An Analysis of the Amihud Illiquidity Premium

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This paper analyzes the Amihud (2002) measure of illiquidity and its role in asset pricing. It is shown first that the effect of illiquidity on asset pricing is clarified by using the turnover version of the Amihud measure and including firm size as a separate variable. When we decompose the Amihud measure into elements that correspond to positive (up) and negative (down) return days, we find that in general, only the down-day element commands a return premium. Further analysis of the up- and down-day elements using order flows shows that a sidedness variable, which captures the tendency for orders to cluster on the sell side on down days, is associated with a more significant return premium than the other components of the Amihud measure. (*JEL* G12)

In an important paper, Amihud (2002) develops a measure of stock illiquidity that is easily and cheaply calculated using daily price and volume data. This measure is computed by time-averaging the daily ratio of absolute return to the dollar volume of trading.[1] Therefore, the illiquidity measure captures the price impact of trading (price move per unit volume). Amihud (2002) shows that the measure is strongly priced in the cross-section of stock returns. This

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[1] The Amihud (2002) measure is the ratio of the absolute return to the dollar volume of trading. Related measures that attempt to capture the relation between the volume of trading and price changes were developed by the Amivest Corporation and reported in their publication *Liquidity Ratios* from 1972 to 2007 and by Martin (1975). For a fuller discussion, see Dubofsky and Groth (1984) and Cooper, Groth, and Avera (1984).

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finding has been confirmed by Chordia, Huh, and Subrahmanyam (2009), among others. In this paper we decompose the Amihud (2002) measure into more fundamental components and ask whether these components have differential effects on stock returns, or whether for pricing purposes they can be combined into a single measure of illiquidity, as assumed by Amihud (2002).

Our analysis is motivated by the recent findings of Brennan et al. (2010), who show that, while the Kyle (1985) framework assumes a symmetric relation between stock price changes and order flows, asymmetry in this relation plays an important role in determining equilibrium rates of return. In particular, they find that equilibrium rates of return are sensitive to the relation between seller-initiated trades and stock price changes, but are not sensitive to the relation between buyer-initiated trades and stock price changes. Buyer-initiated trades and seller-initiated trades, and price increases and decreases, are treated symmetrically in the Kyle (1985) and Amihud (2002) measures of illiquidity. Therefore, given the finding that it is only the price response to seller-initiated trades that is priced in the cross-section of returns, it is natural to analyze the Amihud (2002) measure into more fundamental elements that reflect the sign of the price change and the order flow, and to see whether these elements are also priced differentially.

It is well known that trading volume and price changes are positively correlated.[2] As a result of this correlation we expect the Amihud measure computed using only returns and volume on positive return days to be different from the same measure calculated using data from negative return days. The models of Anshuman and Viswanathan (2005), Garleanu and Pedersen (2007), and Brunnermeier and Pedersen (2009) show that liquidity in down markets may be very different from liquidity in up markets due to liquidity shocks, margin-induced price spirals, or tighter risk management by institutions. Hameed, Kang, and Viswanathan (2010) show empirically that illiquidity in individual stocks as measured by the bid-ask spread of individual stocks increases following negative returns on the stock and negative returns on the market. Thus there are both empirical and theoretical reasons to expect that the Amihud and other measures will be different for positive and negative return days. This raises the issue of whether equilibrium rates of return are affected differently by liquidity in up markets and in down markets.

The empirical results of Brennan et al. (2010) give us one reason to suspect that equilibrium expected returns are likely to be more sensitive to estimates of the Amihud measure that are calculated using only data from negative return days than to estimates that use all the data. A further reason to expect a difference in the relations between expected rates of return and measures of illiquidity in up markets and down markets is that leverage constraints may

2 For a survey of the evidence, see Karpoff (1987). One reason for this may be the disposition effect, which causes investors who hold a security to be less willing to sell after a price decline than after a price rise. Odean (1998) shows that stocks with gains are sold by individual investors at twice the rate of stocks with losses. Similar results have been reported by others.

compel levered investors to sell in down markets, while they are never compelled to buy; for this reason they are more likely to be concerned about liquidity in the event of a price decline than about liquidity in the event of a price increase.[3] A final reason that investors may be more concerned about liquidity in down markets is that they may fear the risk of being trapped in an illiquid stock in a falling market, unable to get out of their position without a major price concession.[4] This would reduce the demand for stocks whose liquidity dries up in down markets. Short-sellers may be similarly fearful of being trapped in a short position in an illiquid stock in a rising market, but the effect of this would be to reduce the supply of the stock provided by short-sellers, and therefore to decrease the stock's expected rate of return. Overall, it seems natural to conjecture that illiquidity in down markets is more important for asset pricing than illiquidity in up markets.

Our empirical findings can be summarized as follows. First, we confirm the importance of differences in liquidity between up and down days by showing that, whether we measure illiquidity by the Amihud measure, by the quoted spread, by market depth, or by a composite measure that takes account of both depth and spread, there is significantly lower average liquidity on down days, and this is true for small as well as for large firms. Second, we verify that there is a return premium associated with the original Amihud (2002) measure for NYSE/AMEX (henceforth, NYAM) stocks over the period 1971–2009, and for NASDAQ stocks over the period 1983–2009.

While the Amihud (2002) measure treats the dollar volume of trading (the product of firm size and turnover) as a measure of trading activity, we argue that it makes sense to estimate the illiquidity return premium using a measure of illiquidity that relies on turnover as the measure of trading activity and to account separately for firm size effects.[5] Strictly speaking, if firm size is included as a separate regressor, then it is not possible to distinguish between models that include firm size in the measure of illiquidity as the Amihud (2002) measure does and those that do not include it. However, we find that for NYAM stocks, the Amihud (2002) measure of illiquidity does not account for the whole of the effect of firm size on returns; indeed, when firm size is included as a separate variable along with the original Amihud measure, the coefficient of firm size is positive for NYAM stocks (and insignificant for NASDAQ stocks), implying that investors require lower rates of return on small firms, holding liquidity constant. Since no one has suggested a reason

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3 Coval and Stafford (2007) show that concentrated selling (or buying) by mutual funds due to fund outflows (inflows) can cause considerable price impact.

4 Lakonishok et al. (1991) show that pension fund managers like to window-dress their portfolios by selling losing stocks before the end of the reporting period.

5 As Cochrane (2005) points out, the Amihud measure imposes an automatic scaling of illiquidity with firm size, so that "smaller stocks which have smaller dollar volume for the same turnover (fraction of outstanding shares that trade) are automatically more illiquid." See Florakis, Gregoriou, and Kostakis (2011) for a similar argument.

why small firms should have lower rates of return, we prefer to rely on the turnover version of the Amihud measure.

Our major finding is that when the (turnover-version) Amihud (2002) measure is decomposed into elements that correspond to positive and negative return days (up days and down days), which we term "half-Amihud" measures, the half-Amihud measure associated with down days is strongly priced in the cross-section of stock returns, while the coefficient of the half-Amihud measure that corresponds to up days is small and statistically insignificant. Thus, while Brennan et al. (2010) find that it is the element of the Kyle (1985) measure that is associated with seller-initiated trades which commands a return premium, we find that it is the element of the Amihud (2002) measure that is associated with down days that commands a return premium. The significant down-day effect is apparent for both NYAM and NASDAQ samples. When the component stocks are divided into three subsamples according to market value, we find that the half-Amihud measure for down days is strongly priced for all three size groups of NYAM stocks, while the half-Amihud measure for up days is either not significantly priced or has a negative premium associated with it (for the large-size group). For NASDAQ stocks, the half-Amihud measure for down days is significantly priced only for the stocks in the lowest third by market value, although the coefficient is positive for all three groups. The coefficient of the half-Amihud measure for up days is insignificant and much smaller than that for down days for the small-size group. For the mid- and large-size groups, the coefficient is positive but not significant.

In order to determine whether buyer- and seller-initiated trading volume have different roles in the liquidity measure, we classify individual transactions into buyer-initiated and seller-initiated trades. Then each of the two half-Amihud measures is further analyzed into a "directional half-Amihud" measure and a term that captures the fraction of turnover that is buyer-initiated (on up days) or seller-initiated (on down days), which, extending Sarkar and Schwartz (2009),[6] we term "up-sidedness" and "down-sidedness," respectively. The directional half-Amihud measure for up (down) days is obtained by dividing the absolute return for up (down) days by the buyer (seller)-initiated turnover for those days. It is a measure of how much the price moves in response to trading pressure on one side of the market. The sidedness measures, on the other hand, capture the tendency of trades to cluster on one side of the market or the other on up and down days.

When we regress returns on these four components of illiquidity, we find that the coefficient of the directional half-Amihud measure for down days is

[6] Sarkar and Schwartz (2009) interpret a high correlation between buyer-initiated and seller-initiated trades within brief time intervals as an indication of two-sidedness, which indicates heterogeneity of information, while a low correlation is indicative of one-sidedness and information asymmetry. They find that market sidedness is associated with order imbalances.

positive and highly significant, but the coefficient of the corresponding measure for up days is small and statistically insignificant. This is consistent with our earlier results for the simple half-Amihud measures: it is the down day element that is priced. Furthermore, while the magnitudes of the coefficients of up-sidedness and down-sidedness are comparable, only the coefficient of down-sidedness is significant in general.

