stocks has declined over the years, as index funds and ETFs have

[12] For example, during April 2006 the average relative bid-ask spread of IWM was 31 times smaller than the average relative bid-ask spread of the shares composing the index: 0.018% vs. 0.558%.
[13] For example, Morningstar reports that the turnover in Vanguard's 500 Index Fund (VFINX) is 12% and in Vanguard's Total Stock Market Index Fund (VTSMX) is 5%. In other words, these funds turn over stocks on average once every 8-20 years.
[14] For example, in 2006, the annual expense ratio of the Russell 2000 index fund of E*TRADE was 0.22%, while the expense ratio of IWM was 0.2%.

become more popular. Importantly, none of the existing theoretical papers suggesting the existence of liquidity premia considers investors that are allowed to invest in illiquid stocks indirectly through liquid funds that specialize in such stocks.

The past four decades have seen the introduction and proliferation of many such investment tools. Mutual funds grew dramatically in the late 1960s, index funds were introduced in the mid-1970s, and ETFs were introduced in the 1990s. The coverage and popularity of these instruments has constantly increased over the years. Thus, we hypothesize that these tools have contributed to a decline in the sensitivity of returns to the illiquidity of individual stocks, and to a decline in the liquidity premium.

4.1.2. Competitive Arbitrage Activity

Arbitragers (such as hedge funds) often hold long positions in illiquid assets and short positions in liquid assets, hoping to pocket the liquidity premium by maintaining the position for an extended time period.[15] For example, some hedge funds require an advance notice of several months before investors can withdraw their funds. These hedge funds can maintain relatively long investment horizons, and are well poised to benefit from a liquidity premium. However, extensive arbitrage activity of this kind inevitably drives the liquidity premium down. Thus, it is possible that intense competition among arbitragers has contributed to the decline in the liquidity premium.

Furthermore, changes in financial markets that facilitate arbitrage may have contributed to this trend. For example, the introduction and proliferation of options and futures contracts over the recent decades have greatly enhanced arbitrage activity,

[15] This strategy is also consistent with arbitraging mispricing, as in Baker and Stein (2004). In their model, liquidity is related to overpricing of stocks driven by investors' sentiment.

effectively loosening constraints on short positions. This trend may have lowered the cost of liquidity-based long-short strategies, contributing to a decline in the liquidity premium.

4.2 Evidence Related to the Possible Explanations

As discussed above, it appears to us that the enhanced arbitrage activity and the presence of low-cost diversification tools, such as index funds and ETFs, lower the compensation that investors receive for holding illiquid assets. Importantly, these arguments do not suggest that liquidity premia should completely vanish. Rather, they offer a plausible explanation for their decline.

Note that the validity of our suggested explanations cannot be easily tested. Insofar as hedge funds, index funds and ETFs were introduced and gained popularity slowly over the years, it is not possible to identify a single abrupt structural change that induced a decline in liquidity premia, which rules out an event study approach. So, while we cannot single out a particular "culprit" for the decline in the liquidity premium documented above, in this section we provide some evidence which appears to be in line with our suggested explanations.

4.2.1 Non-Common Stock

The results presented in Section 3 use only common stocks. An implication of our suggested explanations is that stocks that are less likely to be included in index funds or ETFs will experience a lower (if any) decline in their liquidity premium. One such group of stocks is non-common stocks. These include closed end funds, REITs, and foreign incorporated companies such as ADRs. These are often excluded from indices and similarly from index funds and ETFs.[16] Panel A of Table 6 reports summary statistics for non-common stocks over the period 1986-2008. The size of non-common stocks listed on NYSE and NASDAQ is smaller than that of common stocks. For example, the median market cap of non-common stocks in NYSE is $245 million, as opposed to $594 million for common stocks (see Table 1). By contrast, the size of non-common stocks listed on AMEX is larger than that of common stocks. For example, the median market cap of non-common stocks on AMEX is $61 million, as opposed to $33 million for common stocks (Table 1).

Interestingly, the importance of non-common stocks has risen significantly over recent years. Figure 4 plots the proportion of the number of non-common stocks out of all listed stocks in each of the three exchanges. The figure shows a dramatic increase in the proportion of non-common stocks in both NYSE and AMEX, especially starting from the mid-1980s. As of 2008, non-common stocks account for about 45% of all listings in NYSE and 65% of listings in AMEX. NASDAQ shows a similar, but much less dramatic, trend, mostly due to foreign company listings. In terms of market capitalizations, as of 2008, non-common shares account for 22% in NYSE, 84% in AMEX, and 10% in NASDAQ.

Figure 4 offers us a way to examine the plausibility of our suggested explanations. Given that these non-common stocks are often excluded from indexes and are harder to arbitrage, we expect a moderate or no decline in their sensitivity to liquidity and in their liquidity premium.

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[16] For example, as of 2006, the Russell 3000 index included about 65% of all common-stocks with a stock price above $2 and 60 trading days, but only about 13% of similar REITs, closed and funds, and foreign companies.

To test this hypothesis, we repeat the cross-sectional Fama-MacBeth analysis for the sample of non-common stocks only: CEFs, REITs, and foreign companies (including ADRs). We do this starting in 1986, since before this period we have very little cross-section in this group of securities. The results are presented in Panel B of Table 6. For both NYSE and AMEX the sensitivity of returns to Amihud's illiquidity measure is statistically significant over the entire 1986-2008 period. The liquidity premium is also positive and significant. Moreover, when we split the period into two sub-periods, we do not observe a decline in either the sensitivity or the premium. In comparison, the corresponding periods in Panel B of Table 4 show either no premium (in NYSE) or a significant decline (in AMEX). Surprisingly, Panel B of Table 6 shows that in NASDAQ the liquidity of non-common stocks is not priced. Neither the coefficient of Amihud's measure, nor the premium, are significant in any of the periods. However, we do not see a decline, either. A possible explanation may be that the composition of non-common stocks in NASDAQ is quite different than in the other two exchanges, since it almost entirely consists of ADRs and foreign incorporated stocks, rather than REITs and CEFs.

In sum, as hypothesized, we do not observe a decline in the liquidity premium associated with non-common stocks in all three stock exchanges.

4.2.2 "Penny Stocks"

Another group of stocks excluded from the main analysis consists of very small common stocks. That is, our baseline sample includes all common-stocks, except those with less than 60 trading days during the year and with a price lower than $2. This accounts for 99.44% of the market cap of all common stocks during the sample period.

The remaining stocks represent very small companies. These are typically excluded from index funds and ETFs, which track common indices.[17] Given the explanations provided above, we hypothesize a lower (if any) decline in the liquidity premium for these small stocks. A caveat is that our inferences for these stocks might be tainted by microstructure noise (e.g. Blume and Stambaugh (1983)). Nevertheless, it is very interesting to test this hypothesis, keeping this caveat in mind.

The restriction of at least 60 trading days seems necessary to obtain a reasonable calculation of Amihud's measure. Below we extend the analysis to the group of stocks with a price lower than \$2 and at least 60 trading days throughout the year. For concreteness, we term such stocks "penny stocks." NYSE includes very few such stocks;[18] hence, we restrict attention to NASDAQ and AMEX. In the absence of NASDAQ data before the mid-1980s, and since the sample of "penny stocks" in AMEX before the mid-1980s often becomes too small to accommodate our cross-sectional regressions, we only consider the time period starting in 1986. We present summary statistics in Panel A of Table 7. The average (median) market cap of these stocks is \$19.4 (\$11.6) million in AMEX and \$22.7 (\$13.6) in NASDAQ. The liquidity of these stocks is very low. For example, the median Amihud's measure in NASDAQ is 5.2, compared to 0.35 for the rest of the sample (Table 1).

We now repeat the cross-sectional analysis performed in Section 3 restricting it to the sub-group of "penny stocks." The results are reported in Panel B of Table 7. To correct for possible microstructure bias, in this analysis we employ the weighted-least

[17] For example, as of 2006, Russell 3000 included only about 15 stocks with a price lower than \$2. During that year, S&P 1500 included only seven such stocks. In general, we checked that more than 95% of common stocks with a price lower than \$2 are not included in either the Russell 3000 or S&P 1500 indices.
[18] The monthly average number of stocks with a price lower than \$2 during our sample period listed on NYSE is about 17.

squares procedure suggested in Asparouhova, Bessembinder, and Kalcheva (2009).[19] First, for the entire sample period 1986-2008, we see significant coefficient and liquidity premium in five out of the six specifications. For example, the estimated monthly liquidity premium in AMEX is 0.49% (5.9% annually). This is about four times the premium estimated during the same period for the corresponding sample in Table 4. More importantly, when we look at the two sub-periods, we see no significant decline in any of the six specifications, although the magnitudes seem to have decreased in four out of the six specifications. This conclusion applies to both the t-tests and the non-parametric Wilcoxon tests.

