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The Diminishing Liquidity Premium

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Abstract

Stock liquidity has improved over the recent 4 decades. This improvement was accompanied by a dramatic increase in trading activity. The net effect on the liquidity premium is ambiguous. We show that the characteristic liquidity premium of U.S. stocks has significantly declined over the past 4 decades. In recent years, characteristic liquidity is significantly priced only for the smallest common stocks. This decline stems from an improvement in liquidity and from a lower sensitivity of expected returns to liquidity. By contrast, systematic liquidity has not been trending down and is still significantly priced primarily among NASDAQ stocks.

I. 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 seminal work of Amihud and Mendelson (1986), it has been argued that liquidity has an important effect on the prices of financial assets. In fact, it is common practice to price illiquid assets such as private equity by comparing these assets to similar liquid assets (such as public equity) and then assessing a liquidity discount.

When it comes to public equity, there has been some theoretical debate on the importance and magnitude of the liquidity premium. Amihud and Mendelson

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(1986) assume in their model that trading frequencies are exogenous and conclude that the liquidity premium should be large. According to their model, the liquidity premium is proportional to the present value of transaction costs multiplied by an exogenous trading frequency. In particular, they conclude that the liquidity premium has an order of magnitude that is larger than the transaction costs. By contrast, Constantinides (1986) and Vayanos (1998) endogenize the trading frequency, arguing that investors will diminish their trading rate in the face of high transaction costs. They conclude that the liquidity premium should be "second order" and therefore hard to detect empirically.[1]

Given this theoretical debate, it is important to empirically estimate the magnitude of the liquidity premium. Is it "large" and economically significant as predicted by Amihud and Mendelson (1986), or is it a "second-order effect" as predicted by Constantinides (1986) and Vayanos (1998)? Moreover, is it robust across all stock sizes, and does it exhibit a time trend? In addressing these issues, it is important to note that over the past few decades we have witnessed two robust trends. The first is a sharp decline in transaction costs in equity markets, following a series of technological and regulatory changes (such as decimalization). The second is a dramatic increase in trading frequency. These two trends have conflicting effects on the liquidity premium of public equity. On the one hand, lower transaction costs should decrease the liquidity premium. But on the other hand, a higher trading frequency is expected to be associated with a higher realization of effective transaction costs, leading to a higher liquidity premium. The net effect of these two trends is not clear and is subject to an empirical analysis.

Adding to the existing debate, recent studies (e.g., Pastor and Stambaugh (2003), Acharya and Pedersen (2005), Charoenrook and Conrad (2008), Sadka (2006), Korajczyk and Sadka (2008), among others) have taken liquidity premiums one step further and argued that liquidity is a priced risk factor. The idea is that markets can experience systematic shocks to liquidity, and stocks whose returns are more sensitive to such shocks should require a premium. Thus, we distinguish between two types of liquidity premiums: i) a characteristic liquidity premium, associated with the transaction costs of trading in the security, and ii) a systematic liquidity premium, associated with the sensitivity of the stock returns to shocks in market liquidity. These two are not necessarily related and may exhibit different trends.

In this article we estimate the premium for both characteristic and systematic liquidity over time in U.S. equity markets using three well-established liquidity measures. We find that while the characteristic liquidity premium was large and robust until the mid-1980s in accordance with Amihud and Mendelson (1986), it has become small and "second order" since then. In recent years the characteristic liquidity premium is concentrated only among small stocks in NASDAQ, whose market value accounts for about 0.5% of the total market value of all publicly listed common stocks. We cannot identify a significant characteristic liquidity premium for the rest of the 99.5% of the market value of stocks. Thus, to the extent that a characteristic liquidity premium currently exists in U.S. public equity, it is

[1]See additional related discussions in Jang, Koo, Liu, and Loewenstein (2007), Levy and Swan (2008), and Lynch and Tan (2011).

economically small.[2] Furthermore, our results are completely consistent with the prior literature that has identified a significant characteristic liquidity premium (see, e.g., Amihud and Mendelson (1986), (1989), Brennan and Subrahmanyam (1996), Eleswarapu (1997), Brennan, Chordia, and Subrahmanyam (1998), Amihud (2002), and Chordia, Huh, and Subrahmanyam (2009)). We show that many of the conclusions of these past studies are driven by the early periods, during which the characteristic liquidity premium was large and significant. As for the systematic liquidity premium, we do not find evidence for a premium among New York Stock Exchange (NYSE) and American Stock Exchange (AMEX) stocks, but we do find economically significant premiums in NASDAQ stocks, in particular in the most recent period. In contrast to the case of characteristic liquidity, we do not find a downward trend in systematic liquidity.

Our sample consists of Center for Research in Security Prices (CRSP) common stock data between 1931 and 2011. We apply three liquidity measures, each capturing a different aspect of liquidity. The first is Amihud's (2002) measure, which is a proxy for the price impact, in the spirit of Kyle's (1985) lambda. This measure is calculated as the annual average of daily absolute return to dollar volume (AMIHUD). The second is Hasbrouck's (2009) measure for the effective spread, which is a Bayesian version of Roll's (1984) measure (HR). Following Goyenko, Holden, and Trzcinka (2009), the third measure combines both aspects of liquidity and measures the price impact of the spread, as the ratio of HR to annual dollar volume (HRDVOL).

Similar to Hasbrouck (2009), we conduct the analysis separately for the NYSE, AMEX, and NASDAQ. This allows us to account for the different institutional details associated with the measurement of volume, and the different attributes of the listings in these exchanges. To allow for comparisons across exchanges we present our main analysis for 1964–2011, and we present robustness tests for earlier periods.

Using Fama–MacBeth (1973) cross-sectional regressions we find that over the sample period, the characteristic liquidity premiums of publicly traded common stocks in all three exchanges and across all measures declined dramatically. For example, for common stocks listed on NYSE, the equal-weighted (value-weighted) average annual characteristic liquidity premium of AMIHUD declined from about 1.3% (0.3%) in 1964–1975 to insignificant levels in 2000–2011. A similar trend is observed for common stocks listed on NASDAQ starting from the mid-1980s. For example, the equal-weighted (value-weighted) average annual liquidity premium from 1986 to 1999 is about 1.4% (0.3%), declining to insignificant levels in 2000–2011. A similar decline pattern is observed for AMEX.

We next explore the relation between firm size and the characteristic liquidity premium by sorting all firms into three size terciles. We find that the characteristic liquidity premium is mainly concentrated among small stocks. For large and medium-sized stocks listed on NYSE we cannot identify a premium even in early periods. For smaller stocks (in all exchanges) we do find a characteristic liquidity premium in early periods, but it declines significantly and largely disappears

[2]This is in contrast to the importance of the liquidity premium among highly illiquid assets such as private equity, debt instruments, and mortgage-backed securities.

later on. We do find a characteristic liquidity premium among "penny stocks," which we define as stocks with a price below $2. However, the market cap of these penny stocks accounts for just 0.2% of the total market cap of our sample stocks.

Next, we take a different approach to estimating the magnitude of the characteristic liquidity premium by focusing on liquidity-based trading strategies. We show that the strategy of buying illiquid stocks and selling liquid stocks has lost much of its profitability over the years. The abnormal returns associated with such a strategy in recent periods have become insignificant except for small stocks listed on NASDAQ, accounting for just 0.3% of the total market cap of our sample.

We decompose the liquidity premium into i) a liquidity-level effect and ii) the sensitivity of expected returns to liquidity. The decline in the characteristic liquidity premium may potentially stem from either an improvement in liquidity level and/or from a decline in the sensitivity of expected returns to liquidity. We demonstrate that both effects have been influential in the decline of the premium. Although the first effect seems natural given the improvement in liquidity in financial markets over time, the second is puzzling. We conjecture, first, that this decline might reflect the introduction of financial instruments such as index funds and exchange-traded funds (ETFs). As shown in Subrahmanyam (1991) and Gorton and Pennacchi (1993), these instruments enable investors to indirectly hold illiquid stocks for low transaction costs even if the transaction costs of the individual stocks are high. Thus, the proliferation of these instruments likely leads to a lower sensitivity of expected returns to liquidity. Second, it may be that this trend reflects more intense arbitrage activity in the market, in line with Chordia, Subrahmanyam, and Tong (2013).

We next explore time trends in the systematic liquidity premium. Following the existing literature we measure systematic liquidity as the sensitivity of a stock's return to innovations in market liquidity, which we term "liquidity betas." We estimate these betas for each of our liquidity measures. As with the characteristic liquidity premium, we estimate the systematic liquidity premium using Fama–MacBeth (1973) regression, and using liquidity-betas-based trading strategies. We do not find significant premiums associated with liquidity risk on NYSE and AMEX for any of the periods. For NASDAQ stocks we do find evidence for systematic liquidity pricing, and even more so in the most recent period. Thus, unlike the case of the characteristic liquidity premium, the systematic liquidity premium does not appear to be trending down and may have even become stronger. Systematic liquidity is driven by the risk that a firm's stock price will decline in states of the world where market liquidity is low. Thus, the economic drivers of the systematic liquidity premium are different from those of the characteristic liquidity premium. Consequently, different time trends in the two types of liquidity premium are possible.

The results in this article on both types of premium are of significant economic importance. The characteristic liquidity premium plays a central role in the valuation of financial assets. Thus, the results on the decline of the characteristic liquidity premium are important for both valuation and asset management applications. For example, a 1% decrease in the discount rate may translate into a

15%–20% increase in valuation.[3] 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. We find that the systematic liquidity premium has remained significant (at least among NASDAQ stocks), and thus its role as a risk factor remains intact.

The remainder of the paper is organized as follows: Section II describes the data. Section III presents the empirical results regarding the decline in the characteristic liquidity premium, as well as the decline in the profitability of liquidity-based trading strategies. Section IV presents the empirical findings regarding the pricing of systematic liquidity. We conclude in Section V.

II. Data and Main Variables

Our sample consists of all common stocks drawn from CRSP with share codes 10 and 11 (common shares). For NYSE our sample period is 1931–2011, for AMEX it is 1964–2011, and for NASDAQ it is 1986–2011. To simplify the presentations and allow for comparison across exchanges, we present our main analysis for 1964–2011, and we present results for NYSE for the earlier period separately.

Ideally, liquidity measures should be calculated using intraday data. Because of the lack of such data before the 1980s, we use three liquidity measures calculated from daily data. These measures are found by Hasbrouck (2009) and Goyenko et al. (2009) to be highly correlated with effective spread and price impact measures calculated using intraday data. Each of the liquidity measures we use captures a different aspect of liquidity.

The first liquidity measure is a modified version of the measure presented in Amihud (2002). This is a 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. Formally, AMIHUD for stock i in year t is denoted by $\text{AMIHUD}_{i,t}$ and is given by

$$\text{AMIHUD}_{i,t} = \frac{1}{D_{it}} \sum_{d=1}^{D_{it}} \frac{|R_{idt}|}{\text{VOLD}_{idt} \cdot \text{INF}_{dt}},$$

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 in real terms using end-of-2011 prices.[4,5] The inflation adjustment is needed because the economic meaning of $1 million

[3]For a typical calculation, see the spreadsheet posted on Aswath Damodaran's Web site (http://pages.stern.nyu.edu/~adamodar).

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

[5]Florackis, Gregoriou, and Kostakis (2011) and Brennan, Huh, and Subrahmanyam (2013) propose a variation of AMIHUD in which they divide absolute returns by turnover instead of dollar volume. This essentially corresponds to multiplying AMIHUD by the stock's market cap. In this paper we prefer to focus on the original AMIHUD measure, which was empirically found to be a good proxy for price impact.

has changed over the years. Indeed, the cumulative inflation between 1964 and 2011 was around 630%. It is important to note that this inflation adjustment does not affect our estimates of the liquidity premium (see the discussion of this point in Section III.A). The adjustment, however, does affect our estimates of the sensitivity of expected returns to liquidity. We discuss this in Section III.F and show that our conclusions are robust when instead of adjusting by inflation we adjust by aggregate market cap (as in Acharya and Pedersen (2005), Pastor and Stambaugh (2003)). Similar to Amihud (2002), for each year of our sample we censor the upper and lower 1% of the distribution of AMIHUD to avoid outliers.