We also attempt to decompose each of the two half-Amihud measures into a "half-Kyle" measure and a term that depends on the net turnover ratio. For the half-Kyle measures, the return for up and down days is divided by the net buyer- and seller-initiated turnover, respectively. We refer to these as half-Kyle measures because the Kyle (1985) lambda is equal to the return divided by the net order flow. We find, however, that decomposing the half-Amihud measures in this way is not feasible for our analyses, because negative values make it impossible to calculate log-transforms for too many observations.

The remainder of the paper is organized as follows. In Section 1, we decompose the Amihud (2002) measure into elements that depend first on firm size and the sign of the return, and then into elements that depend also on the sign of trading volume. Section 2 discusses data sources, variable definitions, and descriptive statistics. Section 3 describes the estimation procedures. Section 4 verifies the results of Amihud (2002), and investigates in detail which components of the Amihud measure are priced in the cross-section of stock returns. In Section 5, we examine the robustness of our empirical findings. Section 6 concludes.

1. Analyzing the Amihud (2002) Measure of Illiquidity

1.1 Basic analysis

We denote the original Amihud (2002) measure, which is constructed using the *dollar volume* of trading, by A^o. It is defined as the average of the daily values of[7]

$$A^o = \frac{|r|}{DVOL}, \tag{1}$$

where r is a daily stock return and $DVOL$ is daily dollar volume. Since dollar volume is the product of firm size (market value of equity) and share turnover, the relative importance for asset pricing of turnover and firm size is unclear when only A^o is included in the regression. Therefore, we start by

[7] For simplicity, we use the same notations for both daily and monthly (averaged) variables.

decomposing the Amihud (2002) measure into its *turnover version* and a size-related element as follows:

$$A^o = \frac{|r|}{DVOL} = \frac{|r|}{T}\frac{T}{DVOL} = \frac{|r|}{T}\left(\frac{1}{S}\right) = A\left(\frac{1}{S}\right) \tag{2}$$

$$= \begin{cases} \frac{r^+}{T}\left(\frac{1}{S}\right) = (A^+)\left(\frac{1}{S}\right), & \text{if } r \geq 0 \\ \frac{-r^-}{T}\left(\frac{1}{S}\right) = (A^-)\left(\frac{1}{S}\right), & \text{if } r \leq 0, \end{cases} \tag{3}$$

where T is daily share turnover (daily share volume divided by the total number of shares outstanding), S is firm size measured by the market value of equity, $A = |r|/T$ is the turnover version of the Amihud (2002) measure, $r^+ = \max[0,\ r]$, and $r^- = \min[r,\ 0]$. As shown in Equation (3), we define $A^+ = r^+/T$ and $A^- = -r^-/T$.

Taking natural logarithms on both sides of Equation (2), the original Amihud measure, A^o, is related to the turnover version, A, and firm size, S, by

$$\ln(A^o) = \ln(A) - \ln(S). \tag{4}$$

Given the relation in Equation (3), we can also express $\ln(A^o)$ as follows:

$$\ln(A^o) = \begin{cases} \ln(A^+) - \ln(S), \text{if} r \geq 0 \\ \ln(A^-) - \ln(S), \text{if} r \leq 0. \end{cases} \tag{5}$$

Equation (5) decomposes the original Amihud (2002) measure, A^o, into three components: A^+, A^-, and S. We call A^+ and A^- the half-Amihud measures for up days and down days, respectively. Our first objective is to determine how these three components of the Amihud (2002) measure are priced. Note that the original Amihud (2002) measure of illiquidity implicitly assumes that the two half-Amihuds and the firm-size variable are priced equally.[8]

As we have already noted, the Amihud (2002) measure, unlike the Kyle (1985) measure of price impact, does not distinguish between trading volume that is initiated by buyers and trading volume that is initiated by sellers. Our next step is to decompose the half-Amihud measures into components that are related to buyer- and seller-initiated trades.

1.2 Further analysis based on signed volume and turnover

If we distinguish between buyer-initiated trades and seller-initiated trades, then daily share turnover (T) can be separated into buyer-initiated turnover (T_B) and seller-initiated turnover (T_S): $T = T_B + T_S$. Then, using the signed

8 As previously noted, if a firm size effect on returns is allowed for in addition to the Amihud measure of illiquidity, then it is not possible to distinguish between the indirect effect of firm size on returns through its effect on liquidity and any other effect of firm size on returns.

turnover, we can further decompose the two half-Amihud measures (A^+ and A^-) defined in Equation (5) as follows:

$$\begin{aligned} A^+ &= \frac{r^+}{T} = \left(\frac{r^+}{T_B}\right)\left(\frac{T_B}{T}\right), \quad \text{for } r \geq 0 \\ A^- &= \frac{-r^-}{T} = \left(\frac{-r^-}{T_S}\right)\left(\frac{T_S}{T}\right), \quad \text{for } r \leq 0. \end{aligned} \tag{6}$$

Taking natural logarithms on both sides of Equation (6), we have:

$$\begin{aligned} \ln(A^+) &= \ln\left(\frac{r^+}{T}\right) = \ln\left(\frac{r^+}{T_B}\right) + \ln\left(\frac{T_B}{T}\right) \equiv \ln(A_1^+) + \ln(A_2^+) \\ \ln(A^-) &= \ln\left(\frac{-r^-}{T}\right) = \ln\left(\frac{-r^-}{T_S}\right) + \ln\left(\frac{T_S}{T}\right) \equiv \ln(A_1^-) + \ln(A_2^-), \end{aligned} \tag{7}$$

where $A_1^+ \equiv \frac{r^+}{T_B}$ is the directional half-Amihud for up days and $A_1^- \equiv \frac{-r^-}{T_S}$ is the directional half-Amihud for down days. The first directional half-Amihud is defined as the return divided by the buyer-initiated turnover for up days, and the second directional half-Amihud is defined analogously for down days. The two sidedness components, $A_2^+ \equiv \frac{T_B}{T}$ and $A_2^- \equiv \frac{T_S}{T}$, are the proportions of trading volume or turnover that are attributable to buyer- and seller-initiated trades on up and down days, respectively. We refer to them as the up-sidedness and down-sidedness components, respectively.

The sidedness components for up and down days (A_2^+ and A_2^-) are closely related to the Sarkar and Schwartz (2009) measure of market (one-)sidedness, which captures the tendency of orders to cluster on the buy side or the sell side. Thus, our up-sidedness (down-sidedness) measure captures the tendency of orders to cluster on up days (down days) and, as Sarkar and Schwartz (2009) suggest, provides a measure of information asymmetry on those days.

An alternative decomposition of the half-Amihud measures is suggested by the Kyle (1985) lambda, which depends on the ratio of price changes to net buyer- or seller-initiated trading volume. Specifically, we can rewrite each of the two half-Amihud measures as

$$\begin{aligned} A^+ &= \frac{r^+}{T} = \left(\frac{r^+}{T_B - T_S}\right)\left(\frac{T_B - T_S}{T}\right), \quad \text{for } r \geq 0 \\ A^- &= \frac{-r^-}{T} = \left(\frac{-r^-}{T_S - T_B}\right)\left(\frac{T_S - T_B)}{T}\right), \quad \text{for } r \leq 0. \end{aligned} \tag{8}$$

Taking logarithms on both sides of Equation (8), we have

$$\begin{aligned} \ln(A^+) &= \ln\left(\frac{r^+}{T_B - T_S}\right) + \ln\left(\frac{T_B - T_S}{T}\right) = \ln(K_1^+) + \ln(K_2^+) \\ \ln(A^-) &= \ln\left(\frac{-r^-}{T_S - T_B}\right) + \ln\left(\frac{T_S - T_B)}{T}\right) = \ln(K_1^-) + \ln(K_2^-). \end{aligned} \tag{9}$$

We refer to $K_1^+ = \frac{r^+}{T_B - T_S}$ and $K_1^- = \frac{-r^-}{T_S - T_B}$ in Equations (8) and (9) as the half-Kyle for up days and the half-Kyle for down days, respectively, since both measures divide the daily return by that day's net buyer- or seller-initiated turnover. The two net turnover ratios, $K_2^+ = \frac{T_B - T_S}{T}$ and $K_2^- = \frac{T_S - T_B}{T}$, are proportional net buyer-initiated turnover on up days and proportional net seller-initiated turnover on down days, respectively. Like the sidedness measures, they capture the tendency of orders to cluster on the buy (sell) side on up (down) days.

Figure 1 summarizes the relations between the various decompositions of the Amihud (2002) measure described above. We estimate monthly Fama and MacBeth (1973)-type cross-sectional regressions to investigate which components of the Amihud (2002) measure shown in Figure 1 are most important for asset pricing. Following Amihud (2002), we obtain the monthly variables by averaging the daily values of the Amihud (2002) measure and its components within each month. As shown above, the log-transformation allows us to decompose the Amihud (2002) measure in a simple additive fashion. Moreover, the transformation (at the monthly level) reduces the influence of extreme observations in our empirical analyses.[9]

2. Data and Variable Construction

Our primary data are taken from the Center for Research in Securities Prices (CRSP) for NYAM-listed stocks over the 462 months from July 1971 to December 2009 and for NASDAQ-listed stocks over the 324 months from January 1983 to December 2009 at daily and monthly frequencies. For more detailed decomposition of the Amihud measure, we also use transaction-level data from the Institute for the Study of Securities Markets (ISSM) and the NYSE Trades and Automated Quotations (TAQ) over the 324 months from January 1983 to December 2009 (for NYAM stocks only).