These results seem broadly consistent with a weaker decline in the liquidity premium for small stocks, as expected. Unlike in our baseline analysis, where the decline in the coefficients and the premiums is very robust, here we do see some signs of a decline, but they are not significant. It is also important to notice that in three out of the six specifications in Table 7, the coefficients (or premium) are significant, even in the most recent period. This is consistent with the results in Panel B of Table 5, where we observed that liquidity is priced in the most recent periods among the smallest stocks.

4.2.3 The Holding Period of Common Stocks

In their model, Amihud and Mendelson (1986) establish a clientele effect: short-term investors are attracted to liquid stocks, whereas long-term investors are attracted to illiquid stocks. Atkins and Dyl (1997a) provide consistent evidence using share turnover

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[19] Note that when we apply this procedure to the main results reported in Section 3, there is no material effect on any of our conclusions.

as a measure of the average holding period of a particular stock. They establish that the average holding period of illiquid stocks is significantly larger than that of liquid stocks.

Our proposed explanations for the decline in the liquidity premium suggest that over the years, indirect and cheap ways to invest in illiquid stocks (e.g. index funds and ETFs) attract short-term investors. Hence, those who choose to invest directly in illiquid stocks are likely to be long-term investors who demand a lower liquidity premium. Consequently, if our explanation has any bearing, we expect to see a gap between the time changes in the turnover in liquid stocks, as opposed to liquid stocks.

To examine this point, Figure 5A plots the evolvement over time of the turnover in the top and bottom liquidity deciles in NYSE and NASDAQ, based on Amihud's measure.[20] It is observed that turnover has increased over the years in both illiquid and liquid stocks. This is consistent with the evidence in Chordia, Roll, and Subrahmanyam (2008). However, the trend is much stronger among liquid stocks. That is, in relative terms, the holding period in illiquid stocks has become longer. To show this, Figure 5B plots the difference between the average turnover in the top and bottom liquidity deciles. The upward trend is clearly observed. Moreover, when regressing these differences on a time trend, we find the trend to be highly significant (results not tabulated). Overall, these descriptive results seem broadly consistent with the possible explanation we provided for the decline in the pricing of liquidity.

5 Extensions and Robustness Tests

[20] As in Section 3.2, the small number of common-stocks listed in AMEX in the recent period prevents us from performing this analysis for AMEX in a reliable manner.

In this section we check the robustness of the results to alternative volume-related measures of liquidity, after which we study the pricing effects of liquidity in the pre-Compustat period.

5.1 Alternative Measures of Liquidity

In addition to Amihud's measure, we consider two alternative volume-related measures of liquidity: dollar volume and turnover, both of which were described in Section 2. Note that from Table 2, the correlation between the log of firm size (Lnsize) and the log of dollar volume (Lndvol) is very high: 0.87 in NYSE and somewhat lower in on AMEX and NASDAQ. This high correlation makes it virtually impossible to draw statistical inferences when using these two variables in one regression. For this reason, in this section we present a Fama-MacBeth analysis using turnover only, and a portfolio analysis using both dollar volume and turnover.

Table 8 presents the results of a Fama-MacBeth analysis similar to that presented in Table 4, where turnover is used as a measure of liquidity. All the control variables from Table 3 are included in the model, but are not reported for brevity's sake. The table reports standardized and non-standardized coefficients. The liquidity premium in this case cannot be calculated, since the turnover measure does not lend itself to a benchmark that can be considered "perfectly liquid."

The results show that turnover is strongly priced over the entire period 1964-2008 on all three stock exchanges. For example, the coefficient in NYSE is -0.41 with a t-stat of 4.87. The results also show a decline in the premium on both NYSE and NASDAQ over the years. For example, during the first two sub-periods, both the standardized and non-standardized coefficients in NYSE are significant, but they become insignificant in the latter two periods. The difference between the periods in NYSE is also significant. Similarly, the non-standardized coefficient in NASDAQ is more than four times larger during the period 1986-1996, as opposed to 1997-2008, and, the difference between the two is significant. The standardized coefficient also shows a big economic decline; however, statistically it is only marginally significant. By contrast, the results in AMEX in this case do not show a trend. This in line with the results from Section 3, where the decline in the liquidity premium was strong in NYSE and NASDAQ, but fairly weak in AMEX.

We now turn to explore the profitability of liquidity-based portfolios using Turnover as a measure of liquidity. As in Table 5, we double sort portfolios by size and liquidity and report the out-of-sample four-factor alphas for long-short portfolios related to three size-terciles, as well as to a balanced portfolio. Panel A of Table 9 reports the results for NYSE. It shows that liquidity is strongly priced for the entire sample period for all size terciles, as well as for the balanced portfolio. Moreover, the panel shows a strong decline in the profitability of the portfolios for the two largest size terciles. The balanced portfolio also shows a significant decline: during 1964-1985 the average alpha was 0.64%, whereas it declined during 1986-2008 to just 0.34% (a decline of 47%).

Panel B shows the results for NASDAQ for the period 1986-2008. Once again, the alphas are large and significant for the entire sample period. When examining the two sub-periods, we observe that the average alpha is significant for all size terciles during the first sub-period, but is insignificant in two of the terciles during the later sub-period. The average alpha related to the balanced portfolio is 52% smaller during the second period, as compared to the first period (0.53% vs. 1.12%), though the difference is only marginally significant.

Table 10 repeats the analysis of the profitability of liquidity-based portfolios using dollar-volume as a measure of liquidity. The results are consistent with what we have seen so far. Panel A shows results for NYSE and Panel B shows results for NASDAQ. As before, in both cases the alphas are positive and significant for all size terciles over the entire sample period and during the early periods. However, we observe a significant drop in the alphas during the later periods. For example, Panel A shows that the average alpha related to the balanced portfolio during 1964-1985 in NYSE was 0.66%. The average alpha during 1986-2008 dropped by about 67% to just 0.21%, and the difference between the two is significant.

Overall, the results in this section show that the decline in the liquidity coefficient, and the profitability of liquidity-based trading strategies, are not unique to Amihud's measure. Rather a similar pattern is observed for other volume-related measures of liquidity. As before, the trend in the pricing of liquidity is significant - both statistically and in magnitude - in both NYSE and NASDAQ, but not in AMEX.

5.2 The Pre-Compustat Period

In our Fama-MacBeth regression analysis we use Compustat to calculate the book-to-market variable. Thus, the sample period for our main analysis starts in 1964, when Compustat data is available. It is interesting to explore the magnitude of the liquidity premium in the period that preceded our main analysis. To this end, we repeated both the Fama-French analysis and the analysis of liquidity-based portfolios, for the period 1927-

1963, using CRSP data for NYSE only (AMEX trading started in 1962, while NASDAQ trading began in 1973).

Table 11 reports the results for a Fama-MacBeth analysis, using both Amihud's measure and Turnover as proxies for liquidity. As discussed above, the model excludes the book-to-market variable.[21] The results show that during this early period liquidity was strongly priced. For example, the standardized coefficient of Amihud's measure is 0.15 with a t-stat of 2.76, as opposed to 0.083 with a t-stat of 3.1 during 1964-2008.

In Table 12 we examine the profitability of liquidity-based portfolios in NYSE during the pre-Comustat period using the three liquidity measures: Amihud, Turnover, and dollar-volume. As CRSP data starts in 1926, and since we need at least five years to generate out-of-sample alphas, we explore this issue over the period 1931-1963. For the three liquidity measures, and for all three size terciles, liquidity-based alphas come up highly significant. Again, the magnitudes of the alphas are very large, compared to what we have observed starting from the mid-1960s. For example, the average alpha for the balanced portfolio during 1964-2008 (from Panel A of Table 5) is 0.26%. By contrast, the average alpha during 1931-1963 is 0.43% (about 65% larger). A similar pattern is observed when comparing the results using turnover and dollar-volume to the results in Tables 9 and 10. Liquidity-based trading strategies seem to have been very profitable during the pre-Compustat period.

6 Conclusion

[21] The model also excludes the SMB, HML, and UMD betas, since the Fama-French portfolios are not available on a daily basis before 1963. In a robustness test, we repeated the analysis including all factor betas starting from 1931 using 5 years of monthly data to calculate the loadings. The results are similar.

Using common-stock data between 1964 and 2008 and volume-related liquidity measures, we find that both the sensitivity of returns to liquidity and liquidity premia have significantly declined over the past four-and-a-half decades. Furthermore, the profitability of liquidity-based trading strategies has significantly declined over this period. The evidence is decisive for NYSE and NASDAQ but not for AMEX. Moreover, these results are not driven by size effects.

We offer possible explanations for these results. It is possible that over the years more investors have tended to invest in illiquid stocks indirectly through index funds and ETFs, bypassing the high illiquidity costs, and prolonging the investment horizon of the marginal investor in these stocks. Additionally, competitive arbitrage activity may have caused the liquidity premium to shrink. We provide initial evidence which appears supportive of these explanations. Indeed, we observe a weaker or no decline in the liquidity premium among non-commons stocks and penny-stocks, both of which are often excluded from indices. Furthermore, we identify an increasing difference between the average holding periods of liquid vs. illiquid stocks.