Our second measure is related to transaction costs and not directly to volume. It is the annual average of Roll's (1984) estimate of effective half bid–ask spread. The idea behind this measure is that in the absence of new information, daily price changes exhibit negative autocorrelation. Moreover, the bid–ask spread is proportional to the square root of the negative of the covariance price changes. In practice, this covariance is often positive, making the estimation problematic. Hasbrouck (2009) solved this problem by using a Gibbs estimator. Hereafter we denote this measure by Hasbrouck–Roll (HR). As discussed in Hasbrouck, the correlation between the Gibbs estimator and Trade and Quote (TAQ) data bid–ask spreads for 1993–2005 is 0.965.[6]

Following Goyenko et al. (2009), the third measure combines both aspects of liquidity and proxies for the price impact of the spread.[7] This measure is calculated as the ratio of the HR spread (our spread proxy) to annual dollar volume (in millions of dollars) (HRDVOL). Similar to AMIHUD, we present HRDVOL in real terms by adjusting the dollar volume to inflation using end-of-2011 prices.

As discussed in Goyenko et al. (2009), the three measures we use are sound proxies for illiquidity. Goyenko et al. find that the annual cross-sectional (time-series) correlation between the effective spread from TAQ and HR is 0.779 (0.991). Furthermore, the annual cross-sectional (time-series) correlation between Kyle's (1985) lambda estimated from TAQ and AMIHUD is 0.653 (0.914), and the correlation between Kyle's lambda and HRDVOL is 0.634 (0.949).[8]

To ensure the reliability of our estimates, in our main analysis we calculate the liquidity measures only for stocks that satisfy the following two requirements: i) the stock has return data for at least 60 trading days during the year and ii) the stock is listed at the end of the year and has a year-end price that is higher than \$2.[9]

[6]The CRSP end-of-day bid–ask spreads are available for NASDAQ only since 1986 and NYSE since 1993. Thus, these data are not sufficient for our purposes. Nevertheless, we have checked that all of our results are robust when the HR measure is replaced with the actual bid–ask spread data for the period available.

[7]Goyenko et al. (2009) refer to this measure as the "Roll impact."

[8]We also tried to use the zero-return and zero-volume measures discussed in Goyenko et al (2009). However, these measures show very little cross-sectional variation starting in 2000. This prevented us from obtaining meaningful comparisons across time.

[9]This type of filters is common. See, for example, Amihud (2002), Acharya and Pedersen (2005), and Kamara, Lou, 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.

Table 1 presents summary statistics for the stocks in our sample during 1964–2011, broken down by the exchange on which they are listed. The number of stocks in our sample ranges from 1,052 to 1,615 on NYSE, 1,731 to 3,638 on NASDAQ, and 114 to 913 on AMEX. As can be observed, the three exchanges differ substantially in the composition of their listed stocks. The median market cap of stocks on NYSE during our sample period is $676 million, as opposed to just $122 million on NASDAQ, and $35 million on AMEX. Because size and liquidity are highly correlated, stocks on NYSE are much more liquid than in the other two exchanges. For example, AMIHUD is more than 10 times smaller on NYSE as compared to NASDAQ and AMEX. This fact, in itself, suggests that an analysis of liquidity effects should distinguish among the different exchanges. The three exchanges differ on several other important dimensions that may affect a longitudinal analysis:

i) NASDAQ data on CRSP up to the mid-1980s do not include volume information, preventing the calculation of both AMIHUD and HRDVOL.

ii) It is well known that volume on NASDAQ is inflated (see Atkins and Dyl (1997)), and the amount of inflation has varied over the years because of market reforms. Thus, the economic meaning of AMIHUD and HRDVOL for NASDAQ stocks is different from that for NYSE and AMEX.

iii) Over the years, the different exchanges experienced different market reforms that 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. In addition, decimalization has been applied to the different exchanges at different points in time.

TABLE 1

Summary Statistics of Selected Variables

Table 1 reports the time-series average of the monthly cross-sectional statistics for all stocks in our sample traded on New York Stock Exchange (NYSE), NASDAQ, and American Stock Exchange (AMEX). The sample period for the reported variables is 1964–2011 for NYSE and AMEX and 1986–2011 for NASDAQ. AMIHUD is Amihud's (2002) illiquidity measure adjusted for inflation presented in Dec. 2011 prices. HR is Hasbrouck's (2009) Bayesian version of Roll's (1984) effective half bid–ask spread, estimated via the Gibbs sampler (in %). HRDVOL is the ratio of HR to inflation-adjusted annual dollar volume presented in Dec. 2011 prices (in millions of dollars). SDRET is the standard deviation of monthly returns. 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). SIZE is the end-of-year market capitalization (in millions of dollars). FIRMS is the number of firms in the sample. MIN (MAX) FIRMS is the time-series minimum (maximum) number of firms in the sample.

	NYSE			NASDAQ			AMEX		
Variables	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
AMIHUD	0.086	0.022	0.192	2.061	0.311	4.895	1.596	0.688	2.381
HR (%)	0.453	0.361	0.325	1.236	1.041	0.829	0.848	0.685	0.596
HRDVOL	0.007	0.001	0.019	0.130	0.016	0.395	0.151	0.044	0.301
SDRET (%)	10.22	9.52	3.85	15.45	14.18	8.34	14.18	13.19	6.06
TURNOVER	0.73	0.58	0.57	1.23	0.78	1.49	0.41	0.27	0.53
DVOL ($ million)	3,054	928	5,798	1,153	140	3,535	62	12	180
SIZE ($ million)	2,354	676	5,149	405	122	982	96	35	227
FIRMS	1,266	1,275	125	2,480	2,342	460	511	487	207
MIN FIRMS	1,052			1,731			114		
MAX FIRMS	1,615			3,638			913		

iv) Finally, the three exchanges have experienced different trends in terms of the composition of their listings. Most important, common stocks have become less prevalent on AMEX, where recently they account for only about 35% of the listings.

Because of the significant differences in characteristics and the additional reasons above, in all of our analyses we distinguish among the three exchanges (similar to Hasbrouck (2009)). This helps us prevent mixing 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 the three liquidity measures and share turnover on NYSE and NASDAQ. For each year, we plot the median of the liquidity measure and turnover across the firms available for analysis during that year. Although liquidity seems to have fluctuated during the 1970s and 1980s, it appears to have improved since the early 1990s. This is consistent with the several market reforms (such as decimalization) and technological changes that took effect during these years. The improvement in market liquidity is accompanied by a dramatic increase in turnover. Chordia, Roll, and Subrahmanyam (2011) 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. As noted in the Introduction, the combined effect of these two trends on the pricing of liquidity is ambiguous.

FIGURE 1

Liquidity Measures and Turnover Medians over Time

The graphs in Figure 1 depict annual medians of AMIHUD, HR, HRDVOL, and TURNOVER for NYSE and NASDAQ, based on the cross-sectional estimates presented in Table 1. In these graphs the year bars relate to the estimation year $t-1$.

Graph A. NYSE

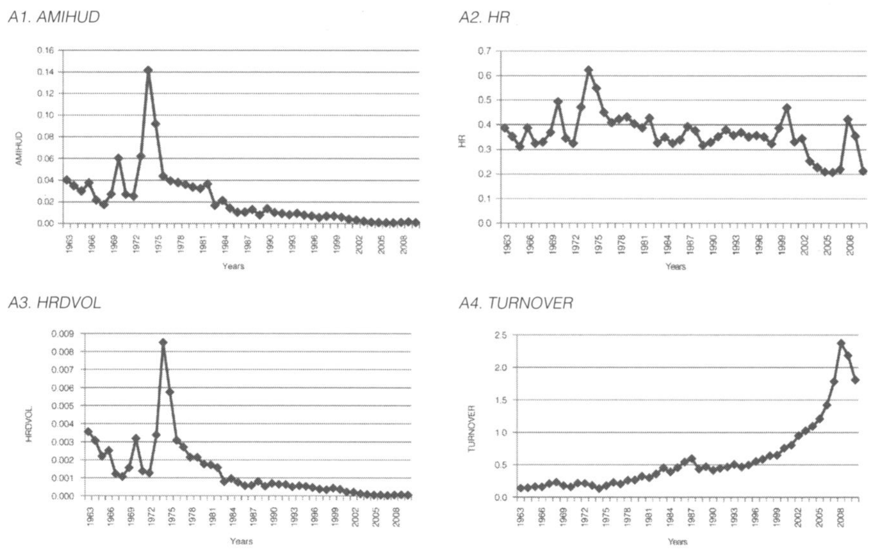


FIGURE 1 (continued)

Liquidity Measures and Turnover Medians over Time

Graph B. NASDAQ

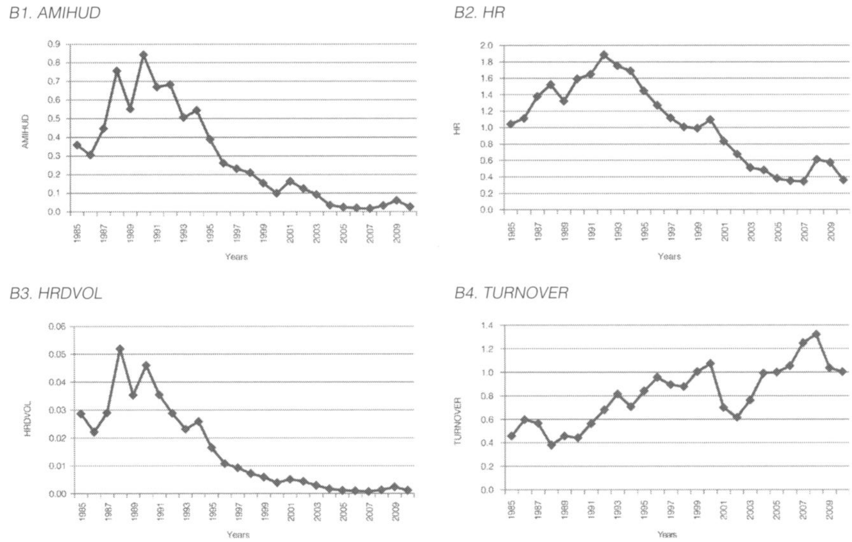


Table 2 reports the averages of the monthly cross-sectional correlations among the three liquidity measures, turnover, market cap (LNSIZE), and the standard deviation of returns (SDRET) during 1964–2011. The correlation between the liquidity measures ranges between 0.44 and 0.87, suggesting that they are correlated but not perfectly so. Thus, each liquidity measure brings a different dimension to the analysis. Note also the high negative correlation of liquidity with size and the positive correlation with the standard deviation of returns.

Our analysis employs several additional variables. The main dependent variable is the stock return. We use monthly returns from CRSP and adjust the returns to account for delisting bias.[10] To account for the sensitivity of stock returns to risk factors, we use the Fama–French (1992) factor loadings calculated by regressing daily excess returns on the four Fama–French 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 largely follow Amihud (2002). These are: i) end-of-year market capitalization, to capture the size effect; ii) monthly standard deviation of returns based on 12–60 observations, 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-year price, helps

[10]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 over-the-counter (OTC) returns of delisted stocks. We thus assign a return of −30% if a delisting is coded as 500 (reason unavailable), 520 (went OTC), 551–573 and 580 (various reasons), 574 (bankruptcy), and 584 (does not meet exchange financial guidelines).

TABLE 2

Cross-Sectional Correlations

Table 2 presents the time-series averages of the monthly cross-sectional Pearson correlations from Jan. 1964 to Dec. 2011 for New York Stock Exchange (NYSE) and American Stock Exchange (AMEX) stocks, and Jan. 1986 to Dec. 2011 for NASDAQ stocks. AMIHUD is Amihud's (2002) illiquidity measure adjusted for inflation presented in Dec. 2011 prices. HR is Hasbrouck's (2009) Bayesian version of Roll's (1994) effective half bid–ask spread, estimated via the Gibbs sampler (in %). HRDVOL is the ratio of HR to inflation-adjusted annual dollar volume presented in Dec. 2011 prices (in millions of dollars). Turnover (TURNOVER) is the sum of monthly stock volume values divided by the average number of outstanding shares throughout the year. SDRET is the standard deviation of monthly returns. LNSIZE is the logarithm of the end-of-year market capitalization (in millions of dollars).

Variables	HR	HRDVOL	TURNOVER	SDRET	LNSIZE
Panel A. NYSE					
AMIHUD	0.44	0.87	−0.17	0.19	−0.55
HR		0.52	0.08	0.42	−0.49
HRDVOL			−0.18	0.12	−0.47
TURNOVER				0.46	−0.01
SDRET					−0.42
Panel B. NASDAQ					
AMIHUD	0.69	0.67	−0.26	0.04	−0.50
HR		0.55	−0.29	0.10	−0.63
HRDVOL			−0.23	0.07	−0.40
TURNOVER				0.37	0.30
SDRET					−0.12
Panel C. AMEX					
AMIHUD	0.55	0.81	−0.22	0.15	−0.58
HR		0.45	0.02	0.38	−0.41
HRDVOL			−0.24	0.01	−0.48
TURNOVER				0.41	0.12
SDRET					−0.13

capture the value premium and possible tax effects on returns; iv) two variables account for past returns to capture short-term momentum: MOM4, equal to the cumulative return during the last 4 months of the previous year, and MOM8, equal to the cumulative return during the first 8 months of the previous year.