To survive in the CRSP sample in a given month, stocks must have no more than five zero-volume days within the month for NYAM stocks, or must have at least 50 trades within the month for NASDAQ stocks.[10] In addition, for the availability of the risk-adjusted return, R^{e2}, which is described in Section 3, stocks must have at least 24 monthly returns in the past 60 months. Only common stocks (share code 10 or 11 in CRSP) are used. When we process transaction-level data, for consistency with the above filtering, stocks must have at least 50 trades per month (on average 2.5 trades per day) for each firm in the ISSM/TAQ databases.

9 To reduce the influence of extreme observations, Hasbrouck (1999, 2005, and 2009) and Chordia, Huh, and Subrahmanyam (2009) apply a square-root transformation to illiquidity measures, while others prefer a logarithmic transformation.

10 In the CRSP database, the information about the number of trades is available for NASDAQ stocks only, which is why we cannot apply the same filter to NYAM stocks.

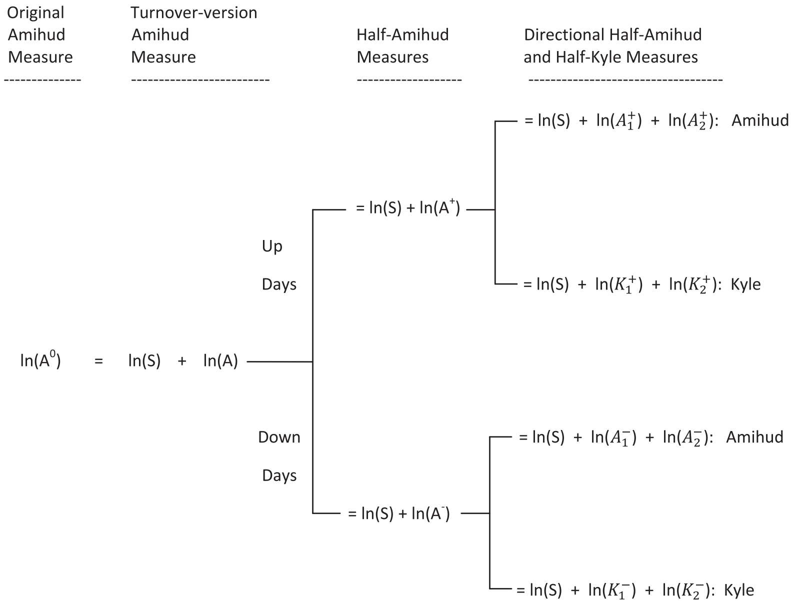

Figure 1
Decomposition of the Amihud (2002) measure of illiquidity
The figure shows: (i) how (the log-transform of) the original Amihud (2002) measure (A^0) can be decomposed into the firm size (S) and the turnover-version Amihud measure (A); (ii) how the turnover-version Amihud measure (A) can be decomposed into the (two) "half-Amihud" measures for up days and down days (A^+ and A^-); and (iii) how each of the two half-Amihud measures (A^+ and A^-) can be decomposed either (a) into the (two) "directional half-Amihud" measures (A_1^+ and A_1^-) as well as the (two) fractional turnover ratios (sidedness components, A_2^+ and A_2^-), or (b) into the (two) "half-Kyle" measures (K_1^+ and K_1^-) as well as the (two) net turnover ratios (K_2^+ and K_2^-). For details about the decomposition and variable definitions, see Section I in the main text.

Since trading protocols have differed between NYAM and NASDAQ, trading volume is not comparable between the markets and this affects the computation of the Amihud measure. Therefore, we treat NYAM and NASDAQ stocks separately in our analysis.

2.1 The Amihud (2002) measure and its components

The original Amihud (2002) measure (A^o), its basic components (A, A^+, A^-, and S), daily stock returns, daily CRSP value-weighted market returns, and the number of shares outstanding are obtained from the CRSP daily file. The daily turnover ratio, T, is computed using CRSP as well as ISSM/TAQ.[11] The buyer- and seller-initiated turnover ratios, T_B and T_S, are computed using ISSM/TAQ.

To calculate the subcomponents (A_1^+, A_2^+, A_1^-, and A_2^-) that depend on the direction of trades, we take intraday transaction data from ISSM/TAQ. For

[11] When necessary, we will distinguish the turnover ratio computed using the ISSM/TAQ databases (denoted by T^*) from T, which is the turnover ratio computed using CRSP.

this purpose, each trade is classified into a buyer- or seller-initiated trade according to the Lee and Ready (1991) algorithm using trades and quotes data from ISSM for 1983–1992 and from TAQ for 1993–2009. To obtain signed volume (order flow), we focus on NYAM stocks because the availability of transaction-level data on NASDAQ-listed stocks is limited to us and the NASDAQ market has different trading protocols (Atkins and Dyl 1997). Trades and quotes that are out of sequence, recorded before the open or after the close, or involved in errors or corrections are expunged.

To match trades and quotes using the Lee and Ready (1991) algorithm, any quote less than five seconds prior to the trade is ignored and the first one at least five seconds prior to the trade is retained for the years from 1983 to 1998. Based on reports from microstructure scholars that timing differences in recording trades and quotes have declined dramatically in recent years, we do not impose this five-second-delay rule for the last 11 years of the sample. Instead, the quote that is closest in time to the transaction, with a time stamp of *two* seconds or more before the transaction, is retained for the years from 1999 to 2009. The transaction data are then signed as follows. If a trade occurs above (below) the prevailing quote midpoint, it is regarded as buyer-initiated (seller-initiated). To minimize possible signing errors in processing order flows, if a trade occurs exactly at the quote midpoint, we discard the trade, following Sadka (2006). Approximately 5% of the trades from the intradaily databases transact at the quote midpoints.[12]

While the Lee and Ready (1991) algorithm is imperfect, Lee and Radhakrishna (2000) and Odders-White (2000) show that its accuracy in the 1990s is quite high: about 85%. However, O'Hara, Yao, and Ye (2011) indicate that imbalance measures constructed from the TAQ database are subject to errors because TAQ excludes odd-lot trades, which have increased substantially in the recent high-frequency-trading era; the errors are particularly severe for imbalances based on the number of trades. Chakrabarty, Moulton, and Shkilko (2012) report that while the Lee-Ready algorithm's misclassification rates are near zero at the daily aggregate level, they are as high as 30% at the transaction level when contemporaneous quotes are matched with trades, and about 21% when they impose a one-second-delay rule. Easley, Lopez de Prado, and O'Hara (2012) suggest that the Lee and Ready (1991) algorithm may be more error-prone when classifying trades in the recent high-frequency era from the monthly TAQ database (that we use), because the database is time-stamped only to the second (not to the millisecond, as in daily TAQ). Given that we utilize daily-aggregated, volume-based (as opposed to trade-number-based) measures of buy- and sell-turnover, classification errors in our study are mitigated. Nonetheless, to alleviate the

[12] For example, 5.3% of the total trades in 2002 occur exactly at the quote midpoints. When a trade occurs exactly at the quote midpoint, we also try to classify the trade using an alternative method called a tick test. That is, if a trade occurs at the quote midpoint, it is signed using the previous transaction price: buyer-initiated if the sign of the last non-zero price change is positive, and vice versa. Using his method does not alter our main results.

concerns raised above, we also report versions of all signed-order-based results while excluding the years 2006 to 2009, during which high-frequency-trading volume is likely substantial.

Denote the total number of shares outstanding by $\#SHARE$, aggregate daily buyer-initiated trades in shares by $SBUY$, and aggregate daily seller-initiated trades in shares by $SSELL$, and define $SVOL^* = SBUY + SSELL$. Also define total share turnover as $T^* = \frac{SVOL^*}{\#SHARE}$, buyer-initiated turnover as $T_B = \frac{SBUY}{\#SHARE}$, and seller-initiated turnover as $T_S = \frac{SSELL}{\#SHARE}$. Then $T^* = T_B + T_S$. Note that for the finer decomposition as well as for robustness tests, we use ISSM/TAQ-based turnover, T^*, which is slightly different from usual CRSP-based turnover, T. Similarly, CRSP-based share volume, $SVOL$, is slightly different from ISSM/TAQ-based share volume, $SVOL^*$ $(= SBUY + SSELL)$, because when intradaily trades are processed, not all trades are classified into the two categories. Moreover, when intradaily trades are classified, other filters are applied (e.g., trades and quotes are discarded if they are out of time sequence, recorded before the opening or after the close, or involved in errors or corrections). Therefore, usually $SVOL > SVOL^*$ $(= SBUY + SSELL)$, and $T \left(= \frac{SVOL}{\#SHARE}\right) > T^* \left(= \frac{SVOL^*}{\#SHARE}\right)$.