The results have important implications for valuation and asset management. In particular, the results seem to be related to the conclusion of Dimson, Marsh, and Staunton (2003), who claim that a part of the realized equity returns in the second half of the 20th century is due to a reduction in equity discount rates. Our findings suggest that a portion of this reduction may have been due to the decline of the liquidity components in expected returns. On the asset management side, the results raise a question regarding the profitability of liquidity-based strategies, which have become popular since Amihud and Mendelson's (1986) seminal paper.

Furthermore, it has been argued that other attributes of firms, such as disclosure policy, may affect their cost of capital (and value) through its effect on liquidity. These claims should be evaluated in light of our findings.

Finally, our focus in this paper was on liquidity as a characteristic, as in Amihud and Mendelson (1986) and Eleswarapu (1997), among others. Recent literature has focused on liquidity as a priced risk factor (e.g. Acharya and Pedersen (2005), Pastor and Stambaugh (2003), and Sadka (2006)). It would be interesting to examine whether this "factor premium" also exhibits a trend similar to the "characteristic premium," which we document in this paper.

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Table 1: Summary Statistics of Selected Variables

The table reports the time-series average of the monthly cross-sectional sample statistics for all stocks in our sample traded on NYSE, AMEX and NASDAQ. The sample for the reported variables is 1964–2008 for NYSE and AMEX and 1986-2008 for NASDAQ. Amihud is Amihud's (2002) illiquidity measure adjusted for inflation presented in December 2008 prices. Turnover is the sum of monthly stock volume values divided by the average number of outstanding shares throughout the year. Dvol is the annual dollar volume (in millions of dollars). Sdret is the standard deviation of the daily returns. Size is the end-of-year market capitalization (in millions of dollars). Firms, is the in the number of firms in the sample. Min (Max) Firms is the time-series minimum (maximum) number of firms in the sample.

	NYSE			AMEX			NASDAQ		
Variables	**Mean**	**Median**	**Std**	**Mean**	**Median**	**Std**	**Mean**	**Median**	**Std**
Amihud	0.097	0.025	0.211	1.635	0.735	2.389	1.701	0.347	3.533
Turnover	0.61	0.48	0.48	0.39	0.26	0.48	1.21	0.77	1.46
Dvol ($ million)	2,124	630	3,967	50	11	147	888	113	2,767
Sdret (%)	2.19	2.03	0.85	3.06	2.89	1.35	3.78	3.54	1.75
Size ($ million)	2,083	594	4,557	88	33	207	344	107	822
Firms	1,298	1,302	132	565	529	204	2,808	2,695	531
Min Firms	1,078			239			2,109		
Max Firms	1,681			1,012			4,010		

Table 2: Cross-Sectional Correlations

The table presents the average of the monthly cross-sectional Pearson correlations from January 1964 to December 2008 for NYSE and AMEX stocks, and January 1986 to December 2008 for NASDAQ stocks. Amihud is Amihud's (2002) illiquidity measure adjusted for inflation presented in December 2008 prices. Turnover is the sum of monthly stock volume values divided by the average number of outstanding shares throughout the year. Lndvol is the logarithm of the annual dollar volume (in millions of dollars). Lnsize is the logarithm of the end-of-year market capitalization (in millions of dollars).

Panel A – NYSE

Variable	Turnover	LnDvol	Sdret	LnSize
Amihud	-0.17	-0.63	0.26	-0.56
Turnover		0.36	0.48	-0.03
LnDvol			-0.14	0.87
Sdret				-0.44

Panel B – AMEX

Variable	Turnover	LnDvol	Sdret	LnSize
Amihud	-0.23	-0.63	0.33	-0.58
Turnover		0.58	0.39	0.11
LnDvol			0.12	0.75
Sdret				-0.24

Panel C – NASDAQ

Variable	Turnover	LnDvol	Sdret	LnSize
Amihud	-0.26	-0.57	0.35	-0.50
Turnover		0.62	0.25	0.26
LnDvol			-0.06	0.83
Sdret				-0.32

Table 3: Fama-MacBeth Regressions over the Entire Sample Period

The table presents the mean of the coefficients from monthly cross-sectional regressions of stock returns on explanatory variables (Eq. (1)). The sample period is 1964–2008 for NYSE and AMEX, and 1986-2008 for NASDAQ, resulting in 540 and 276 monthly cross-sectional regressions, respectively. Amihud is Amihud's (2002) illiquidity measure adjusted for inflation presented in December 2008 prices. Lnsize is the logarithm of the end-of-year market capitalization (in millions of dollars). B_MKT, B_SMB, B_HML and B_UMD are the loadings from a Fama-French four factor model, calculated based on the daily returns. Sdret is the standard deviation of daily returns. MOM4 is the cumulative return over the last 4 months of the year. MOM8 is the cumulative return over the first 8 months of the year. Divyld is the dividend yield, calculated as the sum of cash dividends (per share) during the year divided by the end-of the-year price. LnBM is the logarithm of book-to-market ratio when available, and 0 otherwise. BMdum is a dummy variable equal to 1 if the firm has BM data, and 0 otherwise. AdjRSQ is the time-series average of the adjusted R-squared from the monthly regressions. The monthly liquidity premium is the product of the monthly liquidity coefficient and the monthly average liquidity measure calculated for Amihud's measures. *t*-stats are reported in parentheses below the coefficient estimates.

	NYSE		AMEX		NASDAQ	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
INTERCEPT	0.99	1.83	0.87	1.68	0.58	0.58
	(4.52)	(6.25)	(3.35)	(5.67)	(1.58)	(1.91)
Amihud	0.61	0.60	0.17	0.14	0.05	0.08
	(2.00)	(2.38)	(2.63)	(3.32)	(1.98)	(4.28)
LnSIZE		-0.10		-0.06		0.06
		(3.31)		(1.30)		(1.21)
B_MKT		0.19		-0.07		0.03
		(1.68)		(0.55)		(0.20)
B_SMB		-0.06		0.02		-0.01
		(1.13)		(0.27)		(0.16)
B_HML		0.03		0.12		0.05
		(0.49)		(1.65)		(0.61)
B_UMD		-0.07		-0.07		-0.11
		(0.75)		(0.73)		(0.98)
SDRET		-0.30		-0.29		-0.22
		(4.86)		(5.76)		(4.09)
MOM4		0.01		0.01		0.01
		(5.04)		(4.01)		(4.63)
MOM8		0.00		0.00		0.00
		(3.11)		(3.35)		(1.43)
DIVYLD		-0.03		-0.03		-0.01
		(2.28)		(1.85)		(0.37)
LnBM		0.13		0.32		0.41
		(2.92)		(5.32)		(6.49)
BMdum		0.22		0.36		0.71
		(2.93)		3.25		(5.87)
AdjRSQ	0.01	0.08	0.01	0.05	0.00	0.05
Liquidity Premium (%)	0.080	0.045	0.156	0.136	0.084	0.130
T-stat	(3.51)	(3.07)	(3.66)	(3.82)	(2.66)	(4.98)

Table 4: Fama-MacBeth Regressions — Four Sub-Periods

The table presents results from monthly cross-sectional regressions of stock returns on Amihud's measure of liquidity and explanatory variables. Amihud is Amihud's (2002) illiquidity measure adjusted for inflation presented in December 2008 prices. Panel A presents the results from a univariate analysis of Amihud's measure. Panel B reports results from a multivariate analysis including all the explanatory variables, as in Table 3 (not reported to save space). Coef is the average of Amihud's measure coefficients; SCoef is the average of the standardized Amihud's measure coefficients, where all explanatory variables are normalized by their standard deviation; and Prem is the average of the liquidity premium, which is the product of the monthly liquidity coefficient and the monthly average. The sub-periods are 1964–1974, 1975–1985, 1986–1996, and 1997–2008. *t*-stats are reported in parentheses below the coefficient estimates. "Two Sub-Periods Test" refers to the first and last halves of the sample period: 1965-1985 vs. 1986-2008. T-test and Wilcoxon refer to parametric and non-parametric tests for the differences between the coefficients in the two sub-periods. Similarly "First vs. Last Period Test" refers to the first and last sub-period: 1964-1974 vs. 1997-2008 for NYSE and AMEX, and 1986-1996 vs. 1997-2008 for NASDAQ.