Finally, we control in our regressions for book-to-market to account for the value premium. We 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 $t+1$. For the pre-Compustat period we obtain book values from Moody's Manuals data as posted on Kenneth French's Web site (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html).

A well-known problem is that book-to-market information is missing in many cases. 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), which is equal to 1 whenever the book-to-market exists and is positive, and 0 otherwise. Furthermore, we define a modified book-to-market variable, which is equal to the true book-to-market if it is available and positive, and 0 otherwise. Then, in the regressions we include both the dummy and the modified log(book-to-market) variable. The coefficient on this variable is an estimate of the loading on the original book-to-market variable on the subsample, where it is available and nonnegative.

III. Time Trends and Size Effects in the Characteristic Liquidity Premium

In this section we provide detailed estimates of the characteristic liquidity premium. We then explore how these estimates vary over time and across size. We first provide evidence using cross-sectional Fama–MacBeth (1973) regressions and then revisit these issues using a different methodology to explore the profitability of liquidity-based trading strategies.

A. Cross-Sectional Analysis

For each month m in year t between Jan. 1964 and Dec. 2011 (576 months), we estimate a cross-sectional regression of the form:

$$(1) \qquad R_{i,m,t} \quad = \quad \alpha_{m,t} + \sum_{j=1}^{J} \beta_{j,m,t} X_{i,j,t-1} + \varepsilon_{i,m,t}.$$

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 one of the three liquidity measures (AMIHUD, HR, and HRDVOL). We also include additional explanatory variables that have been shown (or are suspected) to be determinants of returns. These are the Fama–French (1992) 4-factor loadings, as well as: size, momentum, book-to-market, standard deviation of returns, and dividend yield. Note that including both characteristics and factor loadings is now common (see, e.g., Ang et al. (2009)). We run the regressions separately for each of the three exchanges.

We first obtain 576 monthly estimates of the sensitivity of returns to liquidity (regression coefficients), one for each month in the sample period. Multiplying the regression coefficients by the liquidity measure of a certain stock provides us with an estimate for the characteristic liquidity premium of that stock for the given month. Essentially, this is an estimate of the expected return difference between this stock and a stock with perfect liquidity. Averaging this estimate across all stocks provides us with an estimate for the average liquidity premium. Note that the scaling of AMIHUD by inflation does not affect this measure of the liquidity premium.[11]

To begin, Table 3 presents a standard Fama–MacBeth (1973) analysis (broken down by exchange and liquidity measure) for the entire sample period. For each explanatory variable, the table reports the average of the regression coefficients based on all of the monthly observations, as well as a t-statistic testing against the null hypothesis that this average is 0. The table also reports four versions of the estimated characteristic liquidity premium. The first two are the time-series

[11]The reason for this is that the unit of measurement of the liquidity coefficient in Fama–MacBeth (1973) regressions is "returns per illiquidity." Furthermore, the liquidity premium is calculated as the coefficient times the average (or standard deviation) of illiquidity. Thus, any adjustment to the liquidity measure affects the coefficient and the average liquidity in offsetting ways, rendering the liquidity premium (the product of the two) unaffected. Formally, in a linear regression, when one divides the explanatory variable by some constant, the coefficient is multiplied by the same constant. Thus, their product is unaffected.

TABLE 3

Fama–MacBeth Regressions over the Entire Sample Period

Table 3 presents the time-series average of the estimated liquidity premium and other variable coefficients from monthly cross-sectional regressions of stock returns on explanatory variables (equation (1)). The sample period is 1964–2011 for New York Stock Exchange (NYSE) and American Stock Exchange (AMEX), and 1986–2011 for NASDAQ, resulting in 576 and 312 monthly cross-sectional regressions, respectively. AMIHUD is Amihud's (2002) illiquidity measure adjusted for inflation presented in Dec. 2011 prices. HR is Hasbrouck's (2009) Bayesian version of Roll's (1984) effective half bid–ask spread, estimated via the Gibbs sampler (in %). HRDVOL is the ratio of HR to inflation-adjusted annual dollar volume presented in Dec. 2011 prices (in millions of dollars). Liquidity Premium is the monthly liquidity premium, calculated in four ways, EW, VW, MED, and DISP, as the product of the monthly liquidity coefficient and the monthly equal-weighted average, value-weighted average, median, and dispersion (1 standard deviation) of the liquidity measures. 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 (1992) 4-factor model, calculated based on the daily returns. SDRET is the standard deviation of monthly 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 (following Pontiff and Woodgate (2008) we include a dummy variable equal to 1 if the firm has book-to-market data, and 0 otherwise). Adj. R^2 is the time-series average of the adjusted R^2 from the monthly regressions. The *t*-statistics are reported in parentheses below the coefficient estimates.

	NYSE			NASDAQ			AMEX		
	AMIHUD	HR	HRDVOL	AMIHUD	HR	HRDVOL	AMIHUD	HR	HRDVOL
	1	2	3	4	5	6	7	8	9
Panel A. Liquidity Premium (%)									
EW	0.031	0.048	0.028	0.067	0.151	0.021	0.090	0.098	0.058
	(2.29)	(1.20)	(3.21)	(4.03)	(2.50)	(2.01)	(2.47)	(1.22)	(2.64)
VW	0.005	0.027	0.004	0.012	0.061	0.002	0.027	0.058	0.017
	(2.17)	(1.00)	(2.54)	(5.41)	(2.16)	(2.82)	(2.56)	(1.07)	(3.03)
MED	0.012	0.036	0.005	0.017	0.131	0.003	0.040	0.077	0.014
	(2.20)	(1.11)	(2.39)	(5.25)	(2.61)	(2.75)	(2.35)	(1.19)	(2.35)
DISP	0.052	0.037	0.074	0.131	0.094	0.056	0.130	0.075	0.124
	(2.19)	(1.37)	(3.25)	(3.73)	(2.32)	(1.86)	(2.39)	(1.33)	(2.54)
Panel B. Regression Coefficients									
LIQUIDITY	0.33	0.07	3.31	0.04	0.10	0.17	0.10	0.07	0.32
	(1.27)	(0.68)	(1.26)	(3.19)	(1.65)	(1.11)	(2.25)	(0.60)	(1.64)
LNSIZE	−0.08	−0.10	−0.08	0.07	0.07	0.05	−0.03	−0.05	−0.04
	(2.90)	(3.58)	(2.86)	(1.42)	(1.73)	(0.97)	(0.65)	(1.09)	(0.93)
B_MKT	0.04	0.02	0.05	0.06	0.07	0.06	−0.21	−0.25	−0.21
	(0.37)	(0.21)	(0.42)	(0.43)	(0.43)	(0.39)	(1.54)	(1.78)	(1.59)
B_SMB	−0.05	−0.06	−0.05	−0.03	−0.03	−0.02	0.04	0.03	0.05
	(0.89)	(1.02)	(0.82)	(0.42)	(0.45)	(0.34)	(0.44)	(0.34)	(0.54)
B_HML	0.04	0.04	0.03	−0.01	−0.02	−0.01	0.17	0.18	0.17
	(0.55)	(0.54)	(0.48)	(0.09)	(0.21)	(0.12)	(1.97)	(2.00)	(1.96)
B_UMD	−0.12	−0.12	−0.13	−0.20	−0.21	−0.21	−0.07	−0.09	−0.09
	(1.31)	(1.27)	(1.38)	(1.53)	(1.62)	(1.64)	(0.70)	(0.78)	(0.83)
SDRET	−0.04	−0.03	−0.03	−0.04	−0.04	−0.04	−0.04	−0.04	−0.03
	(3.34)	(3.08)	(2.84)	(4.50)	(4.14)	(4.04)	(4.03)	(3.67)	(3.35)
MOM4	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	(3.59)	(3.63)	(3.63)	(2.48)	(2.49)	(2.54)	(3.19)	(3.43)	(3.62)
MOM8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(3.32)	(3.47)	(3.35)	(1.23)	(1.36)	(1.24)	(3.09)	(3.29)	(3.07)
DIVYLD	−0.03	−0.02	−0.02	−0.03	0.00	0.00	−0.02	0.00	−0.01
	(2.09)	(2.14)	(1.95)	(1.17)	(0.15)	(0.22)	(1.38)	(0.35)	(0.39)
LNBM	0.12	0.11	0.11	0.32	0.33	0.33	0.30	0.29	0.30
	(2.88)	(2.71)	(2.67)	(5.51)	(5.46)	(5.47)	(4.97)	(4.55)	(4.82)
Adj. R^2	0.08	0.08	0.08	0.05	0.05	0.05	0.05	0.05	0.05

averages of the equal- and value-weighted averages of the monthly cross-sectional liquidity premiums. The third is the median, where in each month we calculate the median liquidity premium and then average it across time. The fourth is a dispersion measure that is an attempt to gauge the difference in return between liquid and nonliquid firms. It is estimated as the time-series average of the monthly liquidity regression coefficients multiplied by the monthly liquidity standard deviation.

The results are typical for this kind of test. The characteristic liquidity premiums are significant for all three liquidity measures (except for HR on NYSE). For example, the monthly AMIHUD estimated equal-weighted average liquidity premiums are 0.031%, 0.067%, and 0.09% for NYSE, NASDAQ, and AMEX, respectively. The value-weighted characteristic liquidity premiums are much smaller in magnitude: 0.005%, 0.012%, and 0.027% for NYSE, NASDAQ, and AMEX, respectively. The difference between the equal- and value-weighted premiums suggests that much of the liquidity premium is concentrated among smaller stocks.

Next, we explore the presence of time trends in the characteristic liquidity premium. We divide the 48 years between 1964 and 2011 into four subperiods: Period 1 is 1964–1975, period 2 is 1976–1987, period 3 is 1988–1999, and period 4 is 2000–2011. Because of the availability of data, for NASDAQ we consider only two periods: 1986–1999 and 2000–2011. The idea behind dividing the entire sample period into subperiods is to neutralize some of the noise in the monthly coefficients by averaging them over several years. Using 12 years of data gives us 144 monthly observations per subperiod, which is likely to alleviate some of the inevitable noise.

We apply the Fama–MacBeth (1973) analysis (as above) separately to each of the subperiods and compare the resulting premiums. Table 4 presents the results for each exchange and each measure separately using all of the control variables as in Table 3 (not reported to save space). The table presents the equal-weighted premium, value-weighted premium, median premium, and dispersion of the premium.

Panel A of Table 4 presents the results for Amihud's (2002) measure. Consider the results for NYSE reported in columns 1–4. Recall that in Table 3, we observed a significant premium for the entire period, with the value-weighted premium being smaller than the equal-weighted premium. Here we observe that both the equal- and value-weighted premiums for the first subperiod (1964–1975) are positive and significant with monthly values of 0.111% and 0.024%, respectively, which are approximately 1.3% and 0.3% annually. By contrast, the premiums in periods 2, 3, and 4 are much smaller and are not significantly different from 0. Furthermore, the differences between the premiums in the first and the last periods, and the differences between those in the first and last halves of the sample period in columns 1 and 2 of Table 4 are statistically significant, suggesting that the pricing effect of liquidity on NYSE has declined. When we consider the median and the dispersion of the premium, we observe similar results.[12]

Looking at NASDAQ data (columns 5–8), we again observe a downward trend during the two subperiods for which data is available. For example, the equal-weighted (value-weighted) premium during 1986–1999 is 0.116% (0.021%) and highly significant. By contrast, the equal-weighted (value-weighted) premium during 2000–2011 is just 0.009% (0.001%) and insignificant. The difference

[12]Early signs of a decline in the liquidity premium can be seen already in Amihud (2002), who studies NYSE stocks during 1964–1997. Indeed, inspection of Table 2 in Amihud reveals that the average liquidity premium appears to be lower in 1981–1997 than in 1964–1980.