Table 1 reports descriptive statistics for the above variables. The Amihud (2002) measure, A^o, and its components shown in Panels A and D are constructed and defined as follows:

> A^o: The original Amihud (2002) measure, which is the monthly average of daily $|r|/DVOL$, where r is a daily stock return and $DVOL$ is daily dollar volume (in \$1,000).
>
> A: The turnover version of the Amihud (2002) measure, which is the monthly average of daily $|r|/T$, where T is CRSP-based daily share turnover [(daily share volume ($SVOL$) divided by the total number of shares outstanding ($\#SHARE$)]. Instead of T, ISSM/TAQ-based turnover, $T^* = \frac{SVOL^*}{\#SHARE}$, is also used for robustness tests.
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> A^+ (A^-): The half-Amihud measure for up days (down days), which is the monthly average of daily r^+/T ($-r^-/T$), where $r^+ = \max[0, r]$, $r^- = \min[0, r]$, and T is CRSP-based daily share turnover. Instead of T, ISSM/TAQ-based turnover, T^*, is also used for robustness tests.
>
> $A^{+,m}$ ($A^{-,m}$): The half-Amihud measure for up-market days (down-market days). The measures are defined by the averages of daily $|r|/T$ over the days with positive (negative) CRSP value-weighted market returns within a month.
>
> $A_1^+ (A_1^-)$: The directional half-Amihud measure for up days (down days), which is the monthly average of daily r^+/T_B ($-r^-/T_S$), where

Table 1
Descriptive statistics

Variables	NYAM Stocks					NASDAQ Stocks				
	Mean	Median	STD	Skewness	Kurtosis	Mean	Median	STD	Skewness	Kurtosis
	Panel A: Amihud Measure and its Components					Panel D: Amihud Measure and its Components				
A^0	0.297×10^{-2}	0.015×10^{-2}	0.02	18.60	485.12	0.593×10^{-2}	0.025×10^{-2}	0.06	20.47	611.20
A	34.60	13.70	111.04	15.47	379.83	78.71	15.99	404.27	15.34	428.92
A^+	16.18	6.20	59.30	16.46	425.65	39.00	6.50	267.67	16.93	490.29
A^-	18.42	6.91	64.43	15.76	391.14	39.71	7.69	232.37	15.61	427.60
A_1^+	31.37	8.22	150.46	18.52	502.41	–	–	–	–	–
A_2^+	0.56	0.57	0.08	−0.54	1.73	–	–	–	–	–
A_1^-	39.44	11.56	173.70	17.92	495.73	–	–	–	–	–
A_2^-	0.44	0.43	0.08	0.54	1.73	–	–	–	–	–
S	2,669,286.6	447,989.3	9,020,199.3	11.3	191.9	592,149.9	103,061.7	4,332,810.4	18.8	534.1
	Panel B: Log-transformed Measure and its Components					Panel E: Log-transformed Measure and its Components				
$\ln(A^0)$	−10.00	−10.26	2.74	0.34	−0.28	−8.73	−8.71	2.68	−0.03	−0.28
ln(A)	2.52	2.31	1.11	0.80	1.13	2.74	2.61	1.52	0.39	−0.12
$\ln(A^+)$	1.72	1.53	1.13	0.77	1.19	1.89	1.74	1.53	0.45	0.07
$\ln(A^-)$	1.80	1.61	1.17	0.68	1.11	2.02	1.89	1.55	0.36	0.03
$\ln(A_1^+)$	2.22	2.03	1.21	0.80	1.65	–	–	–	–	–
$\ln(A_2^+)$	−0.60	−0.57	0.16	−1.59	7.16	–	–	–	–	–
$\ln(A_1^-)$	2.50	2.31	1.20	0.71	1.60	–	–	–	–	–
$\ln(A_2^-)$	−0.84	−0.83	0.19	−0.47	3.25	–	–	–	–	–
ln(S)	12.53	12.54	1.94	0.02	−0.36	11.48	11.41	1.54	0.29	0.19
	Panel C: Other Key Variables					Panel F: Other Key Variables				
BTM	0.853	0.734	0.596	2.304	9.993	0.657	0.537	0.528	2.270	10.049
MOM1	0.011	0.016	0.200	−0.270	7.345	−0.010	0.003	0.279	−0.535	6.404
MOM2	0.009	0.014	0.194	−0.202	6.429	−0.006	0.005	0.270	−0.295	4.801
MOM3	0.010	0.014	0.191	−0.146	5.978	−0.003	0.006	0.266	−0.176	4.323
MOM4	0.010	0.015	0.189	−0.116	5.741	−0.003	0.006	0.264	−0.121	4.170

This table reports descriptive statistics of key variables for NYSE/AMEX (hereafter "NYAM") stocks from July 1971 to December 2009 (38.5 years, 462 months) and for NASDAQ stocks from January 1983 to December 2009 (27 years, 324 months). Panels A and D show statistics for the Amihud (2002) measure and its components, while Panels B and E show statistics for their log-transformed values [indicated by ln(.)]. Panels C and F contain statistics for other variables. The cross-sectional value for each statistic is first calculated each month, and then the time-series average of those values over the sample period is reported here. *STD* stands for the standard deviation. The variables are defined as follows: A^0: the original Amihud (2002) measure defined as the monthly average of daily ratios of absolute returns to dollar volume in \$1,000; A: the turnover version of the Amihud measure, which is the monthly average of daily ratios of absolute return to share turnover computed using CRSP; A^+ (A^-): the half-Amihud measure for up (down) days, which is the monthly average of daily ratios of absolute returns to turnover on positive (negative) return days; $A_1^+(A_1^-)$: the directional half-Amihud measure for up (down) days which is the monthly average of daily ratios of absolute returns to buyer (seller) initiated turnover on up (down) days computed using ISSM/TAQ; $A_2^+(A_2^-)$: the up-sidedness (down-sidedness) measure, which is the proportion of turnover that is attributable to buyer-initiated (seller-initiated) trades on up (down) days computed using ISSM/TAQ; S: the average of daily market values (daily stock price times the total number of shares outstanding) within a month in \$1,000; *BTM*: the Winsorized value (at the 0.5th and 99.5th percentiles) of a book-to-market ratio ($= BV/MV$), where the book value (BV) is common equity and the market value (MV) is the previous month-end stock price times the number of shares outstanding; *MOM1, MOM2, MOM3*, and *MOM4*: the compounded holding period returns of a stock over the three months (from months t-3 to t-1, months t-6 to t-4, months t-9 to t-7, and months t-12 to t-10, respectively). To survive in the CRSP sample, stocks must have five zero-volume days or fewer within a month (for NYAM stocks), or 50 trades or more within a month (for NASDAQ stocks). In addition, for the availability of R^{e2}, stocks must have monthly returns for the past 60 months (at least 24 months). Only common stocks (share code 10 or 11 in CRSP) are used. The values for ISSM/TAQ-based variables (A_1^+, A_2^+, A_1^-, A_2^-, and their log-transforms) are available only for NYAM-listed stocks from January 1983 to December 2009 (27 years, 324 months). In the ISSM/TAQ databases, stocks must have at least 50 trades per month (on average 2.5 trades per day) for each firm. The average number of component stocks used each month for this table is 1,758.6 (a minimum of 1,447 and a maximum of 2,170) for NYAM stocks and 2,166.1 (a minimum of 148 and a maximum of 3,376) for NASDAQ stocks.

T_B (T_S) is ISSM/TAQ-based daily buyer-initiated turnover (seller-initiated turnover), which is in turn defined as buyer-initiated share volume (seller-initiated share volume) divided by the total number of shares outstanding (i.e., $T_B = \frac{SBUY}{\#SHARE}$, $T_S = \frac{SSELL}{\#SHARE}$).

A_2^+ (A_2^-): The sidedness component for up days (down days), which is the proportion of turnover that is attributable to buyer-initiated trades on up days (seller-initiated trades on down days). Specifically, $A_2^+ = T_B/T^*$ and $A_2^- = T_S/T^*$.

S: The average of daily market values within a month (in \$1,000).

2.2 Other variables

Firm characteristics that are used as control variables in the asset pricing regressions are defined as follows:

BTM: The Winsorized value (each month at the 0.5th and 99.5th percentiles) of the book-to-market ratio ($= BV/MV$), where the book value (BV) is common equity and the market value (MV) is the previous month-end stock price times the number of shares outstanding. In the spirit of Fama and French (1992), the quarterly book-to-market ratio is lagged two quarters. The monthly series is then constructed by assigning the same value to all months in a given quarter.

$MOM1$, $MOM2$, $MOM3$, and $MOM4$: The compounded holding period returns of a stock over the most recent three months (from month t-3 to month t-1), from month t-6 to month t-4, from month t-9 to month t-7, and from month t-12 to month t-10, respectively. For each of the four momentum variables to exist, a stock must have all three monthly returns over the corresponding three-month period.

Monthly stock prices, returns, and the number of shares outstanding are available from the CRSP monthly file, and the book value is from the CRSP/Compustat Merged (quarterly) file. The Fama-French (FF, 1993) factors are available from Kenneth French's website.

Panels A and D of Table 1 report time-series average values of monthly means, medians, standard deviations, and other descriptive statistics for the original Amihud (2002) measure, A^o, and its components. The cross-sectional value for each of the five statistics is calculated each month, and the time-series average of those values is reported. The average number of sample firms used each month is 1,758.6 (a minimum of 1,447 and a maximum of 2,170) for NYAM stocks and 2,166.1 (a minimum of 148 and a maximum of 3,376) for NASDAQ stocks. The average size (*S*) of the NYAM (NASDAQ) sample firms is \$2.67 (\$0.59) billion over the sample period. Most of the variables in Panels A and D are highly leptokurtic, as well as significantly skewed. The large kurtoses imply that the sample distributions of the variables contain a significant number of extreme observations.