Panel A – Univariate Analysis of Amihuds' Measure

	NYSE			AMEX			NASDAQ		
	Coef (1)	**SCoef (2)**	**Prem (3)**	**Coef (4)**	**SCoef (5)**	**Prem (6)**	**Coef (7)**	**SCoef (8)**	**Prem (9)**
64-74	2.08	0.23	0.16	0.56	0.50	0.40	NA	NA	NA
	(2.19)	(2.83)	(2.71)	(2.29)	(3.61)	(3.52)			
75-85	0.93	0.31	0.17	0.05	0.18	0.14	NA	NA	NA
	(2.51)	(3.04)	(2.84)	(1.06)	(1.48)	(1.44)			
86-96	-0.29	-0.03	-0.02	0.05	0.17	0.10	0.05	0.22	0.11
	(1.06)	(0.48)	(0.70)	(1.39)	(1.89)	(1.81)	(2.64)	(3.09)	(2.89)
97-08	-0.21	0.03	0.01	0.02	0.00	0.00	0.04	0.13	0.06
	(0.34)	(0.47)	(0.28)	(0.35)	(0.01)	(0.00)	(1.01)	(1.19)	(1.19)
Two Sub PeriodsTest									
T-test	2.87	3.30	3.77	2.1	2.21	2.53	NA	NA	NA
Wilcoxon	2.40	2.58	3.01	1.49	1.16	1.12	NA	NA	NA
First vs. Last Period Test									
T-test	2.04	1.89	2.42	2.19	2.85	3.07	0.21	0.83	0.64
Wilcoxon	1.27	1.22	1.71	2.48	2.42	2.55	0.07	0.91	0.44

Panel B – Multivariate Analysis of Amihud's Measure

	NYSE			AMEX			NASDAQ		
	Coef (1)	SCoef (2)	Prem (3)	Coef (4)	SCoef (5)	Prem (6)	Coef (7)	SCoef (8)	Prem (9)
64-74	2.01	0.18	0.13	0.36	0.30	0.23	NA	NA	NA
	(2.69)	(3.22)	(3.07)	(2.26)	(3.15)	(2.95)			
75-85	0.18	0.04	0.02	0.05	0.13	0.09	NA	NA	NA
	(0.67)	(0.67)	(0.50)	(1.46)	(1.45)	(1.32)			
86-96	0.21	0.09	0.03	0.15	0.37	0.24	0.12	0.39	0.21
	(0.85)	(1.59)	(1.43)	(3.73)	(3.78)	(3.84)	(6.05)	(5.54)	(5.61)
97-08	0.08	0.03	0.01	0.02	-0.01	-0.01	0.05	0.14	0.06
	(0.13)	(0.58)	(0.53)	(0.32)	(0.08)	(0.09)	(1.48)	(1.74)	(1.60)
Two Sub PeriodsTest									
T-test	1.89	1.01	1.86	1.44	0.46	0.71	NA	NA	NA
Wilcoxon	1.60	1.19	2.06	0.80	0.09	0.24	NA	NA	NA
First vs. Last Period Test									
T-test	2.09	2.04	2.72	2.15	1.99	2.24	1.95	2.30	2.95
Wilcoxon	2.17	2.49	3.42	2.63	2.10	2.31	1.36	2.10	2.99

Table 5: Out-of-Sample Four-Factor Alphas — Portfolios Pre-Sorted by Size

In each month between 1964 and 2008, we sort the stocks in our sample into three size groups, based on the previous end-of-year size. Sizes 1 to 3 refer to the smallest to largest size groups. Within each size group, we sort the stocks into five illiquidity quintiles, based on the previous year's Amihud's liquidity measures. We then form three long-short liquidity-based trading portfolios, one for each size group. The portfolios are long in the most illiquid stocks and short in the most liquid stocks within each size group. The portfolios are rebalanced annually. We also form a balanced portfolio that has equal weights in each of the three long-short portfolios. Panel A reports the average monthly out-of-sample four-factor alphas calculated using Eq. (2) for each of the four sub-periods 1964–1974, 1975–1985, 1986–1996, and 1997–2008 for NYSE. Panel B reports the average monthly out-of-sample four-factor alphas calculated using Eq. (2) for each of the two sub-periods 1986–1996, and 1997–2008 for NASDAQ. "Two Sub-Periods Test" refers to the first and last halves of the sample period: 1965-1985 vs. 1986-2008. T-test and Wilcoxon refer to parametric and non-parametric tests for the differences between the coefficients in the two sub-periods. Similarly "First vs. Last Period Test" refers to the first and last sub-period: 1964-1974 vs. 1997-2008 for the NYSE and AMEX, and 1986-1996 vs. 1997-2008 for NASDAQ.

Panel A – NYSE

	Size 1		Size 2		Size 3		Balanced	
Years	Average Alpha	T-stat	Average Alpha	T-stat	Average Alpha	T-stat	Average Alpha	T-stat
Entire Period								
64-08	0.44%	3.66	0.21%	2.26	0.14%	1.78	0.26%	3.94
Two Sub Periods								
64-85	0.62%	3.94	0.43%	3.29	0.37%	3.51	0.48%	4.84
86-08	0.27%	1.47	0.01%	0.04	-0.09%	-0.79	0.06%	0.68
Four Sub Periods								
64-74	0.84%	3.49	0.54%	2.60	0.44%	2.61	0.61%	3.75
75-85	0.41%	1.98	0.33%	2.00	0.31%	2.33	0.35%	3.08
86-96	0.33%	1.46	0.13%	0.84	0.04%	0.37	0.17%	1.57
97-08	0.21%	0.75	-0.11%	-0.51	-0.20%	-1.10	-0.03%	-0.24
Two Sub PeriodsTest								
T-test	1.49		2.26		3.00		3.11	
Wilcoxon	1.40		2.21		2.55		2.67	
First vs. Last Period Test								
T-test	1.70		2.16		2.57		2.98	
Wilcoxon	2.01		2.21		2.13		2.74	

Panel B – NASDAQ

Years	Size 1 Average Alpha	Size 1 T-stat	Size 2 Average Alpha	Size 2 T-stat	Size 3 Average Alpha	Size 3 T-stat	Balanced Average Alpha	Balanced T-stat
Entire Period								
86-08	1.21%	6.06	0.72%	3.31	-0.15%	-0.81	0.59%	3.90
Two Sub Periods								
86-96	1.74%	7.86	1.07%	4.57	0.12%	0.60	0.98%	5.73
97-08	0.72%	2.25	0.40%	1.12	-0.40%	-1.34	0.24%	0.99
First vs. Last Period Test								
T-test	2.63		1.58		1.45		2.49	
Wilcoxon	2.34		1.28		1.49		2.52	

Table 6: Analysis for Non-Common Stocks

The Table presents the results for a sample of non-common stocks, which includes all stocks with share-codes different from 10 or 11, excluding primes and scores. This includes closed end funds, REITs, ADRs, and other foreign incorporated stocks. The sample period for this analysis is 1986-2008. Panel A reports the time-series averages of the monthly cross-sectional sample statistics for all stocks in the sample, as in Table 1. Panel B presents the results for cross-sectional regressions of stock returns on Amihud's liquidity measure and other explanatory variables, as in Table 3 (Eq. (1)). Amihud's measure is Amihud's (2002) illiquidity measure adjusted for inflation presented in December 2008 prices; Coef is the average of Amihud's measure coefficients; SCoef is the average of the standardized Amihud's measure coefficients, where all explanatory variables are normalized by their standard deviation; and Prem is the average of the liquidity premium, which is the product of the monthly liquidity coefficient and the monthly average. The sub-periods are 1986–1996, and 1997–2008. *t*-stats are reported in parentheses below the coefficient estimates. "First vs. Last Period Test" refers to 1986-1996 vs. 1997-2008. T-test and Wilcoxon refer to parametric and non-parametric tests for the differences between the coefficients in the two sub-periods.

Panel A - Summary Statistics

	NYSE			AMEX			NASDAQ		
Variables	**Mean**	**Median**	**Std**	**Mean**	**Median**	**Std**	**Mean**	**Median**	**Std**
Amihud	0.106	0.029	0.252	1.019	0.306	1.990	2.155	0.414	5.067
Turnover	0.77	0.44	1.84	0.39	0.25	0.57	1.62	0.76	3.33
Dvol ($ million)	749	141	1,887	92	18	260	577	90	1,724
Sdret (%)	1.69	1.47	0.87	1.98	1.56	1.27	3.62	3.25	1.86
Size ($ million)	979	245	2,801	253	61	1,051	277	91	602.49
Firms	702	845	315	157	150	38	274	296	69
Min Firms	137			77			166		
Max Firms	1,083			220			398		

Panel B - Fama-MacBeth Regressions

	NYSE			AMEX			NASDAQ		
	Coef (1)	**SCoef (2)**	**Prem (3)**	**Coef (4)**	**SCoef (5)**	**Prem (6)**	**Coef (7)**	**SCoef (8)**	**Prem (9)**
86-08	0.67	0.09	0.04	0.18	0.43	0.23	0.03	0.10	0.06
	(1.86)	(1.89)	(1.82)	(1.98)	(2.57)	(2.54)	(1.06)	(1.09)	(1.30)
86-96	0.52	0.09	0.05	0.13	0.30	0.16	0.05	0.15	0.07
	(1.37)	(1.10)	(1.10)	(1.79)	(1.92)	(2.00)	(1.01)	(0.98)	(1.02)
97-08	0.81	0.09	0.04	0.23	0.56	0.30	0.01	0.06	0.04
	(1.35)	(1.75)	(1.77)	(1.41)	(1.91)	(1.87)	(0.39)	(0.52)	(0.81)
First vs. Last Period Test									
T-test	0.40	0.04	0.20	0.59	0.77	0.75	0.68	0.47	0.41
Wilcoxon	0.53	0.21	0.25	0.31	0.34	0.38	0.95	0.71	0.85

Table 7: Analysis of "Penny Stocks"

The Table presents the results for a sample of all common shares (share-code 10 and 11) that have at least 60 trading days, and a share-price lower than $2 at the end of the previous year. The sample period for this analysis is 1986-2008. Panel A reports the time-series averages of the monthly cross-sectional sample statistics for all stocks in the sample, as in Table 1. Panel B presents the results for cross-sectional regressions of stocks returns on Amihud's liquidity measure and other explanatory variables, as in Table 3 (Eq. (1)). Amihud's measure is Amihud's (2002) illiquidity measure adjusted for inflation presented in December 2008 prices; Coef is the average of Amihud's measure coefficients; SCoef is the average of the standardized Amihud's measure coefficients, where all explanatory variables are normalized by their standard deviation; and Prem is the average of the liquidity premium, which is the product of the monthly liquidity coefficient and the monthly average. The sub-periods are 1986–1996, and 1997–2008. Regression coefficients and t-stats are calculated using Weighted Least Squares as in Asparouhova, Bessembinder and Kalcheva (2009). T-stats are reported in parentheses below the coefficient estimates. "First vs. Last Period Test" refers to 1986-1996 vs. 1997-2008. T-test and Wilcoxon refer to parametric and non-parametric tests for the differences between the coefficients in the two sub-periods.