TABLE 4

Liquidity Premium from Fama–MacBeth Regressions: Four Subperiods

Table 4 presents the liquidity premiums from monthly cross-sectional regressions of stock returns on AMIHUD, HR, and HRDVOL liquidity measures and all the explanatory variables using equation (1). AMIHUD is Amihud's (2002) illiquidity measure adjusted for inflation presented in Dec. 2011 prices. HR is Hasbrouck's (2009) Bayesian version of Roll's (1984) effective half bid–ask spread, estimated via the Gibbs sampler (in %). HRDVOL is the ratio of HR to inflation-adjusted annual dollar volume presented in Dec. 2011 prices (in millions of dollars). EW, VW, MED, and DISP are the monthly liquidity premiums calculated as the product of the monthly liquidity coefficient and the monthly equal-weighted average, value-weighted average, median, and dispersion (1 standard deviation) of the cross-sectional stock liquidity measures. The subperiods are 1964–1975, 1976–1987, 1988–1999, and 2000–2011 for New York Stock Exchange (NYSE) and American Stock Exchange (AMEX), and 1986–1999 and 2000–2011 for NASDAQ. The *t*-statistics are reported in parentheses below the coefficient estimates. *t*-test and Wilcoxon refer to parametric and nonparametric tests for the differences between the coefficients in the two subperiods. The *t*-test statistics are adjusted for serial correlation using the Newey–West (1987) correction. Two-Subperiods Test refers to the first and last halves of the sample period: 1964–1987 versus 1988–2011. Similarly First- versus Last-Period Test refers to the first and last subperiods: 1964–1975 versus 2000–2011 for NYSE and AMEX, and 1986–1999 versus 2000–2011 for NASDAQ.

	NYSE				NASDAQ				AMEX			
	EW	VW	MED	DISP	EW	VW	MED	DISP	EW	VW	MED	DISP
Periods	1	2	3	4	5	6	7	8	9	10	11	12
Panel A. AMIHUD												
Period 1	0.111	0.024	0.047	0.163	NA	NA	NA	NA	0.209	0.092	0.108	0.269
	(2.82)	(2.41)	(2.51)	(2.98)					(2.69)	(2.78)	(2.83)	(2.83)
Period 2	0.004	0.001	−0.001	0.015	NA	NA	NA	NA	0.074	0.034	0.025	0.123
	(0.14)	(0.04)	(0.12)	(0.27)					(1.13)	(0.66)	(1.99)	(1.37)
Period 3	0.021	0.002	0.002	0.063	0.116	0.021	0.030	0.217	0.076	0.027	0.027	0.119
	(1.19)	(0.84)	(0.75)	(1.29)	(5.57)	(5.76)	(5.67)	(5.47)	(1.43)	(1.38)	(2.37)	(1.38)
Period 4	−0.013	−0.001	−0.002	−0.033	0.009	0.001	0.001	0.030	0.002	0.011	−0.001	0.008
	(0.89)	(0.91)	(1.27)	(0.71)	(0.37)	(0.65)	(0.54)	(0.51)	(0.02)	(0.02)	(0.24)	(0.05)
Two-Subperiods Test												
t-test	2.05	2.13	2.26	1.48	NA	NA	NA	NA	1.44	1.96	1.61	1.25
Wilcoxon	1.66	2.02	2.11	1.20	NA	NA	NA	NA	1.12	1.13	0.98	1.18
First- versus Last-Period Test												
t-test	3.07	2.52	2.68	2.86	3.19	4.85	4.71	2.62	1.78	2.27	1.97	1.51
Wilcoxon	2.79	2.87	2.93	2.48	3.25	4.45	4.53	2.52	2.26	2.16	2.01	2.37
Panel B. HR												
Period 1	0.118	0.064	0.096	0.083	NA	NA	NA	NA	0.363	0.238	0.281	0.266
	(1.41)	(1.22)	(1.35)	(1.52)					(2.12)	(2.05)	(2.11)	(2.18)
Period 2	0.047	0.026	0.035	0.038	NA	NA	NA	NA	0.013	0.005	0.013	0.008
	(0.66)	(0.62)	(0.61)	(0.69)					(0.10)	(0.06)	(0.13)	(0.09)
Period 3	0.054	0.041	0.040	0.041	0.293	0.125	0.252	0.193	0.214	0.127	0.174	0.163
	(0.79)	(0.92)	(0.78)	(0.72)	(3.66)	(3.70)	(3.63)	(3.66)	(1.68)	(1.73)	(1.75)	(1.68)
Period 4	−0.027	−0.024	−0.024	−0.013	−0.015	−0.013	−0.009	−0.021	−0.154	−0.106	−0.126	−0.103
	(0.29)	(0.35)	(0.30)	(0.25)	(0.17)	(0.29)	(0.13)	(0.35)	(0.75)	(0.71)	(0.60)	(0.74)
Two-Subperiods Test												
t-test	0.89	0.70	0.89	1.15	NA	NA	NA	NA	0.90	0.96	0.88	0.87
Wilcoxon	0.64	0.79	0.67	0.53	NA	NA	NA	NA	0.12	0.11	0.07	0.15
First- versus Last-Period Test												
t-test	1.19	1.04	1.07	1.34	2.53	2.39	2.58	2.62	2.04	1.92	2.01	2.13
Wilcoxon	1.07	1.20	1.07	0.92	2.50	2.33	2.46	2.51	1.38	1.40	1.42	1.45
Panel C. HRDVOL												
Period 1	0.059	0.010	0.016	0.119	NA	NA	NA	NA	0.102	0.048	0.034	0.184
	(2.57)	(2.03)	(1.96)	(2.85)					(2.40)	(2.74)	(2.09)	(2.54)
Period 2	0.025	0.003	0.004	0.065	NA	NA	NA	NA	0.040	0.005	0.007	0.092
	(1.27)	(1.14)	(1.08)	(1.34)					(0.97)	(0.59)	(0.64)	(1.11)
Period 3	0.034	0.002	0.003	0.118	0.041	0.004	0.006	0.116	0.068	0.008	0.012	0.162
	(2.41)	(2.02)	(1.94)	(2.58)	(3.12)	(3.04)	(2.87)	(3.22)	(1.90)	(1.64)	(1.47)	(2.05)
Period 4	−0.006	0.000	−0.001	−0.008	−0.003	0.000	0.001	−0.013	0.023	0.007	0.004	0.059
	(0.62)	(0.22)	(0.92)	(0.18)	(0.15)	(0.07)	(0.45)	(0.25)	(0.43)	(0.70)	(0.36)	(0.42)
Two-Subperiods Test												
t-test	1.66	2.01	1.95	0.85	NA	NA	NA	NA	0.63	1.69	1.08	0.32
Wilcoxon	1.45	2.28	2.33	0.89	NA	NA	NA	NA	0.10	0.45	0.34	0.08
First- versus Last-Period Test												
t-test	2.62	2.02	2.03	2.19	2.01	2.84	2.21	2.07	1.28	2.03	1.57	0.93
Wilcoxon	2.69	3.04	3.13	2.17	2.45	3.27	3.01	2.26	1.54	1.70	1.61	1.66

between the two subperiods is highly significant. As for AMEX data (columns 9–12), we observe a similar trend across the four liquidity premium estimates, although somewhat weaker than for NYSE and NASDAQ.

Overall, the evidence using Amihud's (2002) measure suggests a downward trend for the characteristic liquidity premium for all three stock exchanges, with somewhat weaker results for AMEX. The standard results presented in Table 3 seem to be a mix of a highly significant characteristic liquidity premium in the early years with a low and often insignificant characteristic liquidity premium more recently.

Panel B of Table 4 presents results for the HR measure. The HR premium at NYSE is not statistically significant in any period, not even the early periods. Nevertheless, the magnitude of the premiums appears to be declining over the years. The results for NASDAQ and AMEX resemble the AMIHUD results, where we observe a clear and significant decline in the characteristic liquidity premiums, which become insignificant in the most recent period.

Panel C of Table 4 repeats the analysis using the HRDVOL measure. The results are consistent with those presented in Panel A, where we see a significant decline in the characteristic liquidity premiums for NYSE and NASDAQ, but somewhat weaker results for AMEX.

In sum, the picture from the three liquidity measures, the four proxies for the characteristic liquidity premium, and across all three exchanges is consistent. Although characteristic liquidity was priced in the early periods, its pricing has dropped dramatically over years, and in recent years we typically cannot identify a characteristic liquidity premium.

B. Size Analysis

In the previous subsection we remarked on the differences between the equal-weighted and value-weighted estimated characteristic liquidity premiums. It is then natural to ask whether size is a determinant of the characteristic liquidity premium. Furthermore, 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)). To differentiate trends in liquidity from trends in size, it is crucial to control for the relation between liquidity and firm size. Indeed, in our Fama–MacBeth (1973) regressions we specifically control for firm size. However, it may be that size affects liquidity in a nonlinear fashion that is not captured in our regressions.

To address these issues, in each month we sort the stocks within each stock exchange into three size terciles (1, 2, and 3 where 1 is the smallest and 3 is the largest). We then repeat the previous analysis, interacting the three liquidity measures with dummies for the different size terciles. Table 5 shows the equal-weighted liquidity premium related to both the entire period and to the subperiods for each of the three exchanges and three liquidity measures.

Panel A of Table 5 shows the results for AMIHUD. Consider NYSE first. Over the entire subperiod, liquidity is priced for the smaller stocks. Moreover, the decline in the characteristic liquidity premium for NYSE stocks, documented in Table 4, occurs solely to the smallest size tercile. The other two terciles show

TABLE 5
Liquidity Premium by Size Terciles

Table 5 presents the liquidity premium by size group from monthly cross-sectional regressions of stock returns on AMIHUD, HR, and HRDVOL liquidity measures and all explanatory variables using a variant of equation (1). AMIHUD is Amihud's (2002) illiquidity measure adjusted for inflation presented in Dec. 2011 prices. HR is Hasbrouck's (2009) Bayesian version of Roll's (1984) effective half bid–ask spread, estimated via the Gibbs sampler (in %). HRDVOL is the ratio of HR to inflation-adjusted annual dollar volume presented in Dec. 2011 prices (in millions of dollars). Specifically using dummy variables, we allow for three different coefficients for the three liquidity measures based on allocation to three size terciles. The size allocation is set every year based on the stock's end-of-year $t-1$ market capitalization. The table presents the results of the equal-weighted liquidity premium based on the three size terciles where Size 1 to Size 3 refer to the smallest to largest size groups. The equal-weighted liquidity premium is the product of the monthly liquidity coefficient and the equal-weighted average of AMIHUD, HR, and HRDVOL measures. The subperiods are 1964–1975, 1976–1987, 1988–1999, and 2000–2011 for New York Stock Exchange (NYSE) and American Stock Exchange (AMEX), and 1986–1999 and 2000–2011 for NASDAQ. The t-statistics are reported in parentheses below the coefficient estimates. t-test and Wilcoxon refer to parametric and nonparametric tests for the differences between the coefficients in the two subperiods. The t-test statistics are adjusted for serial correlation using the Newey–West (1987) correction. Two-Subperiods Test relates to the first and last halves of the sample period: 1964–1987 versus 1988–2011. Similarly, the First- versus Last-Period Test relates to the first and last subperiod: 1964–1975 versus 2000–2011 for NYSE and AMEX, and 1986–1999 versus 2000–2011 for NASDAQ. Exchange Cap Ratio is the average of the monthly tercile market cap to its specific exchange market cap. Market Cap Ratio (available for all three exchanges from 1986 to 2011) is the average of the monthly tercile market cap to the sum of the market cap of the three exchanges.