To reduce the influence of extreme observations in the empirical analyses and to permit a simple additive decomposition of the Amihud measure, we apply a logarithmic transformation [denoted by ln(.)] to all of the A-associated variables reported in Panels A and D. Statistics for the transformed variables are shown in Panels B and E. The log-transformation decreases the skewness and kurtosis of the variables substantially. After the log-transformation, both of the illiquidity components for down days [$\ln(A^-)$ and $\ln(A_1^-)$] are larger than the corresponding components for up days [$\ln(A^+)$ and $\ln(A_1^+)$] for both samples (where applicable). This implies that the average price change per unit of turnover is greater on down days, and the average price change per unit of sell volume on down days is greater than the average price change per unit of buy volume on up days. On the other hand, the average and median up-sidedness component is greater than the average and median down-sidedness component: on average 56% of turnover on up days is classified as buyer-initiated, and 44% of turnover on down days is classified as seller initiated.

To investigate further the differences between liquidity on up and down days, we calculate each month three (il)liquidity measures for up days and down days separately: (i) proportional quoted spread in % (*%QSPR*); (ii) dollar depth in \$1,000 (*DDepth*); and (iii) composite illiquidity (*ComposIlliq*),[13] which is calculated following Chordia, Roll, and Subrahmanyam (2001). The data for these calculations are taken from the ISSM/TAQ databases. To test the null hypothesis that the differences between the two mean values are equal to zero, we also provide statistics from the pooled sample t-tests. To compute the monthly averaged values for the three (il)liquidity measures, each intradaily trade is first matched with relevant ask and bid quotes via the Lee and Ready (1991) algorithm; the intradaily values of the three measures are calculated within each day; the daily mean values are obtained by averaging the intradaily values; and then the daily values for up days and down days are separately averaged within each month.

We report the results in Table A1 in the Appendix. To alleviate the influence of outliers, the six data series are Winsorized each month at the 0.5^{th} and 99.5^{th} percentiles. For the whole sample, the average quoted spread

[13] For more detailed information about the definitions and data, see the note to Table A1 in the Appendix.

(*%QSPR*) is higher on down days and the average dollar depth (*DDepth*) is lower on down days; as a result the average composite measure of illiquidity (*ComposIlliq*) is higher on down days and the difference is statistically significant. In groups based on firm size, we observe similar patterns, although asymmetry seems less prominent in the group of the largest stocks (*MV3*).

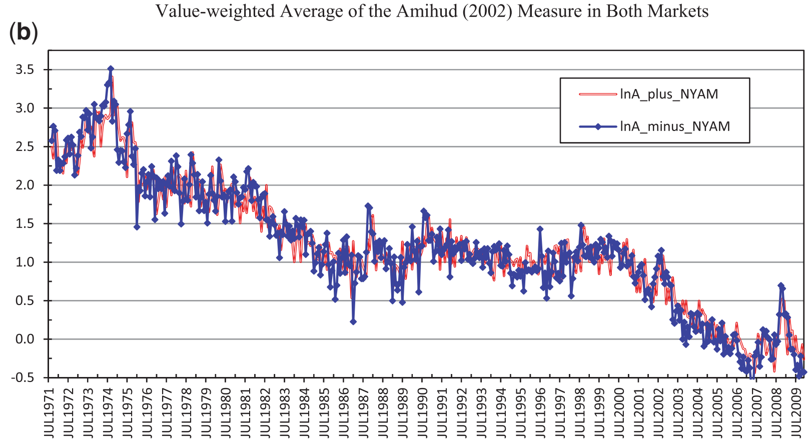
In summary, we have confirmed the existence of significant differences between illiquidity on up and down days which are not captured by the original Amihud measure. We shall see below that the difference in liquidity between up days and down days is important for asset pricing because it is only down day (il)liquidity that is reflected in returns.

For other control variables, Panels C and F of Table 1 show that the book-to-market ratio for NYAM stocks is 0.85 on average over the 38.5-year period, while the ratio for NASDAQ stocks is 0.66 over the 27-year period. The mean returns of the momentum variables (*MOM1*-*MOM4*) range from 0.9% to 1.1% for the NYAM stocks, but they are negative (−0.3% to −1.0%) for the NASDAQ stocks.

Figure 2 plots time series of monthly value-weighted averages for the Amihud (2002) measure and its components for both NYAM and NASDAQ stocks. Figure 2(a) shows that the average Amihud (2002) measures, $\ln(A^o)$, follow a generally decreasing trend reflecting improvement in market liquidity since the early 1970s. The average Amihud measure for NASDAQ stocks converges toward that for the exchange markets, but it is more volatile and generally higher. Figures 2(b) and 2(c) show that the two half-Amihud measures also have decreasing trends in both markets, but the half-Amihud for down days, $\ln(A^-)$, is more volatile throughout the period, although it tracks $\ln(A^+)$ fairly closely: there are big spikes around the months of the 1987 stock market crash and the recent financial crisis. Figure 2(d) shows that most of the variation in the Amihud measure is attributable to variation in the directional half-Amihud measures rather than the sidedness measures. The directional half-Amihud measure for down days, $\ln(A_1^-)$, is larger and more volatile than that for up days, $\ln(A_1^+)$. The down-sidedness component, $\ln(A_2^-)$, tends to be smaller than the up-sidedness component, $\ln(A_2^+)$, until mid-2007, when the measures converge. We do not show plots for the equal-weighted averages, but they are comparable to those of the value-weighted series. As one would expect, however, the levels of the equal-weighted series are much higher (and more volatile).

Table 2 reports average correlations between the key variables. The lower triangle in the table contains the correlation coefficients for NYAM stocks, while the upper triangle does the same for NASDAQ stocks. The correlation between the Amihud (2002) measure, A^o, and its log-transform, $\ln(A^o)$, is only around 0.35, reflecting the extreme skewness of the untransformed measure. More importantly, the correlation between $\ln(A^o)$ and the turnover version, $\ln(A)$, is 0.80 (0.87) while the correlation between $\ln(A^o)$ and $\ln(S)$ is −0.94

Value-weighted Average of the Amihud (2002) Measure in Both Markets



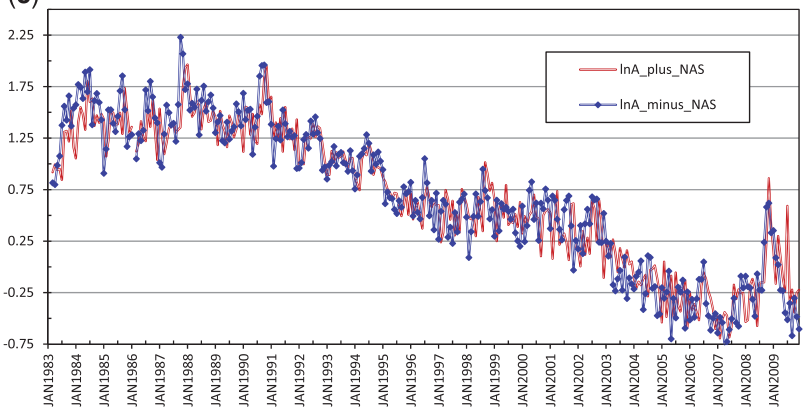
Value-weighted Averages of the Half-Amihud Measures for NYAM Stocks

Figure 2
Time-series plots of the Amihud (2002) measure and its components
The figure shows the time-series plots of the Amihud (2002) measure and its components. The monthly cross-sectional average is weighted by the previous month-end market value of each stock. Figure 2(a) plots the original Amihud (2002) measure, $\ln(A^0)$, for NYAM stocks (denoted by *lnA0_NYAM* in the legend) over the 462 months (1971:07–2009:12) and for NASDAQ Stocks (*lnA0_NAS* in the legend) over the 324 months (1983:01–2009:12). Figure 2(b) plots the two half-Amihud measures, $\ln(A^+)$ and $\ln(A^-)$, for NYAM stocks (denoted by *lnA_plus_NYAM* and *lnA_minus_NYAM,* respectively), while Figure 2(c) does the same for NASDAQ stocks. Figure 2(d) plots the two directional half-Amihud measures, $\ln(A_1^+)$ and $\ln(A_1^-)$ (denoted by *lnA1_plus* and *lnA1_minus*, respectively), as well as the two sidedness components, $\ln(A_2^+)$ and $\ln(A_2^-)$ (denoted by *lnA2_plus* and *lnA2_minus*, respectively), for NYAM stocks.

(−0.88) for the two sets of stocks, confirming the important role of firm size in the original Amihud measure of illiquidity.