Panel A - Summary Statistic

	AMEX			NASDAQ		
Variables	**Mean**	**Median**	**Std**	**Mean**	**Median**	**Std**
Amihud	23.1	11.6	31.3	12.5	5.2	17.6
Turnover	0.43	0.29	0.48	0.96	0.64	1.02
Dvol ($ million)	22.3	6.41	55	89.25	21	294
Sdret (%)	7.18	6.57	2.94	7.12	6.62	2.76
Size ($ million)	19.4	11.57	26.2	22.7	13.6	33.9
Firms	93	83	34	524	515	253
Min Firms	42			119		
Max Firms	179			1,161		

Panel B - Fama-MacBeth Regressions

	AMEX			NASDAQ		
	Coef (1)	**SCoef (2)**	**Prem (3)**	**Coef (4)**	**SCoef (5)**	**Prem (6)**
86-08	0.03	0.69	0.49	0.06	0.38	0.25
	(1.39)	(2.46)	(2.10)	(2.54)	(2.70)	(2.55)
86-96	0.01	0.74	0.55	0.02	0.47	0.33
	(0.53)	(1.60)	(1.31)	(2.21)	(2.48)	(2.42)
97-08	0.04	0.65	0.45	0.09	0.30	0.18
	(1.35)	(1.91)	(1.80)	(2.13)	(1.44)	(1.27)
First vs. Last Period Test						
T-test	0.60	0.15	0.20	1.55	0.57	0.74
Wilcoxon	0.89	0.18	0.11	1.61	0.05	0.04

Table 8: Fama-MacBeth Regressions for the Turnover Measure

The table presents results from monthly cross-sectional regressions of stock returns on the explanatory variables (Eq. (1)). Turnover is the sum of monthly stock volume values divided by the average number of outstanding shares during the year; "Coef" is the average of the Turnover coefficients and "SCoef" is the average of the standardized Turnover coefficients (where the explanatory variables are normalized by their standard deviation). The sub-periods are 1964–1974, 1975–1985, 1986–1996, and 1997–2008. T-stats are reported in parentheses below the coefficient estimates. "Two Sub-Periods Test" refers to the first and last halves of the sample period: 1965-1985 vs. 1986-2008. T-test and Wilcoxon refer to parametric and non-parametric tests for the differences between the coefficients in the two sub-periods. Similarly, "First vs. Last Period Test" refers to the first and last sub-period: 1964-1974 vs. 1997-2008 for NYSE and AMEX, and 1986-1996 vs. 1997-2008 for NASDAQ.

	NYSE		AMEX		NASDAQ	
	Coef (1)	Stnd (2)	Coef (3)	Stnd (4)	Coef (5)	Stnd (6)
64-08	-0.41	-0.13	-0.81	-0.30	-0.27	-0.28
	(4.87)	(4.51)	(5.86)	(5.72)	(5.41)	(5.14)
64-74	-0.85	-0.24	-0.52	-0.24	NA	NA
	(4.38)	(4.50)	(2.11)	(2.91)		
75-85	-0.55	-0.14	-1.15	-0.27	NA	NA
	(2.40)	(2.44)	(3.42)	(3.53)		
86-96	-0.17	-0.07	-1.10	-0.40	-0.46	-0.38
	(1.40)	(1.42)	(4.24)	(4.26)	(5.12)	(5.18)
97-08	-0.07	-0.08	-0.51	-0.27	-0.10	-0.20
	(0.85)	(1.13)	(1.95)	(1.93)	(2.13)	(2.42)
Two Sub PeriodsTest						
T-test	3.51	2.01	0.16	0.71	NA	NA
Wilcoxon	3.39	1.98	0.04	0.70	NA	NA
First vs. Last Period Test						
T-test	3.71	1.91	0.02	0.17	3.55	1.64
Wilcoxon	3.64	1.87	0.16	0.94	4.01	1.69

Table 9: Out-of-Sample Four-Factor Alphas — Turnover Portfolios Pre-Sorted by Size
In each month between 1964 and 2008, we sort the stocks in our sample into three size groups, based on the previous end-of-year size. Sizes 1 to 3 refer to the smallest to largest size groups. Within each size group, we sort the stocks into five illiquidity quintiles, based on the previous year's Turnover. We then form three long-short liquidity-based trading portfolios, one for each size group. The portfolios are long in the most illiquid stocks (low turnover) and short in the most liquid stocks (high turnover) within each size group. The portfolios are rebalanced annually. We also form a balanced portfolio that has equal weights in each of the three long-short portfolios. Panel A reports the average monthly out-of-sample four-factor alphas calculated using Eq. (2) for each of the four sub-periods 1964–1974, 1975–1985, 1986–1996, and 1997–2008 for NYSE. Panel B reports the average monthly out-of-sample four-factor alphas calculated using Eq. (2) for each of the two sub-periods 1986–1996, and 1997–2008 for NASDAQ. "Two Sub-Periods Test" refers to the first and last halves of the sample period: 1965-1985 vs. 1986-2008. T-test and Wilcoxon refer to parametric and non-parametric tests for the differences between the coefficients in the two sub-periods. Similarly, "First vs. Last Period Test" refers to the first and last sub-period: 1964-1974 vs. 1997-2008 for NYSE and AMEX, and 1986-1996 vs. 1997-2008 for NASDAQ.

Panel A - NYSE

	Size 1		Size 2		Size 3		Balanced	
Years	Average Alpha	T-stat	Average Alpha	T-stat	Average Alpha	T-stat	Average Alpha	T-stat
Entire Period								
64-08	0.80%	6.43	0.38%	3.34	0.29%	2.43	0.49%	5.13
Two Sub Periods								
64-85	0.80%	4.93	0.59%	3.63	0.54%	3.45	0.64%	4.75
86-08	0.80%	4.25	0.18%	1.12	0.04%	0.21	0.34%	2.53
Four Sub Periods								
64-74	0.84%	3.26	0.59%	2.30	0.59%	2.27	0.68%	3.02
75-85	0.75%	3.84	0.59%	2.92	0.50%	2.76	0.61%	3.97
86-96	0.79%	3.46	0.24%	1.16	0.07%	0.35	0.36%	2.36
97-08	0.81%	2.75	0.12%	0.50	0.01%	0.04	0.31%	1.47
Two Sub PeriodsTest								
T-test	0.01		1.83		2.17		1.62	
Wilcoxon	0.09		1.93		2.43		1.92	
First vs. Last Period Test								
T-test	0.09		1.37		1.52		1.18	
Wilcoxon	0.17		1.64		1.81		1.47	

Panel B – NASDAQ

Years	Size 1 Average Alpha	Size 1 T-stat	Size 2 Average Alpha	Size 2 T-stat	Size 3 Average Alpha	Size 3 T-stat	Balanced Average Alpha	Balanced T-stat
Entire Period								
86-08	1.06%	4.33	1.02%	4.06	0.37%	1.51	0.81%	3.95
Two Sub Periods								
86-96	1.59%	5.69	1.15%	4.56	0.61%	2.21	1.12%	4.91
97-08	0.57%	1.46	0.89%	2.11	0.14%	0.36	0.53%	1.59
First vs. Last Period Test								
T-test	2.13		0.53		0.99		1.45	
Wilcoxon	2.47		0.48		1.04		1.66	

Table 10: Out-of-Sample Four-Factor Alphas — Dollar-Volume Portfolios Pre-Sorted by Size

In each month between 1964 and 2008, we sort the stocks in our sample into three size groups, based on the previous end-of-year size. Sizes 1 to 3 refer to the smallest to largest size groups. Within each size group, we sort the stocks into five illiquidity quintiles, based on the previous year's dollar-volume. We then form three long-short liquidity-based trading portfolios, one for each size group. The portfolios are long in the most illiquid stocks (low dollar-volume) and short in the most liquid stocks (high dollar-volume) within each size group. The portfolios are rebalanced annually. We also form a balanced portfolio that has equal weights in each of the three long-short portfolios. Panel A reports the average monthly out-of-sample four-factor alphas calculated using Eq. (2) for each of the four sub-periods 1964–1974, 1975–1985, 1986–1996, and 1997–2008 for NYSE. Panel B reports the average monthly out-of-sample four-factor alphas calculated using Eq. (2) for each of the two sub-periods 1986–1996, and 1997–2008 for NASDAQ. "Two Sub-Periods Test" refers to the first and last halves of the sample period: 1965-1985 vs. 1986-2008. T-test and Wilcoxon refer to parametric and non-parametric tests for the differences between the coefficients in the two sub-periods. Similarly, "First vs. Last Period Test" refers to the first and last sub-period: 1964-1974 vs. 1997-2008 for NYSE and AMEX, and 1986-1996 vs. 1997-2008 for NASDAQ.