	NYSE			NASDAQ			AMEX		
	Size 1	Size 2	Size 3	Size 1	Size 2	Size 3	Size 1	Size 2	Size 3
Periods	1	2	3	4	5	6	7	8	9
Panel A. AMIHUD									
Entire Period	0.089	0.016	0.004	0.177	0.013	−0.006	0.160	0.123	0.013
	(2.80)	(0.82)	(0.29)	(4.32)	(0.63)	(0.48)	(1.91)	(2.37)	(0.35)
Period 1	0.271	0.033	−0.013	NA	NA	NA	0.430	0.156	0.059
	(3.13)	(0.63)	(0.32)				(2.63)	(1.61)	(0.94)
Period 2	0.035	0.029	0.029	NA	NA	NA	0.170	0.114	0.041
	(0.50)	(0.61)	(1.04)				(1.17)	(1.11)	(0.62)
Period 3	0.067	0.016	0.009	0.286	0.041	0.028	0.026	0.174	−0.064
	(1.47)	(0.59)	(0.36)	(5.73)	(1.28)	(1.62)	(0.19)	(1.87)	(0.98)
Period 4	−0.019	−0.015	−0.008	0.050	−0.019	−0.045	0.014	0.047	0.016
	(0.51)	(0.87)	(0.23)	(0.74)	(0.73)	(3.04)	(0.06)	(0.39)	(0.17)
Two-Subperiods Test									
t-test	2.12	0.76	0.25	NA	NA	NA	1.67	0.24	1.02
Wilcoxon	1.77	0.03	0.03	NA	NA	NA	1.58	0.19	1.19
First- versus Last-Period Test									
t-test	3.31	0.83	0.10	2.82	1.45	3.27	1.52	0.72	0.39
Wilcoxon	2.97	0.41	0.22	3.21	0.71	3.53	1.87	0.72	0.97
Exchange Cap Ratio	2.1%	9.2%	88.7%	2.0%	7.6%	90.4%	4.0%	11.7%	84.3%
Market Cap Ratio (1986–2011)	1.4%	7.0%	72.6%	0.3%	1.3%	16.4%	0.0%	0.1%	0.9%
Panel B. HR									
Entire Period	0.135	−0.009	−0.052	0.322	0.077	−0.069	0.166	0.062	0.062
	(2.03)	(0.17)	(1.07)	(3.04)	(0.87)	(0.88)	(1.22)	(0.58)	(0.64)
Period 1	0.278	−0.022	−0.066	NA	NA	NA	0.720	0.280	0.150
	(1.89)	(0.23)	(0.80)				(2.66)	(1.39)	(0.99)
Period 2	0.097	0.043	−0.057	NA	NA	NA	0.124	−0.158	0.019
	(0.77)	(0.45)	(0.68)				(0.55)	(1.03)	(0.15)
Period 3	0.081	0.021	0.066	0.516	0.226	0.048	0.224	0.357	0.072
	(0.74)	(0.24)	(0.75)	(3.34)	(2.04)	(0.48)	(0.92)	(1.81)	(0.44)
Period 4	0.084	−0.079	−0.150	0.096	−0.097	−0.205	−0.310	−0.196	0.020
	(0.57)	(0.53)	(1.17)	(0.67)	(0.69)	(0.09)	(0.94)	(0.69)	(0.07)
Two-Subperiods Test									
t-test	0.80	0.36	0.20	NA	NA	NA	1.72	0.19	0.17
Wilcoxon	0.32	0.44	0.25	NA	NA	NA	1.60	0.59	0.79
First- versus Last-Period Test									
t-test	0.95	0.32	0.56	2.08	1.87	1.61	2.63	1.37	0.41
Wilcoxon	0.64	0.48	0.61	1.86	2.16	2.15	2.40	1.18	0.71
Exchange Cap Ratio	2.1%	9.2%	88.7%	2.0%	7.6%	90.4%	4.0%	11.7%	84.3%
Market Cap Ratio (1986–2011)	1.4%	7.0%	72.6%	0.3%	1.3%	16.4%	0.0%	0.1%	0.9%

(continued on next page)

TABLE 5 (continued)

Liquidity Premium by Size Terciles

	NYSE			NASDAQ			AMEX		
	Size 1	Size 2	Size 3	Size 1	Size 2	Size 3	Size 1	Size 2	Size 3
Periods	1	2	3	4	5	6	7	8	9
Panel C. HRDVOL									
Entire Period	0.083	0.015	0.002	0.051	0.030	−0.005	0.144	0.115	0.031
	(3.87)	(0.96)	(0.18)	(2.02)	(1.98)	(0.47)	(2.82)	(2.99)	(1.34)
Period 1	0.147	0.006	−0.026	NA	NA	NA	0.220	0.081	0.047
	(2.94)	(0.18)	(0.87)				(2.51)	(1.46)	(1.47)
Period 2	0.084	0.056	0.035	NA	NA	NA	0.123	0.109	0.036
	(1.60)	(1.42)	(1.33)				(1.25)	(1.62)	(0.79)
Period 3	0.105	0.012	0.000	0.103	0.035	0.014	0.152	0.233	0.067
	(2.78)	(0.44)	(0.03)	(3.20)	(1.57)	(1.23)	(1.60)	(3.32)	(1.30)
Period 4	−0.004	−0.013	0.000	−0.010	0.025	−0.027	0.079	0.039	−0.025
	(0.15)	(0.55)	(0.01)	(0.24)	(1.25)	(1.63)	(0.64)	(0.37)	(0.44)
Two-Subperiods Test									
t-test	1.57	1.00	0.19	NA	NA	NA	1.00	1.50	0.80
Wilcoxon	1.69	0.67	0.20	NA	NA	NA	0.64	1.21	0.05
First- versus Last-Period Test									
t-test	2.80	0.46	0.64	2.15	0.35	2.12	1.46	0.66	0.98
Wilcoxon	2.83	0.31	0.64	2.75	0.77	1.93	1.67	0.24	0.74
Exchange Cap Ratio	2.1%	9.2%	88.7%	2.0%	7.6%	90.4%	4.0%	11.7%	84.3%
Market Cap Ratio (1986–2011)	1.4%	7.0%	72.6%	0.3%	1.3%	16.4%	0.0%	0.1%	0.9%

no pricing of characteristic liquidity even in the early periods. For each month we also calculated the percentage of market cap associated with each size tercile (out of the exchange market cap and the total market cap). The time-series averages of these percentages are denoted in the table by "Exchange Cap Ratio" and "Market Cap Ratio." These ratios show that the smallest tercile on NYSE accounts on average for just 2.1% of our NYSE sample market cap and 1.4% of the total market cap. Thus, the pricing of characteristic liquidity and its decline are attributed to a small fraction of the total market cap.

Now, consider NASDAQ. Here we observe that in the early period stocks in size terciles 1 and 3 command a characteristic liquidity premium. However, the magnitude of the premium in the largest stocks (size 3) is about 10 times smaller than that of the smallest stocks (size 1). Additionally, we observe a decline in the premium for the size terciles where it was initially significant. In the last period all premiums are either nonsignificant or negative.

Finally, considering AMEX, we see that the largest stocks (size 3) do not command a characteristic liquidity premium in any period, whereas sizes 1 and 2 do show a premium that declines over time (although the decline is significant only for size 1). Importantly, in the most recent period, none of the size terciles on AMEX shows a significant premium. Note that AMEX stocks account for only about 1% of the market cap in our sample.

Panels B and C of Table 5 present similar analyses for HR and HRDVOL. The results are generally consistent with those presented in Panel A, where we observed that the premiums are largely concentrated in the smaller size terciles and only during the early periods. Those premiums largely disappear by the last period. Collectively, the evidence in this section suggests that the characteristic liquidity premium in publicly traded common stocks is narrowly concentrated among small stocks, and even there it has been declining.

C. Liquidity-Based Trading Strategies

The higher expected returns of illiquid stocks have long attracted long-term investors aspiring 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 characteristic liquidity premium, it is important to know whether the profitability of these trading strategies has declined as well.

To study this question we construct portfolios double sorted on both size and liquidity. That is, we first sort stocks listed on each stock exchange into three size groups, based on the previous end-of-year size. Then, within each size group, we sort stocks into five illiquidity quintiles, based on the previous year's AMIHUD, HR, or HRDVOL measures. By assigning equal weights to all firms, we obtain 15 portfolios for each month during our sample period. For each size tercile and each month, we then construct long–short portfolios for each liquidity measure. 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 portfolios, we can i) examine whether the profitability of liquidity-based portfolios has changed over the years, ii) examine the extent to which characteristic liquidity is priced in each size tercile, and iii) 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 4 Fama–French (1992) factors (MKTRF, HML, SMB, and UMD). Our approach is similar to that of Brennan et al. (1998) and Chordia, Subrahmanyam, and Anshuman (2001). For each month m between 1964 and 2011, we regress the monthly excess returns of a portfolio on the returns of the 4 Fama–French factors during the preceding 60 months. Thus, for each month m and portfolio p we obtain an estimate of the 4-factor loadings as of that month, denoted by $\beta_{\text{MKT},p,m}$, $\beta_{\text{HML},p,m}$, $\beta_{\text{SMB},p,m}$, and $\beta_{\text{UMD},p,m}$. Now, for each month m we calculate the out-of-sample 4-factor alpha of portfolio p (denoted $\text{ALPHA}_{p,m}$) 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:

$$(2)\quad \begin{aligned} \text{ALPHA}_{p,m} \;=\; & (\text{RET}_{p,m} - \text{RF}_m) - \beta_{\text{MKT},p,m}(\text{MKT}_m - \text{RF}_m) \\ & - \beta_{\text{SMB},p,m}\text{SMB}_m - \beta_{\text{HML},p,m}\text{HML}_m - \beta_{\text{UMD},p,m}\text{UMD}_m, \end{aligned}$$

where $\text{RET}_{p,m}$, 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 576 out-of-sample alpha estimates. It should be noted that these alphas are before transaction costs, which may be substantial for illiquid stocks. Therefore, our results may be viewed as an upper bound for the profitability of such strategies.

We performed this analysis for NYSE and NASDAQ only. Calculating double-sorted alphas for AMEX in the most recent periods is not feasible because the number of common stocks listed on AMEX is only around 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.

The alphas of the liquidity-based long–short portfolios for each size tercile are presented in Table 6 by subperiod. Consider first the results for NYSE

TABLE 6

Out-of-Sample 4-Factor Alphas: Portfolios Presorted by Size

In each month between 1964 and 2011, we sort the stocks in each stock exchange 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, HR, and HRDVOL liquidity measures. AMIHUD is Amihud's (2002) illiquidity measure adjusted for inflation presented in Dec. 2011 prices. HR is Hasbrouck's (2009) Bayesian version of Roll's (1984) effective half bid–ask spread, estimated via the Gibbs sampler (in %). HRDVOL is the ratio of HR to inflation-adjusted annual dollar volume presented in Dec. 2011 prices (in millions of dollars). For each liquidity measure, 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 4-factor alphas calculated using equation (2) for each of the four subperiods 1964–1975, 1976–1987, 1988–1999, and 2000–2011 for New York Stock Exchange (NYSE). Panel B reports the average monthly out-of-sample 4-factor alphas calculated using equation (2) for each of the two subperiods, 1986–1999 and 2000–2011, for NASDAQ. *t*-test and Wilcoxon refer to parametric and nonparametric tests for the differences between the coefficients in the two subperiods. The *t*-test statistics are adjusted for serial correlation using the Newey-West (1987) correction. Two-Subperiods Test relates to the first and last halves of the sample period: 1964–1987 versus 1988–2011. Similarly, the First-versus Last-Period Test refers to the first and last subperiods: 1964–1975 versus 2000–2011 for NYSE, and 1986–1999 versus 2000–2011 for NASDAQ.

	Size 1		Size 2		Size 3		Balanced	
Periods	Average Alpha	*t*-Statistic	Average Alpha	*t*-Statistic	Average Alpha	*t*-Statistic	Average Alpha	*t*-Statistic
Panel A1. NYSE AMIHUD								
Entire Period								
1964–2011	0.41%	3.42	0.14%	1.42	0.11%	1.40	0.22%	3.22
Two Subperiods								
1964–1987	0.62%	4.01	0.40%	3.19	0.35%	3.56	0.46%	4.87
1988–2011	0.21%	1.14	−0.13%	0.83	−0.14%	1.21	−0.02%	0.16
Four Subperiods								
1964–1975	0.91%	3.95	0.42%	2.11	0.46%	2.83	0.60%	3.89
1976–1987	0.32%	1.59	0.38%	2.48	0.24%	2.17	0.32%	2.96
1988–1999	0.50%	2.00	0.00%	0.02	−0.12%	0.92	0.13%	1.18
2000–2011	−0.07%	0.27	−0.25%	1.00	−0.15%	0.83	−0.16%	0.94
Two-Subperiods Test								
t-test	1.69		2.65		3.25		3.33	
Wilcoxon	1.62		2.24		2.96		2.80	
First- versus Last-Period Test								
t-test	2.68		2.06		2.44		3.12	
Wilcoxon	2.86		1.70		2.08		2.84	
Panel A2. NYSE HR								
Entire Period								
1964–2011	−0.06%	0.50	−0.05%	0.57	−0.01%	0.07	−0.04%	0.54
Two Subperiods								
1964–1987	0.03%	0.16	−0.05%	0.44	−0.02%	0.17	−0.01%	0.16
1988–2011	−0.14%	0.84	−0.04%	0.37	0.01%	0.04	−0.06%	0.58
Four Subperiods								
1964–1975	0.33%	1.62	−0.02%	0.11	0.02%	0.12	0.11%	0.93
1976–1987	−0.28%	1.29	−0.08%	0.51	−0.05%	0.36	−0.14%	1.09
1988–1999	−0.19%	0.91	−0.04%	0.28	−0.14%	1.01	−0.13%	1.11
2000–2011	−0.08%	0.33	−0.05%	0.25	0.16%	0.66	0.01%	0.05
Two-Subperiods Test								
t-test	0.74		0.04		0.13		0.34	
Wilcoxon	0.29		0.21		0.44		0.19	
First- versus Last-Period Test								
t-test	1.33		0.12		0.49		0.52	
Wilcoxon	0.97		0.19		0.48		0.37	

(continued on next page)

TABLE 6 (continued)