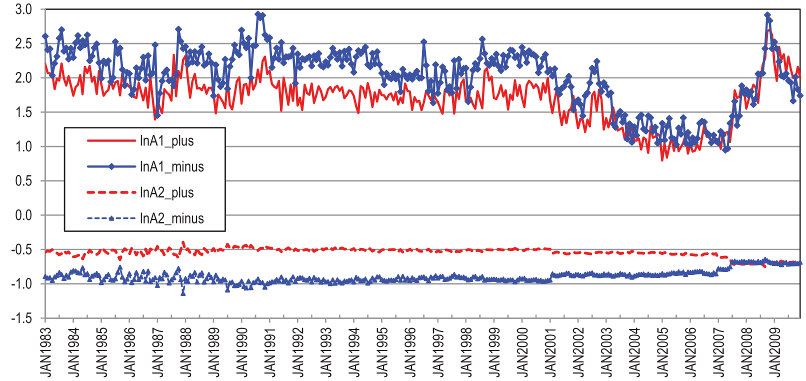
The turnover-version Amihud measure, $\ln(A)$, has a slightly higher correlation with the half-Amihud measure for down days (0.95) than for up days (0.94). Decomposition of the half-Amihud measures is possible only for the NYAM stocks for which tick data are available to us. The correlations show

(c)



Value-weighted Averages of the Half-Amihud Measures for NASDAQ Stocks

(d)



Value-weighted Averages of the Directional Half-Amihud Measures and the Sidedness Components for NYAM Stocks

Figure 2
(Continued)

that the major determinants of the half-Amihud measures are the corresponding directional half-Amihud measures: the correlation between these measures is 0.90 for up days [$\ln(A^{+})$ and $\ln(A_1^{+})$] and 0.88 for down days [$\ln(A^{-})$ and $\ln(A_1^{-})$]. In contrast, the correlations of the half-Amihud measures with the corresponding sidedness components are −0.12 and 0.20. Similarly, there is little correlation between the directional half-Amihud measure and the corresponding sidedness measure: −0.26 for up days and 0.07 for down days. Note that the up-sidedness measure, $\ln(A_2^{+})$, is strongly negatively correlated (−0.95) with the down-sidedness measure, $\ln(A_2^{-})$. Therefore, if in a given month selling in a stock is a high proportion of turnover on down days, which implies a high down-sidedness measure, then there is also a tendency

Table 2
Correlations between key variables

	A^0	$\ln(A^0)$	$\ln(A)$	$\ln(A^+)$	$\ln(A^-)$	$\ln(A_1^+)$	$\ln(A_2^+)$	$\ln(A_1^-)$	$\ln(A_2^-)$	$\ln(S)$	BTM	MOM1	MOM2	MOM3	MOM4
A^0	1	0.338	0.325	0.290	0.303	–	–	–	–	−0.259	0.128	−0.114	−0.095	−0.083	−0.075
$\ln(A^0)$	0.348	1	0.867	0.802	0.838	–	–	–	–	−0.877	0.317	−0.183	−0.167	−0.159	−0.153
$\ln(A)$	0.357	0.796	1	0.938	0.953	–	–	–	–	−0.526	0.253	−0.121	−0.107	−0.104	−0.102
$\ln(A^+)$	0.331	0.729	0.935	1	0.812	–	–	–	–	−0.477	0.235	−0.118	−0.096	−0.092	−0.090
$\ln(A^-)$	0.332	0.768	0.952	0.800	1	–	–	–	–	−0.521	0.243	−0.116	−0.109	−0.107	−0.106
$\ln(A_1^+)$	0.281	0.718	0.916	0.904	0.758	1	–	–	–	–	–	–	–	–	–
$\ln(A_2^+)$	−0.066	−0.255	−0.200	−0.121	−0.238	−0.255	1	–	–	–	–	–	–	–	–
$\ln(A_1^-)$	0.268	0.693	0.898	0.732	0.882	0.757	−0.106	1	–	–	–	–	–	–	–
$\ln(A_2^-)$	0.042	0.193	0.157	0.081	0.203	0.206	−0.947	0.065	1	–	–	–	–	–	–
$\ln(S)$	−0.280	−0.944	−0.556	−0.499	−0.542	−0.454	0.236	−0.431	−0.176	1	−0.307	0.194	0.181	0.171	0.162
BTM	0.121	0.336	0.198	0.179	0.190	0.199	−0.131	0.177	0.101	−0.355	1	0.044	0.004	−0.126	−0.153
MOM1	−0.094	−0.137	−0.133	−0.135	−0.119	−0.112	0.040	−0.105	−0.035	0.118	0.013	1	0.039	0.054	0.041
MOM2	−0.078	−0.129	−0.111	−0.102	−0.109	−0.100	0.046	−0.104	−0.040	0.118	−0.013	0.022	1	0.028	0.044
MOM3	−0.078	−0.125	−0.107	−0.096	−0.107	−0.096	0.050	−0.104	−0.043	0.115	−0.133	0.043	0.015	1	0.020
MOM4	−0.078	−0.127	−0.108	−0.096	−0.108	−0.098	0.052	−0.104	−0.044	0.117	−0.158	0.047	0.040	0.010	1

This table reports the time-series averages of monthly cross-section correlations between the Amihud (2002) measure, its components, and other key variables for NYAM stocks from July 1971 to December 2009 and for NASDAQ stocks from January 1983 to December 2009. The lower (upper) triangle contains the correlation coefficients for NYAM (NASDAQ) stocks,. The variable definitions are provided in Table 1. The values for ISSM/TAQ-based variables [$\ln(A_1^+)$, $\ln(A_2^+)$, $\ln(A_1^-)$, and $\ln(A_2^-)$] are available only for NYAM-listed stocks from January 1983 to December 2009. The average number of component stocks used each month for this table is 1,758.6 (a minimum of 1,447 and a maximum of 2,170) for NYAM stocks and 2,166.1 (a minimum of 148 and a maximum of 3,376) for NASDAQ stocks.

for selling to be a high proportion of turnover on up days, which means a low up-sidedness measure; thus, the negative correlation is driven by the pervasiveness of buying or selling in a stock in a given month.

The Amihud, half-Amihud, and directional half-Amihud measures all have negative correlations (about -0.10) with the momentum variables (*MOM1-MOM4*) for both markets, so that higher momentum is associated with reduced illiquidity or improved liquidity (See Lee and Swaminathan 2000). As we see in the lower triangle, however, up-sidedness, $\ln(A_2^+)$, is slightly positively correlated with momentum, while down-sidedness, $\ln(A_2^-)$, is slightly negatively correlated with it: this is consistent with a tendency for buy-orders to be high relative to sell-orders after a price increase.

3. Estimation Procedure

To determine which components of the Amihud (2002) measure play an important role in asset pricing, we follow the Brennan, Chordia, and Subrahmanyam (BCS, 1998) approach, which uses individual stock data. This avoids the data-snooping biases inherent in portfolio-based approaches (Roll 1977; Lo and MacKinlay 1990) and also eliminates any bias caused by errors in estimating the Fama-French (FF, 1993) factor loadings. Ang, Liu, and Schwarz (2008) also argue that using individual stocks provides more efficient tests of whether factors are priced.

The dependent variable in the estimation is defined as the return adjusted for the three Fama-French (1993) factors (FF3: MKT_t, SMB_t, and HML_t) [For details, see Brennan, Chordia, and Subrahmanyam (1998) and Chordia, Huh, and Subrahmanyam (2009)]. Let $\tilde{R}_j$ and R_F denote the monthly return for stock j and the risk-free rate, respectively. We estimate the FF3 factor loadings in two ways yielding two different estimates of the FF3-adjusted returns. First, we use the entire sample period, denoting the resulting FF3-adjusted excess return by R_{jt}^{e1}. Second, for each month we use rolling estimates of the factor loadings (β_j) that are estimated using the time series of the past 60 months (at least 24 months). We denote the corresponding estimate of the FF3-adjusted return by R_{jt}^{e2}. The FF3-adjusted return, R_{jt}^{eh} ($h = 1, 2$), for stock j in each month t is calculated as the sum of the intercept and the residual from time-series regressions in which the dependent variable is the stock return in excess of the one-month T-bill rate. Then the FF3-adjusted returns can be written as

$$R_{jt}^{eh} \equiv (\tilde{R}_{jt} - R_{Ft}) - (\hat{\beta}_{j1} MKT_t + \hat{\beta}_{j2} SMB_t + \hat{\beta}_{j3} HML_t), h = 1 \text{ or } 2. \quad (10)$$

One of the two sets of FF3-adjusted returns is then used as the dependent variable in the following Fama-Macbeth (1973) cross-sectional regressions:

$$R_{jt}^{eh} = c_0 + \sum_{i=1}^{M} \phi_i \Lambda_{ijt-l} + \sum_{n=1}^{N} c_n Z_{njt-l} + e_{jt},\ h = 1 \text{ or } 2, \quad (11)$$

where A_{ijt} ($i = 1, 2, \ldots, M$) are the M components of the Amihud (2002) measure for stock j in month t, as discussed in Sections 1 and 2, Z_{njt} ($n = 1, \ldots, N$) are control variables for firm j in month t, and l is the number of months by which the explanatory variables are lagged. We control for firm characteristics such as book-to-market equity (*BTM*) and past returns (*MOM1-MOM4*) since, according to Avramov and Chordia (2006), a constant-beta version of the Fama and French (1993) three-factor model cannot adequately capture the predictive ability of firm characteristics in stock returns. Following Brennan, Chordia, and Subrahmanyam (1998), we lag the explanatory variables by two months.

We report statistics for regressions with three different dependent variables: (i) the unadjusted excess returns, R^e_{jt}; (ii) the FF3-adjusted excess return using the first method, R^{e1}_{jt}; and (iii) the FF3-adjusted excess return using the second method, R^{e2}_{jt}. Following Fama and MacBeth (1973), we estimate the vector of coefficients $c = [c_0\ \phi_1\ \phi_2 \ldots \phi_M\ c_1\ c_2 \ldots c_N]'$ in Equation (11) each month by ordinary least-squares regressions, and the final estimator is the time-series average of the monthly coefficients. The standard error of this estimator is taken from the time series of the monthly coefficient estimates.

Asparouhova, Bessembinder, and Kalcheva (2010) propose that weighted least-squares (WLS) regressions can alleviate biases in estimation that are caused by the well-known bid-ask bounce. Therefore, as a robustness check we also estimate WLS regressions using the prior-month gross return as a weighting variable.