Panel A – NYSE

	Size 1		Size 2		Size 3		Balanced	
Years	Average Alpha	T-stat	Average Alpha	T-stat	Average Alpha	T-stat	Average Alpha	T-stat
Entire Period								
64-08	0.72%	5.71	0.35%	3.23	0.23%	2.46	0.43%	5.26
Two Sub Periods								
64-85	0.88%	5.18	0.58%	3.84	0.51%	3.77	0.66%	5.37
86-08	0.56%	3.05	0.13%	0.83	-0.05%	-0.38	0.21%	1.98
Four Sub Periods								
64-74	1.11%	4.06	0.51%	2.11	0.52%	2.34	0.71%	3.47
75-85	0.64%	3.23	0.65%	3.52	0.51%	3.17	0.60%	4.45
86-96	0.59%	2.68	0.14%	0.75	0.15%	1.20	0.29%	2.49
97-08	0.54%	1.84	0.11%	0.48	-0.23%	-1.09	0.14%	0.80
Two Sub PeriodsTest								
T-test	1.25		2.11		3.06		2.72	
Wilcoxon	1.37		2.14		2.62		2.74	
First vs. Last Period Test								
T-test	1.43		1.17		2.46		2.12	
Wilcoxon	1.82		1.14		2.21		2.12	

Panel B – NASDAQ

Years	Size 1 Average Alpha	Size 1 T-stat	Size 2 Average Alpha	Size 2 T-stat	Size 3 Average Alpha	Size 3 T-stat	Balanced Average Alpha	Balanced T-stat
Entire Period								
86-08	1.15%	5.00	1.10%	4.46	0.01%	0.04	0.75%	3.97
Two Sub Periods								
86-96	1.72%	6.27	1.25%	4.63	0.33%	1.40	1.10%	5.03
97-08	0.62%	1.74	0.95%	2.37	-0.28%	-0.82	0.43%	1.43
First vs. Last Period Test								
T-test	2.45		0.63		1.47		1.81	
Wilcoxon	2.77		0.46		1.37		1.97	

Table 11: Fama-MacBeth Analysis for the Pre-Compustat Period

The table presents results from cross-sectional regressions of stock-returns on liquidity measures and other explanatory variables, as in Table 3, excluding LnBM and the factor loadings on SMB, HML, and UMD. The sample period is 1927-1963 and the data consists of NYSE stocks only. Amihud's measure is Amihud's (2002) illiquidity measure adjusted for inflation presented in December 2008 prices. Turnover is the sum of monthly stock volume values divided by the average number of outstanding shares throughout the year. Lnsize is the logarithm of the end-of-year market capitalization (in millions of dollars). BETA is the loading from a one-factor model, calculated based on the daily returns over the year, using the Scholes-Williams (1977) method. Sdret is the standard deviation of daily returns. MOM4 is the cumulative return over the last 4 months of the year. MOM8 is the cumulative return over the first 8 months of the year. Divyld is the dividend yield, calculated as the sum of cash dividends (per share) during the year, divided by the end-of the-year price. Coef is the average of Amihud's measure coefficients. SCoef is the average of the standardized Amihud's measure coefficients, where all explanatory variables are normalized by their standard deviation. The liquidity premium is the average of the liquidity premium, which is the product of the monthly liquidity coefficient and the monthly average. AdjRSQ is the time-series average of the adjusted R-squared from the monthly regressions. *t*-stats are reported in parentheses below the coefficient estimates.

	Coef		Scoef	
	(1)	(2)	(3)	(4)
INTERCEPT	1.33	1.45	1.33	1.45
	(5.14)	(5.16)	(5.14)	(5.16)
Amihud	0.28		0.15	
	(3.27)		(2.76)	
Turnover		-0.50		-0.18
		(4.80)		(5.84)
LnSIZE	-0.08	-0.12	-0.13	-0.19
	(2.46)	(3.37)	(2.45)	(3.28)
BETA	0.08	0.10	0.07	0.07
	(0.47)	(0.58)	(0.57)	(0.70)
SDRET	-0.13	-0.03	-0.05	0.04
	(1.74)	(0.47)	(0.60)	(0.47)
MOM4	0.01	0.01	0.10	0.11
	(1.67)	(1.76)	(1.42)	(1.53)
MOM8	0.00	0.00	0.00	0.01
	(0.01)	(0.37)	(0.11)	(0.28)
DIVYLD	-0.01	-0.01	-0.05	-0.05
	(0.89)	(1.00)	(1.33)	(1.35)
AdjRSQ	0.10	0.10	0.10	0.10
Liquidity Premium (%)	0.075		0.075	
T-stat	(2.52)		(2.52)	

Table 12: Portfolio Analysis for the Pre-Compustat Period

The table reports results for portfolios pre-sorted by size for the time period 1931-1963. In each month between 1931 and 1963, we sort the stocks in our sample into three size groups, based on the previous end-of-year size. Sizes 1 to 3 refer to the smallest to largest size groups. Within each size group, we sort the stocks into five illiquidity quintiles, based on the previous year's liquidity measure (Amihud, Turnover, or Lndvol). We then form three long-short liquidity-based trading portfolios, one for each size group. The portfolios are long in the most illiquid stocks and short in the most liquid stocks within each size group. The portfolios are rebalanced annually. We also form a balanced portfolio that has equal weights in each of the three long-short portfolios. The table reports the average monthly out-of-sample four-factor alphas calculated using Eq. (2) for each of the three liquidity measures.

	Size 1		Size 2		Size 3		Balanced	
Period 31-63	Average Alpha	T-stat	Average Alpha	T-stat	Average Alpha	T-stat	Average Alpha	T-stat
Amihud	0.47%	2.36	0.41%	3.03	0.41%	4.11	0.43%	4.08
Turnover	0.89%	4.45	0.83%	4.46	0.54%	3.72	0.75%	5.02
Lndvol	1.13%	5.22	0.74%	4.45	0.58%	4.87	0.81%	6.02