Out-of-Sample 4-Factor Alphas: Portfolios Presorted by Size

	Size 1		Size 2		Size 3		Balanced	
Periods	Average Alpha	t-Statistic	Average Alpha	t-Statistic	Average Alpha	t-Statistic	Average Alpha	t-Statistic
Panel A3. NYSE HRDVOL								
Entire Period								
1964–2011	0.54%	4.18	0.22%	2.17	0.12%	1.40	0.29%	3.99
Two Subperiods								
1964–1987	0.77%	4.94	0.49%	3.78	0.37%	2.91	0.54%	5.37
1988–2011	0.32%	1.65	−0.05%	0.35	−0.13%	1.25	0.04%	0.42
Four Subperiods								
1964–1975	1.00%	4.52	0.52%	2.48	0.47%	2.25	0.66%	3.94
1976–1987	0.53%	2.45	0.46%	2.99	0.26%	1.87	0.42%	3.78
1988–1999	0.65%	2.70	0.08%	0.47	−0.13%	1.07	0.20%	2.01
2000–2011	−0.01%	0.05	−0.19%	0.73	−0.14%	0.78	−0.11%	0.62
Two-Subperiods Test								
t-test	1.83		2.65		3.05		3.29	
Wilcoxon	1.73		2.33		2.32		2.81	
First- versus Last-Period Test								
t-test	2.72		2.07		2.22		2.93	
Wilcoxon	3.03		1.67		1.77		2.76	
Panel B1. NASDAQ AMIHUD								
Entire Period								
1986–2011	1.05%	5.80	0.53%	2.35	−0.25%	1.35	0.44%	2.94
Two Subperiods								
1986–1999	1.40%	6.80	0.97%	4.59	0.18%	0.91	0.85%	5.23
2000–2011	0.63%	2.05	0.02%	0.04	−0.75%	2.33	−0.04%	0.14
First- versus Last-Period Test								
t-test	2.10		2.13		2.57		2.83	
Wilcoxon	2.57		1.41		2.62		2.72	
Panel B2. NASDAQ HR								
Entire Period								
1986–2011	0.55%	3.59	0.07%	0.43	−0.20%	1.37	0.14%	1.27
Two Subperiods								
1986–1999	0.80%	4.09	0.49%	2.96	−0.01%	0.05	0.43%	3.71
2000–2011	0.25%	1.06	−0.42%	1.44	−0.42%	1.60	−0.20%	1.03
First- versus Last-Period Test								
t-test	1.85		2.82		1.43		2.86	
Wilcoxon	1.98		3.27		1.56		3.05	
Panel B3. NASDAQ HRDVOL								
Entire Period								
1986–2011	1.13%	5.96	0.86%	4.05	−0.16%	0.84	0.61%	3.82
Two Subperiods								
1986–1999	1.55%	6.73	1.25%	5.77	0.25%	1.20	1.02%	5.61
2000–2011	0.64%	2.09	0.40%	1.05	−0.64%	1.94	0.13%	0.49
First- versus Last-Period Test								
t-test	2.40		1.95		2.26		2.63	
Wilcoxon	2.71		1.39		1.89		2.53	

presented in Panel A. As in Table 5, the average premium is larger for the smaller size group. Moreover, similar to the Fama–MacBeth (1973) 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 more recent period. For example, in the first two subperiods the alpha of the AMIHUD long–short portfolio (Panel A.1) is positive and significant for all three size terciles. In particular, the alpha in size 3 (largest stocks) is 0.46% and 0.24% per month in the first and second periods, respectively. An even larger abnormal return is observed among the smaller stocks (size 1), where during the first and second subperiods we have monthly alphas of 0.91% and 0.32%, respectively. In sharp contrast, the alphas of the long–short portfolios are not statistically significant in the last period.

To perform a formal test incorporating all size terciles, we construct a "balanced portfolio" that has equal weights in each of the three long–short portfolios. This portfolio is required to include stocks from all size terciles, allowing us to control for size. We then estimate average alphas on the balanced portfolio during the different subperiods. The results (rightmost column of Table 6) again show positive alphas in the first two subperiods and statistically insignificant alphas in the last two subperiods. The *t*-test and Wilcoxon test indicate that the decline is statistically significant.

Looking at the HR and HRDVOL long–short portfolios we can observe results similar to those obtained in the Fama–MacBeth (1973) analysis. In particular, the HR measure is only marginally priced in the first period for size 1 and not significant elsewhere, and the HRDVOL measure shows a decline in alphas across all sizes.

Next, consider the results for NASDAQ, presented in Panel B of Table 6. Here, we have only two subperiods, and the overall picture seems similar. However, the trend patterns are different across the different size groups. First, the magnitude of the premiums on NASDAQ is much bigger during 1986–1999 compared to the corresponding period on NYSE. For example, the AMIHUD premium is 0.50% (1.40%) for size 1 on NYSE (NASDAQ). Second, although all sizes show a significant decline, the premium does not vanish for the smaller stocks.

Overall, the results using liquidity-based portfolios reinforce the cross-sectional results that the characteristic liquidity premium is much stronger at the smaller size and exhibits a downward trend across all sizes and exchanges.

D. The Characteristic Liquidity Premium among "Penny Stocks"

A natural extension to the results is to look at stocks with a stock price below our price criterion. We expect to find an even larger liquidity premium in this sample. Thus, we extend the analysis to stocks with prices lower than $2 and at least 60 trading days throughout the year. For concreteness, we term such stocks "penny stocks." A caveat is that our inferences for these stocks might be tainted by microstructure noise (e.g., Blume and Stambaugh (1983)). In an effort to correct for possible microstructure bias, in this analysis we employ the weighted least squares procedure proposed in Asparouhova, Bessembinder, and Kalcheva (2010).[13] As NYSE and AMEX have very few such stocks, we restrict our attention to NASDAQ. This sample accounts for only around 0.20% of the total market cap of common stocks.

We repeat the cross-sectional analysis performed in Section III.A, restricting it to the subgroup of penny stocks. The results (not tabulated for brevity) show that for the entire sample period 1986–2011, there is a significant characteristic liquidity premium for all three liquidity measures. The estimated monthly

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

equal-weighted liquidity premium ranges from 0.12% to 0.55% (1.4% to 6.6% annually) depending on the measure used. This is about 4 times the premium estimated during the same period for the corresponding sample in Table 4, and more than 2 times bigger than the smallest size (size 1) in Panel A of Table 5. Notably, we do not observe a significant decline in the characteristic liquidity premium for this class of stocks for any of the liquidity measures.

To summarize, penny stocks account for only around 0.20% of the market cap of our baseline sample. Although the results for the rest of the stocks suggest a decline in the characteristic liquidity premium, often to insignificant levels, we do not find such a decline for penny stocks, and the premium remains large.[14]

E. A Longer Time Series: NYSE during 1931–2011

The results so far show that for more than 30 years now, the liquidity premium for common stocks on NYSE has not been significantly different from 0. Moreover, for more than 20 years, the alpha associated with liquidity-based trading strategies has not been different from 0. To evaluate these results in a more complete historical perspective, we consider the longest period available to us. Because CRSP data are available starting in 1926, we begin our analysis in 1931, the first year for which we can calculate the Fama–French (1992) factors.

Graph A of Figure 2 plots the 10-year moving average of the AMIHUD, HR, and HRDVOL characteristic liquidity premium calculated from Fama–MacBeth (1973) regressions with control variables as in Table 3 during 1931–2011. Graph B plots a 10-year moving average of the alphas related to the balanced portfolio for the NYSE, calculated as in Table 6. Both graphs show that in historical terms, the most recent 20 years have been unusual in that the characteristic liquidity premium and the alphas are consistently very low. Note, however, that no clear trend can be observed before the mid-1970s. Indeed, up until that period the premium appears to have been fluctuating, typically at relatively high levels.

To further explore these data, we divide our sample period into four subperiods of about 20 years each: 1931–1950, 1951–1970, 1971–1990, and 1991–2011. The average monthly premiums are: 0.113%, 0.035%, 0.049%, and 0.005% for AMIHUD; 0.375%, 0.046%, 0.07%, and 0.032% for HR; and 0.084%, 0.027%, 0.042%, and 0.015% for HRDVOL. Thus, the last period exhibits a much lower premium, which in fact is not significantly different from 0. The t-statistics for the difference between the first and last periods are 2.44, 2.61, and 2.71, respectively. The monthly alphas show an even more dramatic picture, where the first versus last periods are: 0.403% and −0.04% for AMIHUD, 0.314% and −0.051% for HR, and 0.721% and 0.022% for HRDVOL. The t-statistics for the difference between the first and last periods are 2.40, 1.84, and 2.97, respectively. To summarize, characteristic liquidity was significantly priced in the early period (1931–1963), and the decline in the premium is a phenomenon of the last 3–4 decades.

[14]Consistent with these findings, Ang, Shtauber, and Tetlock (2013) find that liquidity is priced among smaller stocks on the OTC market.

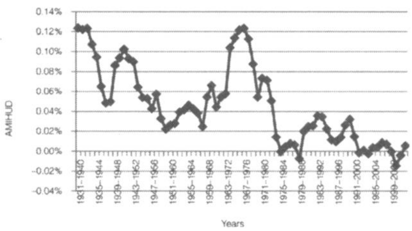
FIGURE 2

NYSE 10-Year Moving Average of Cross-Sectional Liquidity Premiums and Alphas for 1931–2011

The graphs in Figure 2 depict the 10-year moving average of the New York Stock Exchange (NYSE) equal-weighted liquidity premium and the monthly 4-factor alpha of liquidity-based trading strategy using the AMIHUD, HR, and HRDVOL liquidity measures for 1931–2011. The equal-weighted monthly liquidity premium is the product of the monthly liquidity coefficients and the monthly average of the selected liquidity measure (see Table 4). The 4-factor alphas are for the balanced portfolio, which assigns equal weights to the three size portfolios. The size portfolios, in turn, are portfolios that are long in the most illiquid stocks and short in the most liquid stocks, based on the AMIHUD, HR, and HRDVOL measures (see Table 6).

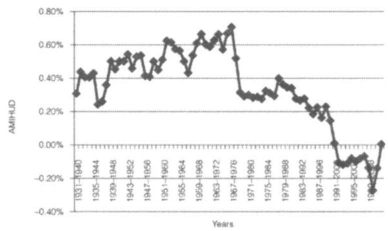
Graph A. Average Liquidity Premium

A1. AMIHUD Liquidity Premium

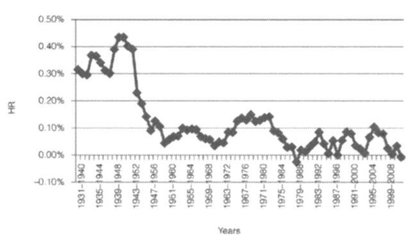


Graph B. Average Balanced Portfolio Alphas

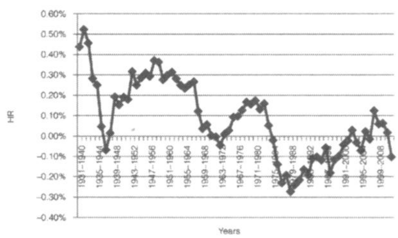
B1. AMIHUD Alpha



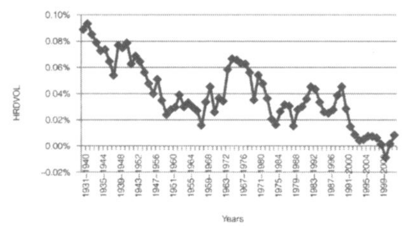
A2. HR Liquidity Premium



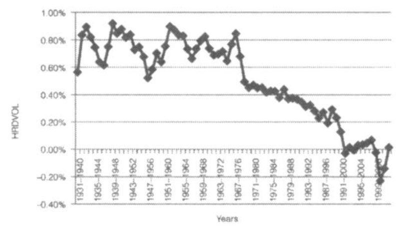
B2. HR Alpha



A3. HRDVOL Liquidity Premium



B3. HRDVOL Alpha



F. Determinants of the Characteristic Liquidity Premium

We have demonstrated that the characteristic liquidity premium has been declining over time and that in recent years it has been concentrated among small stocks. Our cross-sectional liquidity premium is calculated as the product of the AMIHUD, HR, or HRDVOL liquidity measures and the related regression coefficient. Thus, the decline in the liquidity premium that we document may be a result of an improvement in liquidity (Figure 1), or a lower sensitivity of expected returns to liquidity, or both. In this subsection we explore these two potential effects.

As mentioned, our dollar-volume-related measures (AMIHUD and HRDVOL) are adjusted for inflation. For the analysis in this section, the adjustment method is potentially important because it affects the regression coefficient. Another possible adjustment method is to scale by the exchange market cap, which reflects the change in trading volume during the sample period. For example, Acharya and Pedersen (2005) adjust the AMIHUD measure by NYSE and AMEX (NYMX) market cap. Similarly, Pastor and Stambaugh (2003) adjust their liquidity measure by NYMX market cap. To ensure robustness, for the analysis in this section we also provide results in which both AMIHUD and HRDVOL are adjusted by NYMX market cap. NASDAQ volume is not included in the adjustment because it is available only from the 1980s.