4. Priced Components of the Amihud (2002) Measure

4.1 The Amihud (2002) measure

We first verify that there is a return premium associated with the log-transformed original Amihud (2002) measure, $\ln(A^o)$. We estimate Equation (11) including only $\ln(A^o)$ and control variables using monthly individual stock data for the period from July 1971 to December 2009 for NYAM-listed stocks and from January 1983 to December 2009 for NASDAQ-listed stocks.

The results for the two samples are reported in Panels A and B of Table 3. For expositional convenience, regression coefficients are multiplied by 100 throughout the tables. The average number of stocks in the cross-sectional regressions ranges from 1,597.0 to 1,757.8 for NYAM stocks and from 2,003.3 to 2,166.1 for NASDAQ stocks, depending on the method of FF3-adjustment and whether control variables are included or not.[14] When

[14] While the average number of stocks used each month is 1,757.8 over the sample period in Specification 1a with R^{e2} in Panel A (NYAM stocks), for example, the number of stocks used in a month varies month by month: the minimum number is 1,447 and the maximum number is 2,170 in this case. In the corresponding specification (1b) in Panel B (NASDAQ stocks), the minimum is 148 (in March 1983) while the maximum is 3,376.

Table 3
The Pricing of the Amihud (2002) Measure

Panel A: Pricing of the Amihud (2002) Measure for NYAM Stocks (1971:07–2009:12)

Explanatory Variables	R^e		R^{e1}		R^{e2}	
	1a	2a	1a	2a	1a	2a
Intercept	2.288**	2.022**	1.143**	1.160**	1.145**	1.316**
	4.28	*4.92*	*4.21*	*5.66*	*3.97*	*6.04*
$\ln(A^0)$	0.154**	0.165**	0.109**	0.130**	0.107**	0.134**
	3.96	*5.34*	*4.51*	*7.09*	*4.27*	*7.02*
BTM		0.256**		0.160*		0.086
		3.12		*2.42*		*1.23*
MOM1		0.857**		0.872**		0.838**
		2.89		*3.49*		*3.02*
MOM2		0.983**		0.954**		0.782**
		3.52		*4.11*		*3.01*
MOM3		1.349**		1.277**		1.130**
		5.60		*6.22*		*4.62*
MOM4		0.200		0.199		0.033
		0.94		*1.05*		*0.14*
Avg R-sqr	0.019	0.046	0.008	0.027	0.008	0.030
Avg Obs	1757.8	1597.6	1755.3	1597.0	1757.8	1597.6

Panel B: Pricing of the Amihud (2002) Measure for NASDAQ Stocks (1983:01–2009:12)

Explanatory Variables	R^e		R^{e1}		R^{e2}	
	1b	2b	1b	2b	1b	2b
Intercept	2.818**	2.254**	1.996**	1.625**	2.236**	1.986**
	5.08	*4.73*	*4.61*	*4.17*	*4.71*	*4.92*
$\ln(A^0)$	0.221**	0.225**	0.198**	0.210**	0.225**	0.238**
	4.80	*5.83*	*5.06*	*6.06*	*5.18*	*6.58*
BTM		0.777**		0.635**		0.609**
		6.12		*6.18*		*5.48*
MOM1		0.645*		0.690**		0.639*
		2.05		*2.73*		*2.12*
MOM2		0.775**		0.668**		0.654*
		2.65		*2.78*		*2.28*
MOM3		0.715**		0.544*		0.482
		2.81		*2.55*		*1.87*
MOM4		0.123		0.091		0.026
		0.53		*0.47*		*0.11*
Avg R-sqr	0.011	0.033	0.008	0.021	0.009	0.025
Avg Obs	2166.1	2004.6	2164.5	2003.3	2166.1	2004.6

This table reports the results of monthly Fama-MacBeth (1973) cross-sectional regressions that include the log-transformed Amihud (2002) measure, $\ln(A^0)$. Panel A contains the result for NYAM-listed stocks from July 1971 to December 2009, while Panel B does the same for NASDAQ-listed stocks from January 1983 to December 2009. The dependent variable is R^e, R^{e1}, or R^{e2}. The definitions of the variables are as follows. R^e: the monthly excess return (in excess of the one-month T-bill rate); R^{e1}: the FF3-adjusted excess return, i.e., the constant term plus the residual from the time-series regression of the excess return on the FF three factors using the *entire* sample range of the data; R^{e2}: the FF3-adjusted excess return using the Fama-French (FF) three factors with factor loadings estimated from the five-year rolling regressions (past monthly returns should be available for at least 24 months); and A^0: the original Amihud (2002) measure defined as the monthly average of daily ratios of absolute return to dollar volume in $1,000. The other variables are defined in Table 1. The values in the first row for each explanatory variable are the coefficient estimates, and the values italicized in the second row of each variable are *t*-statistics computed based on Fama-MacBeth (1973). To survive in the sample, stocks must have five zero-volume days or fewer within a month (for NYAM stocks) or 50 trades or more within a month (on average 2.5 trades or more per day) (for NASDAQ stocks). In addition, for the availability of R^{e2}, stocks must have monthly returns for the past 60 months (at least 24 months). Only common stocks (share code 10 or 11 in CRSP) are used. The sample loses the first two observations in the cross-sectional regressions due to the two-month lagging. The coefficients are all multiplied by 100. *Avg R-sqr* is the average of monthly adjusted R^2. *Avg Obs* is the monthly average number of companies used in the cross-sectional regressions. Significance at the 1% and 5% levels is indicated by ** and *, respectively.

the dependent variable is the FF3-adjusted return, the average adjusted R-squared (*Avg R-sqr*) for both samples is 0.8% without control variables, rising to 2.1%–3.0% when the control variables are included.

As can be seen in Panel A of Table 3 for NYAM stocks, the coefficient of the Amihud (2002) measure, $\ln(A^o)$, is positive and highly significant in all of the regressions, and is little affected by whether or not the return is FF3-adjusted and by whether or not the control variables are included in the regressions. Using the standard deviation of the Amihud measure reported in Table 1, the estimated coefficient implies that a one-standard-deviation change in the log-transformed Amihud measure (in Specification 2a with R^{e1}) will change expected (excess) returns on a security by ($2.74 \times 0.13 =$) 0.36% per month or 4.27% per year. This is puzzlingly high, considering that the average monthly (raw) return reported by Chordia, Huh, and Subrahmanyam (2007) is 1.19% for an average of 1,647 NYAM-listed stocks over the past 40 years. The effect is even stronger for NASDAQ stocks, as shown in Panel B: in the corresponding specification (2b) with R^{e1}, a one-standard-deviation increase in the log-transformed Amihud measure will lead to higher expected (excess) returns of 0.56% per month or 6.75% per year. This magnitude appears high for a liquidity premium. The coefficient of the Amihud measure for NASDAQ stocks in Panel B is approximately 50% higher than the corresponding coefficient for NYAM stocks shown in Panel A. As discussed below, this discrepancy is removed when we employ the turnover version of the measure and treat firm size as a separate variable.

The three past returns (*MOM1-MOM3*) are strongly positively related to current month returns for NYAM stocks; the effect is somewhat weaker for NASDAQ stocks. The book-to-market (BTM) effect for NYAM stocks becomes insignificant when returns are risk-adjusted using rolling estimates of the factor loadings. In contrast, Panel B of Table 3 shows that the BTM effect remains strong for NASDAQ stocks even after the FF3-adjustments.

4.2 Decomposing the Amihud (2002) measure

We decompose the Amihud (2002) measure, $\ln(A^o)$, into its turnover version, $\ln(A)$, and firm size, $\ln(S)$, including them as separate regressors:

$$Y_{jt} = c_0+\phi_1 \ln(A)_{jt-2}+\phi_2 \ln(S)_{jt-2}+\sum_{n=1}^{5} c_n Z_{njt-2}+e_{jt}. \tag{12}$$

The estimates of Equation (12) are reported in Panels A and B of Table 4. The turnover-version Amihud measure, $\ln(A)$, has a highly significant positive effect on returns in both NYAM and NASDAQ samples. Moreover, in contrast to the results in Table 3, where the coefficient of $\ln(A^0)$ was around 50% higher for the NASDAQ sample, now the coefficient is of similar magnitude in the two samples. The coefficients of the size component, ln(S), are negative and statistically significant in every case. However, while the original Amihud (2002) measure constrains the coefficients of ln(A) and ln(S) to be equal and of the opposite sign, we find that for the NYAM sample the absolute value of the coefficient of ln(S) is only 38%–69% of that of ln(A) in Specification 4a, and the hypothesis that the sum of the two coefficients is equal to zero is rejected at the 5% level. In contrast, for the NASDAQ sample, the coefficient of the firm size variable is greater in absolute value than the coefficient of ln(A).

For comparison purposes, Panels C and D of Table 4 report the results of regressions that include the firm size variable along with the original Amihud measure, ln(A^o). For the NYAM sample, the coefficient of ln(S) tends to be significant, but with a positive sign, suggesting that large firms have higher rates of return, ceteris paribus. If we accept the conventional view that the size effect is negative (or zero), this is consistent with the original Amihud measure over-adjusting for the effects of firm size by its use of the dollar volume of trading in the denominator. Similar results are documented by Huh (2012), who reports that when the Amihud (2002) measure (Winsorized) is used as an illiquidity measure in the regressions, the measure is strongly positively related to returns, whereas the size effect is not significant. When one of the price-impact measures [Kyle (1985)-type lambdas] is used as an illiquidity measure in his study, however, the size effect is negative and statistically significant.[15]

The choice between the two Amihud measures is less clear for NASDAQ stocks for which, as shown in Panel D of Table 4, the coefficient of the size variable is insignificant in the presence of ln(A^o). As noted above, it is not possible to identify the size effect and the (il)liquidity effect separately if both firm size and either of the two Amihud measures are included in the same regression. However, if we restrict the sign of any size effect to being negative, then we can conclude from the NYAM results that the pure illiquidity effect is captured better by the turnover version, ln(A).