Figure 1: Amihud's Liquidity Measures Averages over Time

Figure 1-A — NYSE

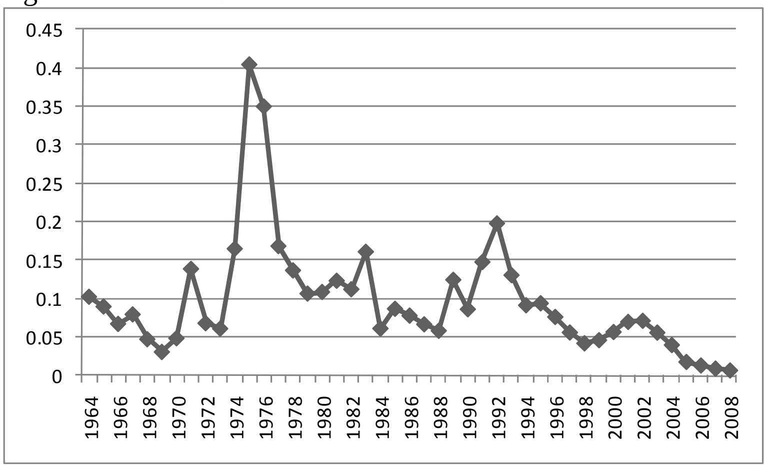


Figure 1-B —AMEX

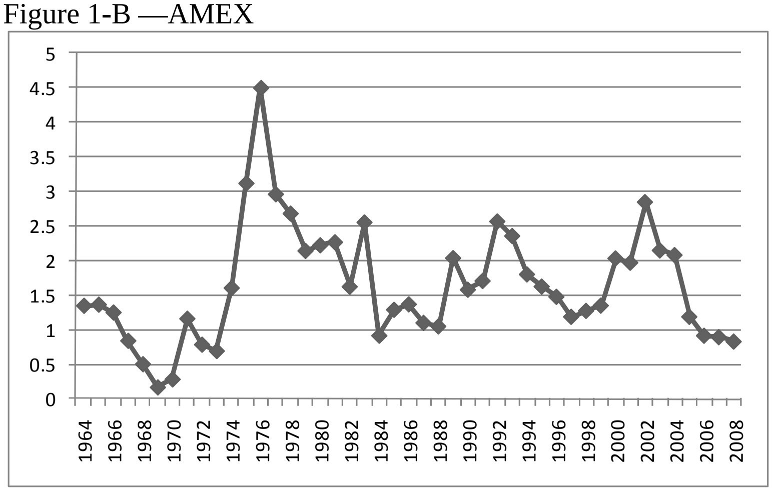
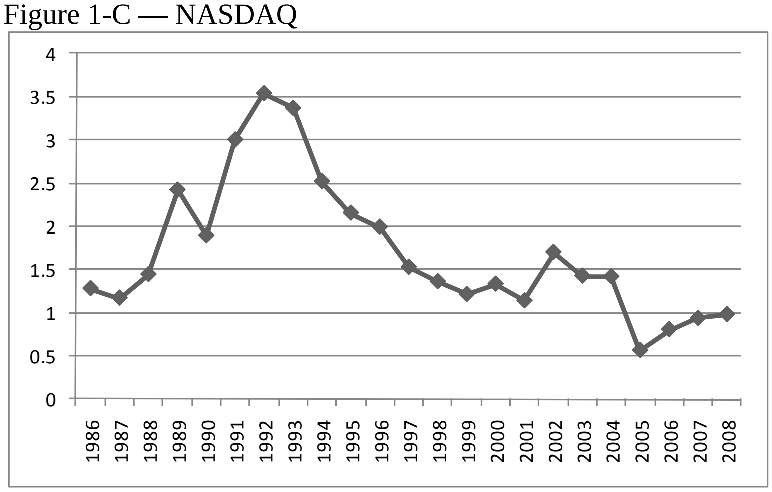


Figure 1-C — NASDAQ



The figures depict the yearly averages of the monthly cross-sectional Amihud illiquidity measures scaled for inflation in December 2008 prices.

Figure 2: Average Illiquidity Cross-Sectional Regression Coefficients

Figure 2-A — NYSE

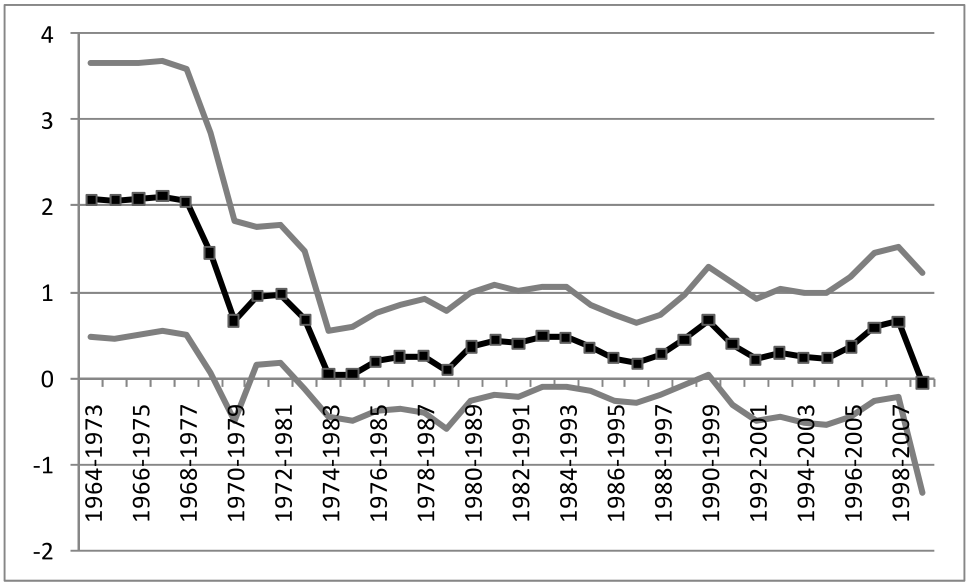


Figure 2-B — AMEX

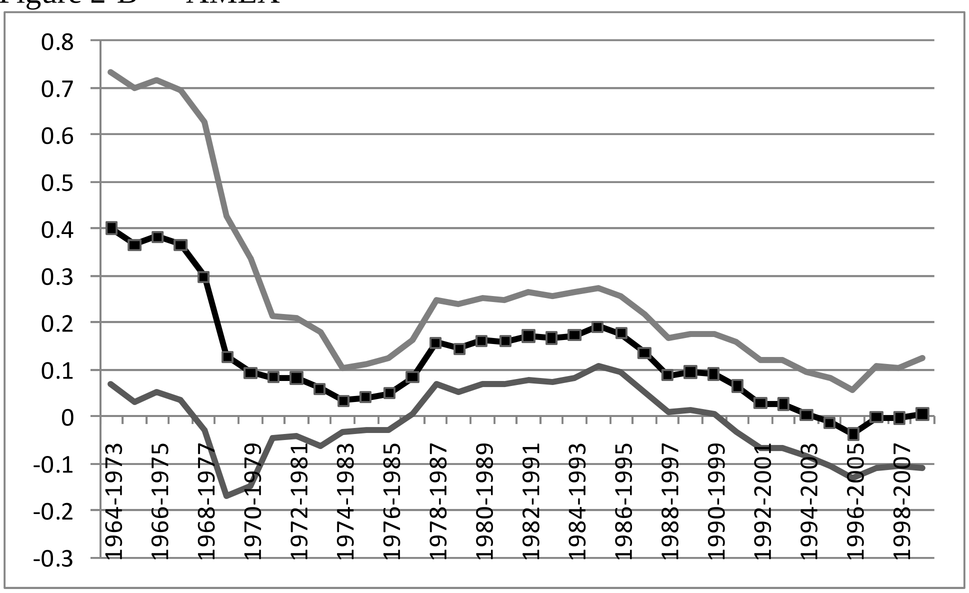
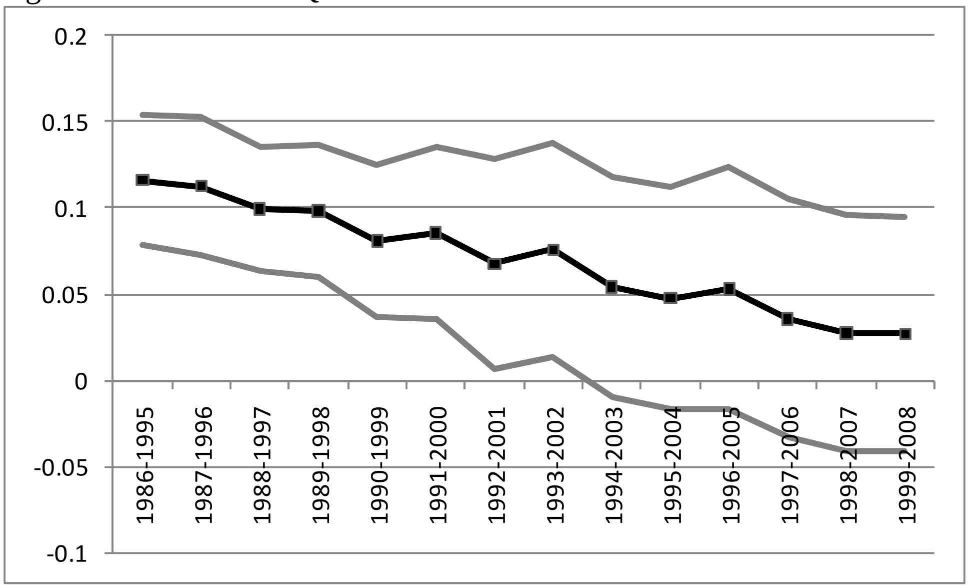


Figure 2-C — NASDAQ



The figures depict the 10-year moving average along with 5% confidence intervals of Amihud's liquidity measure coefficients, from Fama-MacBeth regressions, based on Panel B of Table 4.