Panel A of Table 7 presents time-series averages of AMIHUD, HR, and HRDVOL medians over the four subperiods and across the three exchanges. AMIHUD and HRDVOL are adjusted by both inflation and NYMX market cap. There is a clear improvement in liquidity over time in NYSE and NASDAQ, whereas the improvement in AMEX depends on the measure used. All else being equal, the improvement in market liquidity seems to be an important factor in the decline of the liquidity premium.

The improvement in market liquidity itself is not surprising. The more interesting question is what happened to the sensitivity of expected returns to liquidity during the sample period, as there is no a priori reason for this sensitivity to change over time. Panel B of Table 7 depicts the regression coefficients based on the Fama–MacBeth (1973) regressions described in the previous section (Table 3) with all relevant controls.

Consider AMIHUD first. In Panel B of Table 7 we can immediately observe that the liquidity coefficients are significant in the early period of the sample in all exchanges and not significant in the recent period. Strikingly, similar to Panel A, the coefficients show a downward trend that is statistically significant in all three exchanges. Thus, in addition to the decline in liquidity, there is a decline in the sensitivity of expected returns to liquidity. Continuing with HR, we do not observe a trend in liquidity coefficients on NYSE (recall that HR is not priced on NYSE), but we do observe a significant decline in the coefficients associated with NASDAQ and AMEX. Finally, HRDVOL also shows a decline in the coefficients, although the statistical significance is stronger for the NYMX adjustment.

To summarize, Table 7 indicates that both the liquidity measures and their associated coefficients exhibit a significant decline over time. Thus, it appears that the decline in the liquidity premium, which is a product of these 2 factors, reflects both of these trends. The decline in liquidity itself is well known and documented. Below we present two possible explanations for the decline in the coefficients.

The first possible explanation is the introduction and proliferation of index funds and ETFs. These instruments allow investors to buy and sell illiquid assets indirectly for low transaction costs (see a similar argument in Cherkes, Sagi, and Stanton (2009) within the context of closed-end funds). Although models such as Amihud and Mendelson (1986), Constantinides (1986), and Vayanos (1998) differ in their assumptions about trading frequency, they all assume direct holding of illiquid assets. As shown in Subrahmanyam (1991) and Gorton and Pennacchi (1993), liquidity traders are more protected from informed trading by trading in baskets. For example, direct investment in Russell 2000 stocks is expensive in

TABLE 7

Determinants of the Liquidity Premium

Table 7 presents the time-series average of AMIHUD, HRDVOL, and HR medians and their associated regression coefficients (equation (1)). AMIHUD is Amihud's (2002) illiquidity measure adjusted for inflation (INF) and New York Stock Exchange (NYSE) and American Stock Exchange (AMEX) combined (NYMX) market cap. HRDVOL is the ratio of HR to the annual dollar volume, where the dollar volume is adjusted for INF and NYMX market cap (in millions of dollars). HR is Hasbrouck's (2009) Bayesian version of Roll's (1984) effective half bid–ask spread, estimated via the Gibbs sampler (in %). Panel A presents the results of the liquidity measures and Panel B presents the results of the regression coefficients. The subperiods are 1964–1975, 1976–1987, 1988–1999, and 2000–2011 for NYSE and AMEX, and 1986–1999 and 2000–2011 for NASDAQ. The *t*-statistics are reported in parentheses below the coefficient estimates. *t*-test and Wilcoxon refer to parametric and nonparametric tests for the differences between the coefficients in the two subperiods. The *t*-test statistics are adjusted for serial correlation using the Newey–West (1987) correction. Two-Subperiods Test relates to the first and last halves of the sample period: 1964–1987 versus 1988–2011. Similarly, the First- versus Last-Period Test relates to the first and last subperiods: 1964–1975 versus 2000–2011 for NYSE and AMEX, and 1986–1999 versus 2000–2011 for NASDAQ.

	AMIHUD						HRDVOL								
	INF			NYMX			INF			NYMX			HR		
	NYSE	NASDAQ	AMEX	NYSE	NASDAQ	AMEX	NYSE	NASDAQ	AMEX	NYSE	NASDAQ	AMEX	NYSE	NASDAQ	AMEX
Periods	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Panel A. Liquidity Measures															
Period 1	0.043	NA	0.613	0.0082	NA	0.112	0.0027	NA	0.053	0.0005	NA	0.010	0.393	NA	0.755
Period 2	0.035	NA	0.926	0.0066	NA	0.179	0.0020	NA	0.069	0.0004	NA	0.013	0.401	NA	0.797
Period 3	0.009	0.517	0.578	0.0037	0.201	0.254	0.0005	0.026	0.032	0.0002	0.010	0.013	0.351	1.411	0.683
Period 4	0.002	0.075	0.624	0.0025	0.078	0.586	0.0001	0.003	0.020	0.0001	0.003	0.021	0.301	0.596	0.495
Two-Subperiods Test															
t-test	4.63	NA	1.07	3.71	NA	4.02	4.39	NA	2.36	3.43	NA	1.64	2.68	NA	2.83
Wilcoxon	5.87	NA	0.67	4.61	NA	4.81	5.76	NA	2.77	4.15	NA	2.73	2.55	NA	3.08
First- versus Last-Period Test															
t-test	3.84	5.26	0.05	3.56	3.62	5.57	4.00	4.95	1.79	3.81	4.80	2.07	2.21	5.77	3.23
Wilcoxon	4.13	4.29	0.66	3.32	3.32	4.13	4.13	4.24	1.76	3.44	3.93	2.34	1.88	4.19	3.03

(continued on next page)

TABLE 7 (continued)

Determinants of the Liquidity Premium

	AMIHUD						HRDVOL								
	INF			NYMX			INF			NYMX			HR		
	NYSE	NASDAQ	AMEX	NYSE	NASDAQ	AMEX	NYSE	NASDAQ	AMEX	NYSE	NASDAQ	AMEX	NYSE	NASDAQ	AMEX
Periods	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Panel B. Fama–MacBeth Regression Coefficients															
Period 1	1.645	NA	0.280	6.761	NA	1.356	11.386	NA	1.971	44.816	NA	8.950	0.224	NA	0.403
	(2.29)		(1.85)	(2.14)		(1.98)	(2.02)		(1.68)	(1.78)		(1.68)	(1.21)		(1.94)
Period 2	0.093	NA	0.070	0.197	NA	0.267	4.187	NA	0.408	18.553	NA	1.527	0.091	NA	−0.022
	(0.31)		(1.73)	(0.13)		(1.42)	(1.53)		(1.57)	(1.47)		(1.32)	(0.65)		(0.18)
Period 3	0.249	0.065	0.035	0.170	0.197	0.081	7.438	0.297	0.482	9.272	0.624	0.842	0.128	0.293	0.242
	(0.87)	(5.09)	(0.94)	(0.25)	(5.63)	(0.84)	(1.89)	(3.06)	(1.52)	(1.38)	(3.13)	(1.19)	(0.86)	(3.66)	(1.63)
Period 4	−0.661	0.012	0.004	−0.656	0.007	0.012	4.464	0.150	0.460	4.380	0.053	0.441	−0.174	−0.015	−0.302
	(1.05)	(0.52)	(0.06)	(1.08)	(0.33)	(0.18)	(0.40)	(0.40)	(0.57)	(0.45)	(0.16)	(0.53)	(0.61)	(0.17)	(0.92)
Two-Subperiods Test															
t-test	2.07	NA	1.80	2.08	NA	2.12	0.27	NA	0.97	1.63	NA	1.65	0.91	NA	0.96
Wilcoxon	1.67	NA	1.74	2.06	NA	1.00	1.01	NA	0.68	1.78	NA	0.56	0.77	NA	0.20
First- versus Last-Period Test															
t-test	2.45	2.09	1.69	2.31	4.53	1.95	0.55	0.41	1.06	1.50	1.55	1.58	1.17	1.58	1.91
Wilcoxon	2.38	2.24	2.39	2.97	4.14	1.20	1.66	1.29	1.84	2.45	1.87	1.35	1.28	1.73	1.49

terms of illiquidity costs. However, Russell 2000,ETFs (e.g., IWM) are highly liquid, presumably because there is little information trading in ETFs.[15] 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.[16] Therefore, we expect that investors' compensation for investing in illiquid stocks has declined over the years, as index funds and ETFs have become more popular.

The second possible explanation is an increase in arbitrage activity, which is associated with more price efficiency (see Chordia, Subrahmanyam, and Tong (2013) for a similar argument). Arbitrageurs (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 period.[17] Other institutional investors may hold long positions in illiquid assets, bidding their price up. However, extensive activity of this kind inevitably drives the liquidity premium down. Thus, it is possible that intense competition among arbitragers and long-term institutional investors has contributed to the decline in the liquidity premium.

It should be emphasized that although these explanations may hold on average, they likely fail in periods associated with financial crisis, during which we often witness arbitrageurs behaving differently. For example, Brunnermeier and Pedersen (2009) point out that during volatile periods, liquidity providers and arbitrageurs are less willing to provide liquidity and exploit mispricing.

IV. Time Trends and Size Effects in the Systematic Liquidity Premium

Pastor and Stambaugh (2003), Acharya and Pedersen (2005), Sadka (2006), and Korajczyk and Sadka (2008), among others, argue that liquidity is a priced risk factor. The idea is that markets can experience systematic shocks to liquidity.[18] Stocks whose returns are more sensitive to such shocks should require a return premium. This premium is different from the characteristic premium we have explored thus far. In this section we explore whether similar time trends also apply to systematic liquidity.[19]

Following the literature, we measure systematic liquidity as the sensitivity of the stock's return to innovations in market liquidity, where the market is

[15]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% versus 0.558%.

[16]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) it is 5%. In other words, these funds turn over stocks on average once every 8–20 years.

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

[18]Indeed, in untabulated analysis we find a significant percentage increase of illiquidity measures during National Bureau of Economic Research recession periods.

[19]Acharya and Pedersen (2005) also study a different liquidity premium associated with the covariance between stock liquidity and market liquidity. We analyzed this premium as well; however, it did not show any robust pricing in any period. Thus, to save space, we do not report these results in the article, but they are available from the authors.

taken as the NYMX universe.[20] For each liquidity measure (AMIHUD, HR, and HRDVOL) we create a monthly market liquidity series (MLIQ), which is the monthly value-weighted average of stock liquidity during our sample period.[21] Next, we construct the market liquidity factor (LIQF), which consists of the monthly innovations, ε_m, in MLIQ, using a 60-month rolling AR(2) model:[22]

$$\text{(3)} \qquad \mathrm{MLIQ}_m = \alpha + \phi_1 \mathrm{MLIQ}_{m-1} + \phi_2 \mathrm{MLIQ}_{m-2} + \varepsilon_m.$$

Finally, liquidity betas are estimated for each stock in our sample, using a time-series regression of 36–60 monthly returns on the Fama–French (1992) 4 factors together with LIQF:

$$\text{(4)} \qquad \begin{aligned}(\mathrm{RET}_{i,m} - \mathrm{RF}_m) = {} & \alpha_i + \beta_{\mathrm{MKT},i}(\mathrm{MKT}_m - \mathrm{RF}_m) + \beta_{\mathrm{SMB},i}\mathrm{SMB}_m \\ & + \beta_{\mathrm{HML},i}\mathrm{HML}_m + \beta_{\mathrm{UMD},i}\mathrm{UMD}_m \\ & + \beta_{\mathrm{LIQF},i}\mathrm{LIQF}_m + \varepsilon_{i,m},\end{aligned}$$

where β_{LIQF} is the liquidity beta.

Note that all of our liquidity measures (AMIHUD, HR, and HRDVOL) measure illiquidity (i.e., higher values correspond to lower liquidity). Thus, a negative beta indicates that a positive shock to market illiquidity (i.e., the market becomes less liquid) is associated with a negative return. As a result, a stock with a negative liquidity beta is riskier than a stock with a positive liquidity beta and should command a positive systematic liquidity premium.

To test for the existence of such a premium, we again use cross-sectional monthly regressions similar to those in Table 3, where for each month m in year t we include the liquidity beta estimated as of the end of year $t-1$ as an additional explanatory variable. If systematic liquidity is priced, we expect the coefficient associated with the liquidity beta to have a negative sign. We estimate the systematic liquidity premium as the product of the coefficient of the liquidity beta and 1 standard deviation of the cross-sectional betas. This seems to be a natural estimate because the magnitude of the average cross-sectional beta is not informative and it may be negative or positive.