Figure 3: Alphas of Long-Short Liquidity Portfolios Based on Amihud's Measure

Figure 3-A — NYSE

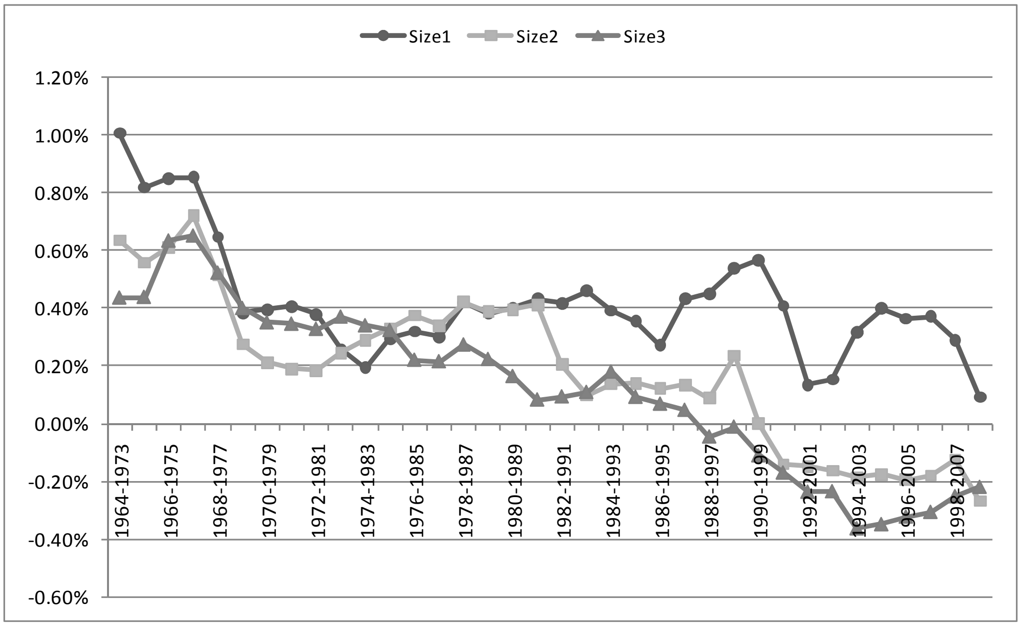
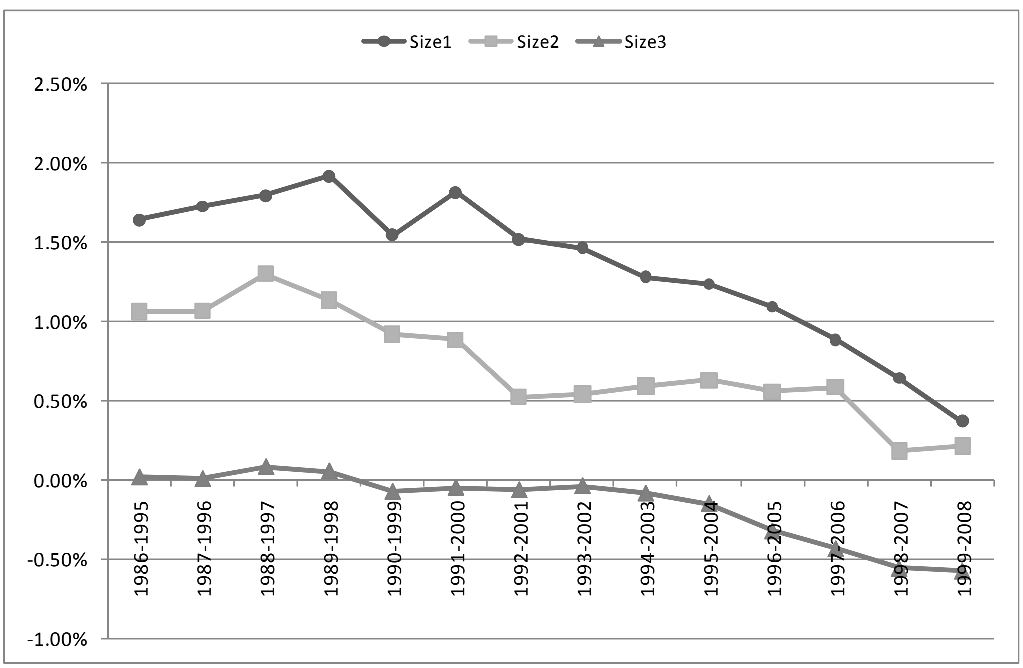
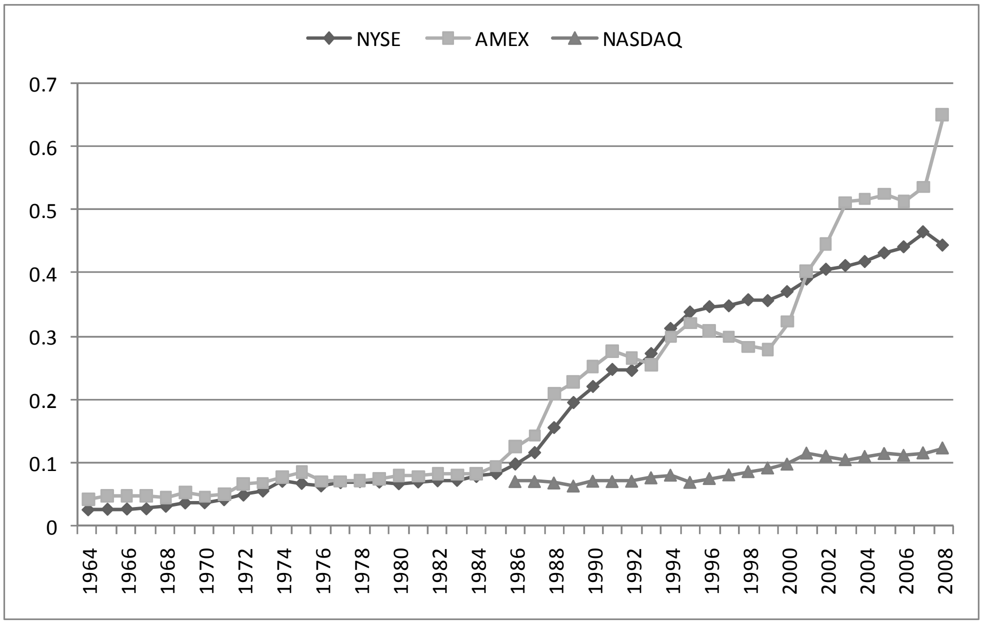


Figure 3-B — NASDAQ



The figures present the 10-year moving averages of the monthly four-factor alphas, from portfolios that are long in the most illiquid stocks and short in the most liquid stocks, based on Amihud's measure from Table 5. Sizes 1 to 3 refer to the smallest to largest size groups.

Figure 4: Ratio of Non-Common Shares to All Shares

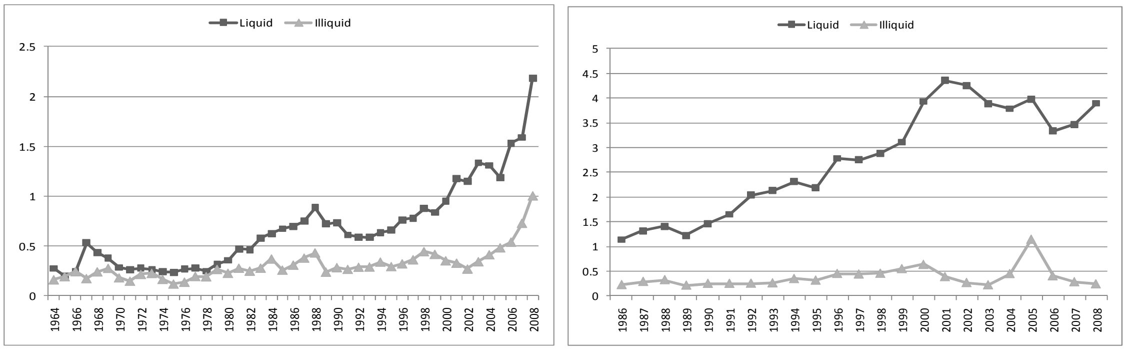


The figure depicts the yearly averages of the ratio between the number of non-common shares on CRSP (firms with share codes other than 10 and 11, except primes and scores) to the number of all CRSP firms, with a price of at least $2 and at least 60 trading days in a year.

Figure 5: Turnover spread between Liquid and Illiquid Stocks

Figure 5-A —Average Turnover in Liquid vs. Illiquid decile Portfolios

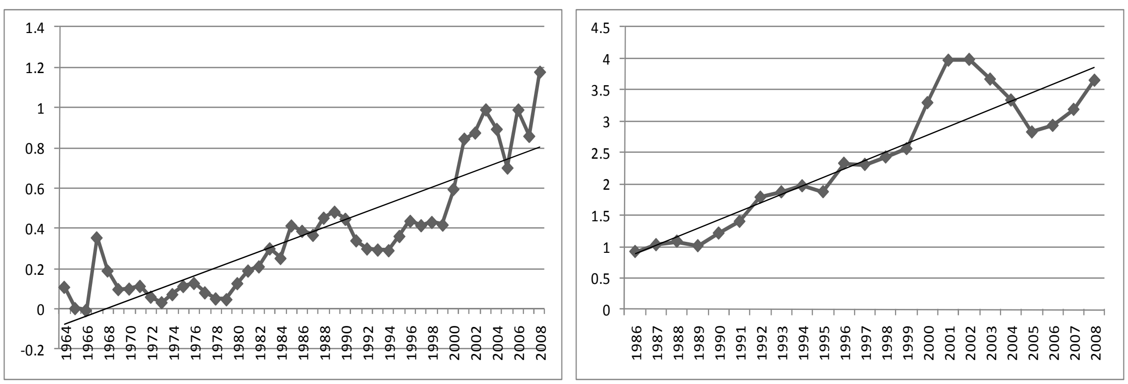
NYSE NASDAQ



The graphs depict the yearly turnover averages of stocks from the top and bottom liquidity deciles based on Amihud's measure.

Figure 5-B — NYSE and NASDAQ — Trend of the Difference

NYSE NASDAQ



The graphs depict the differences between the yearly turnover averages of stocks from the top and bottom liquidity deciles based on Amihud's measure.