Table 8 presents results for Fama–MacBeth (1973) regressions related to the liquidity betas associated with AMIHUD, HR, and HRDVOL.[23] We find significant liquidity pricing for all three measures among the smallest stocks on NASDAQ in the most recent period. For the medium-sized NASDAQ stocks we find inconclusive results: For AMIHUD we find a premium in the first period, for HR we find a premium in the most recent period, and for HRDVOL we do not find evidence for a premium in any period. For large stocks on NASDAQ and for

[20]We follow Pastor and Stambaugh (2003), among others, and exclude NASDAQ when we calculate the market liquidity factor. This prevents the problems (discussed in Section II) associated with double counting of volume in NASDAQ as well as with time consistency.

[21]We also tried a version where the market liquidity uses equal weighting. The results are not materially different.

[22]In this model MLIQ_m, MLIQ_{m-1}, and MLIQ_{m-2} associated with AMIHUD and HRDVOL are measured in real terms as of month m. This prevents artificial variations due to changes in inflation.

[23]The Fama–MacBeth (1973) regressions include characteristic liquidity as a control variable, although excluding it does not change the results qualitatively.

all NYSE and AMEX stocks we do not find consistent evidence of systematic liquidity pricing.

We now turn to an analysis of portfolios based on liquidity betas. In each year and for each stock exchange we sort the stocks into three size terciles, based

TABLE 8

Systematic Liquidity Premiums by Size Terciles

Table 8 presents results for systematic liquidity premiums by size group from monthly cross-sectional regressions of stock returns on AMIHUD, HR, and HRDVOL liquidity betas and other explanatory variables. The systematic liquidity betas are estimated as follows. For each liquidity measure (AMIHUD, HR, and HRDVOL) we create a monthly market liquidity series (MLIQ), which is the monthly value-weighted average of stock liquidity during our sample period, where the market is taken as the New York Stock Exchange (NYSE) and American Stock Exchange (AMEX) combined (NYMX) universe. Next, we construct the market liquidity factor (LIQF), which consists of the monthly innovations, ε_m, in MLIQ, using a 60-month rolling AR(2) model (equation (3)). Finally, liquidity betas are estimated for each stock in our sample, using a time-series regression of 36–60 monthly returns on the Fama-French (1992) 4 factors together with LIQF (equation (4)). Similar to Table 5, we present the results for the systematic liquidity premium based on three size terciles: Sizes 1, 2, and 3, from the smallest to the largest size groups. The systematic liquidity premium is the product of the monthly liquidity beta coefficient and the dispersion (1 standard deviation) of the AMIHUD, HR, and HRDVOL cross-sectional liquidity betas. The subperiods are 1964–1975, 1976–1987, 1988–1999, and 2000–2011 for NYSE, and 1986–1999 and 2000–2011 for NASDAQ. The *t*-statistics are reported in parentheses below the coefficient estimates. The *t*-test statistics are adjusted for serial correlation using the Newey-West (1987) correction. Two-Subperiods Test relates to the first and last halves of the sample period: 1964–1987 versus 1988–2011. Similarly, First- versus Last-Period Test relates to the first and last subperiods: 1964–1975 versus 2000–2011 for NYSE, and 1986–1999 versus 2000–2011 for NASDAQ.

	NYSE			NASDAQ			AMEX		
	Size 1	Size 2	Size 3	Size 1	Size 2	Size 3	Size 1	Size 2	Size 3
Periods	1	2	3	4	5	6	7	8	9
Panel A. AMIHUD									
Entire Period	0.044	0.037	0.015	−0.106	−0.066	0.082	0.007	−0.009	0.088
	(1.11)	(1.30)	(0.61)	(1.89)	(1.54)	(2.00)	(0.10)	(0.12)	(1.33)
Period 1	0.041	0.035	−0.029	NA	NA	NA	−0.026	0.087	0.112
	(0.69)	(0.82)	(0.69)				(0.24)	(1.05)	(1.25)
Period 2	0.006	0.054	−0.071	NA	NA	NA	0.156	0.044	0.050
	(0.12)	(1.06)	(1.41)				(1.75)	(0.55)	(0.63)
Period 3	−0.013	−0.035	0.053	−0.058	−0.142	0.045	−0.240	−0.221	0.151
	(0.18)	(0.66)	(1.16)	(0.03)	(2.69)	(0.96)	(1.61)	(1.65)	(1.27)
Period 4	0.141	0.092	0.105	−0.162	0.023	0.125	0.134	0.072	0.045
	(1.29)	(1.10)	(1.04)	(2.01)	(0.34)	(1.79)	(0.66)	(0.33)	(0.23)
Two-Subperiods Test									
t-test	0.53	0.30	1.21	NA	NA	NA	0.85	0.95	0.15
Wilcoxon	0.24	0.25	1.87	NA	NA	NA	0.06	1.25	0.34
First- versus Last-Period Test									
t-test	0.81	0.69	0.95	0.91	1.94	0.97	0.65	0.06	0.29
Wilcoxon	0.71	1.17	0.82	1.64	2.16	0.48	1.49	0.03	0.26
Panel B. HR									
Entire Period	−0.037	0.012	−0.002	−0.054	−0.076	−0.032	0.130	0.034	0.026
	(1.03)	(0.45)	(0.08)	(1.63)	(1.74)	(0.87)	(1.53)	(0.51)	(0.43)
Period 1	−0.068	−0.040	0.052	NA	NA	NA	−0.023	−0.085	0.129
	(1.15)	(0.88)	(1.06)				(0.23)	(0.87)	(1.29)
Period 2	0.049	0.063	−0.048	NA	NA	NA	0.084	−0.027	−0.025
	(0.86)	(1.37)	(1.01)				(0.93)	(0.35)	(0.32)
Period 3	−0.021	0.042	0.004	0.083	0.005	−0.006	0.143	−0.091	−0.135
	(0.33)	(0.74)	(0.08)	(1.36)	(0.09)	(0.13)	(0.94)	(0.76)	(1.29)
Period 4	−0.107	−0.018	−0.016	−0.214	−0.171	−0.062	0.291	0.319	0.153
	(1.11)	(0.29)	(0.33)	(2.99)	(2.61)	(1.07)	(1.38)	(1.64)	(0.88)
Two-Subperiods Test									
t-test	0.76	0.01	0.17	NA	NA	NA	1.21	1.25	0.29
Wilcoxon	1.43	0.64	0.06	NA	NA	NA	1.29	1.80	0.24
First- versus Last-Period Test									
t-test	0.34	0.30	0.98	3.17	2.01	0.77	0.29	0.37	0.89
Wilcoxon	1.29	0.53	1.21	3.28	2.41	0.52	0.68	0.50	1.37

(continued on next page)

TABLE 8 (continued)

Systematic Liquidity Premiums by Size Terciles

	NYSE			NASDAQ			AMEX		
	Size 1	Size 2	Size 3	Size 1	Size 2	Size 3	Size 1	Size 2	Size 3
Periods	1	2	3	4	5	6	7	8	9
Panel C. HRDVOL									
Entire Period	−0.022	0.047	−0.013	−0.119	−0.022	0.014	−0.014	0.082	0.075
	(0.64)	(1.71)	(0.53)	(2.21)	(0.52)	(0.35)	(0.18)	(1.11)	(0.90)
Period 1	0.004	0.072	−0.055	NA	NA	NA	−0.044	0.188	0.131
	(0.08)	(1.70)	(1.22)				(0.46)	(1.81)	(1.37)
Period 2	−0.022	0.033	−0.022	NA	NA	NA	0.123	0.103	0.032
	(0.39)	(0.65)	(0.37)				(1.27)	(1.22)	(0.42)
Period 3	−0.065	0.033	−0.007	−0.043	−0.021	−0.029	−0.068	0.049	0.248
	(0.91)	(0.59)	(0.16)	(0.56)	(0.43)	(0.55)	(0.41)	(0.36)	(1.38)
Period 4	−0.004	0.048	0.031	−0.207	−0.022	0.065	−0.073	0.008	−0.100
	(0.05)	(0.75)	(0.58)	(2.81)	(0.32)	(1.00)	(0.33)	(0.03)	(0.50)
Two-Subperiods Test									
t-test	0.38	0.22	0.98	NA	NA	NA	0.74	0.76	0.02
Wilcoxon	0.09	0.06	1.21	NA	NA	NA	0.17	0.45	0.71
First- versus Last-Period Test									
t-test	0.09	0.31	1.24	1.62	0.01	1.14	0.11	0.70	0.98
Wilcoxon	0.04	0.14	1.60	2.53	0.51	1.26	0.64	0.48	1.30

on the previous end-of-year size.[24] Sizes 1 to 3 refer to the smallest to largest size terciles. Within each size tercile we sort the stocks into five liquidity beta quintiles, based on previous-year AMIHUD, HR, and HRDVOL liquidity betas. Based on this sorting we create 15 equal-weighted portfolios. Then, for each size tercile and each month we construct a long–short portfolio that is long in the negative beta stocks (riskier stocks) and short in the most positive beta stocks. The portfolios are rebalanced annually.

We also form a balanced portfolio that has equal weights in each of the three long–short portfolios. As before, we evaluate the profitability of these portfolios on NYSE and NASDAQ using 4-factor alphas. The results are not tabulated to save space.

Similar to the cross-sectional results, we find that systematic liquidity is not priced on NYSE except for HR, for which we observe significant pricing in sizes 1 and 2 during the first period only with an annual alpha of 5%. On NASDAQ we do find that systematic liquidity is priced during the entire sample period with an annual alpha of around 4%. Considering subperiods, we find that the pricing is consistent and significant across all three measures in the second period, whereas during the first period the results are inconclusive. In fact, with the HRDVOL measure we even observe a robust increase in the pricing of systematic liquidity between the two subperiods.

To summarize, the premiums for systematic liquidity are concentrated in smaller stocks and primarily in NASDAQ. Furthermore, systematic liquidity in NASDAQ is significant in the most recent period and to some extent even presents an increase in magnitude over time.

[24]We obtain qualitatively similar results when we first sort the stocks into three liquidity terciles by the liquidity measure (AMIHUD, HR, or HRDVOL) and then sort by the corresponding liquidity beta. This shows that the characteristic liquidity does not subsume the liquidity risk effect.

Systematic liquidity is driven by the risk that a firm's stock price will decline in states of the world where market liquidity is low. Thus, the economic drivers of systematic liquidity are different from those that determine characteristic liquidity. Our evidence suggests that sensitivity to systematic liquidity risk has not been trending down over the years and may have even become stronger. This stands in contrast to our findings on characteristic liquidity.

V. Conclusion

Liquidity and its associated price effects are an important aspect of financial markets. Liquidity discounts are large and pervasive in illiquid markets such as private equity and debt markets. However, given that publicly traded equity is generally more liquid, it is reasonable to ask whether the magnitude of the liquidity premium associated with publicly traded stocks is of economic significance. To this end, it is important to distinguish between characteristic liquidity and systematic liquidity.

It is a well-known fact that liquidity in public stock markets has improved over the years following numerous regulatory reforms and technological improvements. These improvements have also been accompanied by a dramatic increase in trading activity, which may have resulted in an increase in the total cost of trading. The net effect of these two trends on the magnitude of the liquidity premium of publicly traded equity is not clear.

To address this issue empirically, in this article we estimate the liquidity premium from 1931 to 2011, applying three established liquidity measures. We find that the characteristic liquidity premium has declined significantly over the past 40 years. Although this premium was economically large until the mid-1980s, it has become small and "second order" since then. In fact, for roughly 99.5% of the market cap of common stocks we cannot identify a characteristic liquidity premium in the most recent period we examine. Characteristic liquidity is still significantly priced only among the very small stocks on NASDAQ. These results are consistent with the recent literature suggesting that markets have become more efficient following more intense arbitrage activity. By contrast, we do not find a similar trend in systematic liquidity.

Our results may 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. A portion of this reduction may have been attributed to the decline of the characteristic liquidity premium.

The results have important implications because liquidity premiums may play a central role in the valuation of financial assets. Furthermore, it has been argued that other attributes of firms, such as disclosure policy, may affect their cost of capital (and value) through their effect on liquidity. These claims should be evaluated in light of our findings. 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.

It should be emphasized that our results use data from U.S. stock markets only. These equity markets are probably the most liquid markets in the world.

It is likely that liquidity pricing is more significant in less liquid markets (see, e.g., Bekaert, Harvey, and Lundblad (2007) for liquidity pricing in emerging markets). Whether the liquidity premium has declined in other less liquid markets and other asset classes (such as emerging markets, private equity, and corporate bonds) is subject to further empirical exploration.

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