In our subsequent regressions, we include firm size as a separate variable, and it is open to the reader who wishes to interpret its coefficient as part of the illiquidity effect to do so, although the turnover-based specification of the Amihud measure implies a more reasonable magnitude for the illiquidity effect. The estimates in Tables 1 and 4 (e.g., Specification 4a with R^{e1} in Panel A of Table 4) indicate that a one-standard-deviation change in ln(A) is associated with incremental expected return of about ($1.11 \times 0.23 =$) 0.26% per month or about 3.06% per annum for NYAM stocks. The corresponding NASDAQ calculation in Panel B yields 0.29% per month or 3.52% per annum. In contrast, as we have seen above, a one-standard-deviation change in the original Amihud (2002) measure corresponds to a change in

[15] See Tables 7–10, 12, and 14 in his study.

Table 4
Pricing of the basic components of the Amihud (2002) measure

Panel A: Pricing of the Basic Components of the Amihud (2002) Measure for NYAM Stocks (1971:07–2009:12)

Explanatory Variables	R^e		R^{e1}		R^{e2}	
	3a	4a	3a	4a	3a	4a
Intercept	2.457**	1.674*	0.765	0.374	0.647	0.465
	2.86	*2.40*	*1.88*	*1.22*	*1.51*	*1.39*
ln(A)	0.152**	0.216**	0.166**	0.225**	0.177**	0.236**
	3.14	*5.05*	*4.38*	*6.64*	*4.44*	*6.63*
ln(S)	−0.166**	−0.148**	−0.090**	−0.089**	−0.081**	−0.089**
	−3.13	*−3.50*	*−3.07*	*−4.22*	*−2.66*	*−3.98*
BTM		0.274**		0.182**		0.109
		3.25		*2.71*		*1.53*
MOM1		0.905**		0.922**		0.890**
		3.09		*3.71*		*3.22*
MOM2		0.990**		0.978**		0.812**
		3.64		*4.25*		*3.13*
MOM3		1.351**		1.297**		1.150**
		5.74		*6.35*		*4.71*
MOM4		0.221		0.217		0.053
		1.06		*1.16*		*0.23*
Avg R-sqr	0.024	0.050	0.010	0.029	0.010	0.031
Avg Obs	1757.8	1597.6	1755.3	1597.0	1757.8	1597.6

Panel B: Pricing of the Basic Components of the Amihud (2002) Measure for NASDAQ Stocks (1983:01–2009:12)

Explanatory Variables	R^e		R^{e1}		R^{e2}	
	3b	4b	3b	4b	3b	4b
Intercept	3.387*	2.986*	2.566*	2.140*	2.396*	2.210*
	2.19	*2.40*	*2.24*	*2.33*	*1.97*	*2.24*
ln(A)	0.203*	0.192**	0.173**	0.193**	0.232**	0.244**
	2.33	*2.83*	*3.48*	*4.44*	*4.11*	*5.18*
ln(S)	−0.259**	−0.270**	−0.235**	−0.243**	−0.233**	−0.251**
	−2.64	*−3.49*	*−2.82*	*−3.63*	*−2.61*	*−3.51*
BTM		0.735**		0.606**		0.587**
		5.40		*5.72*		*5.15*
MOM1		0.751*		0.755**		0.709*
		2.54		*3.12*		*2.42*
MOM2		0.797**		0.705**		0.673*
		2.91		*3.09*		*2.43*
MOM3		0.738**		0.569**		0.504*
		3.12		*2.79*		*2.02*
MOM4		0.107		0.089		0.023
		0.49		*0.47*		*0.09*
Avg R-sqr	0.019	0.038	0.012	0.023	0.012	0.028
Avg Obs	2166.1	2004.6	2164.5	2003.3	2166.1	2004.6

Panel C: Pricing of the Amihud (2002) Measure for NYAM Stocks (1971:07–2009:12) [including ln(*S*)]

Explanatory Variables	R^e		R^{e1}		R^{e2}	
	3c	4c	3c	4c	3c	4c
Intercept	2.446**	1.673*	0.757	0.374	0.646	0.469
	2.86	*2.40*	*1.87*	*1.23*	*1.52*	*1.41*
ln(A^0)	0.153**	0.215**	0.166**	0.224**	0.176**	0.235**
	3.17	*5.07*	*4.40*	*6.63*	*4.43*	*6.60*
ln(S)	−0.012	0.068	0.077	0.136**	0.095*	0.146**
	−0.17	*1.09*	*1.75*	*3.52*	*2.06*	*3.54*
BTM		0.274**		0.182**		0.109
		3.24		*2.70*		*1.53*

(continued)

Table 4
Continued

Panel C: Pricing of the Amihud (2002) Measure for NYAM Stocks (1971:07–2009:12) [including ln(S)]

Explanatory Variables	R^e		R^{e1}		R^{e2}	
	3a	4a	3a	4a	3a	4a
MOM1		0.903**		0.920**		0.888**
		3.08		*3.70*		*3.21*
MOM2		0.989**		0.978**		0.811**
		3.63		*4.24*		*3.13*
MOM3		1.351**		1.297**		1.149**
		5.74		*6.35*		*4.71*
MOM4		0.221		0.217		0.053
		1.06		*1.16*		*0.23*
Avg R-sqr	0.024	0.050	0.010	0.029	0.010	0.031
Avg Obs	1757.8	1597.6	1755.3	1597.0	1757.8	1597.6

Panel D: Pricing of the Amihud (2002) Measure for NASDAQ Stocks (1983:01–2009:12) [including ln(S)]

Explanatory Variables	R^e		R^{e1}		R^{e2}	
	3d	4d	3d	4d	3d	4d
Intercept	3.383*	2.982*	2.564*	2.136*	2.397*	2.209*
	2.20	*2.40*	*2.25*	*2.33*	*1.97*	*2.24*
ln(A^0)	0.202*	0.191**	0.172**	0.193**	0.230**	0.243**
	2.34	*2.85*	*3.50*	*4.45*	*4.13*	*5.19*
ln(S)	−0.056	−0.079	−0.063	−0.050	−0.003	−0.008
	−0.35	*−0.64*	*−0.55*	*−0.56*	*−0.03*	*−0.08*
BTM		0.735**		0.606**		0.587**
		5.39		*5.72*		*5.15*
MOM1		0.749*		0.754**		0.708*
		2.53		*3.11*		*2.41*
MOM2		0.798**		0.706**		0.674*
		2.91		*3.09*		*2.43*
MOM3		0.739**		0.569**		0.504*
		3.11		*2.79*		*2.02*
MOM4		0.108		0.090		0.024
		0.50		*0.48*		*0.10*
Avg R-sqr	0.019	0.038	0.012	0.023	0.012	0.028
Avg Obs	2166.1	2004.6	2164.5	2003.3	2166.1	2004.6

Panels A and B report the results of monthly Fama-MacBeth (1973) regressions that include the basic components (log-transformed) of the Amihud (2002) measure, ln(A) and ln(S). Panel A contains the result for NYAM-listed stocks from July 1971 to December 2009, while Panel B does the same for NASDAQ-listed stocks from January 1983 to December 2009. To compare the effect of the turnover-version Amihud measure in Panels A and B with that of the original Amihud (2002) measure, the analogs of the two panels in Table 3 are reported in Panels C and D, which include ln(S). The dependent variable is R^e, R^{e1}, or R^{e2}. The definitions of the variables are as follows. R^e: the monthly excess return (in excess of the one-month T-bill rate); R^{e1} is the FF3-adjusted excess return, i.e., the constant term plus the residual from the time-series regression of the excess return on the FF three factors using the entire sample range of the data; R^{e2} is the FF3-adjusted excess return using the Fama-French (FF) three factors with factor loadings estimated from the five-year rolling regressions (past monthly returns should be available for at least 24 months); and ln(A): the natural logarithm of A, which is the turnover version of the Amihud (2002) measure. The other variables are defined in Table 1. The values in the first row for each explanatory variable are coefficient estimates, and the values italicized in the second row of each variable are t-statistics computed based on Fama-MacBeth (1973). To survive in the sample, stocks must have five zero-volume days or fewer within a month (for NYAM stocks) or 50 trades or more within a month (on average 2.5 trades or more per day) (for NASDAQ stocks). In addition, for the availability of R^{e2}, expected returns of 4.27% per annum for NYAM stocks and as much as 6.75% per annum for NASDAQ stocks!

Our findings for the effect of the Amihud (2002) measure on returns are generally consistent with those of Amihud (2002) and Chordia, Huh, and Subrahmanyam (2009). More recently, however, Ben-Rephael, Kadan, and Wohl (2012, hereafter BKW) provide evidence that the illiquidity premium has declined over time, and that the coefficient of the Amihud (2002) measure in risk premium regressions has become statistically insignificant in recent periods. For comparison, therefore, we estimate cross-sectional regressions by subperiod using monthly estimates of the turnover-version Amihud measure that are constructed in a fashion similar to theirs. Following BKW, we compute the annual average of daily (turnover-scaled) Amihud values for the previous year (y_{t-1}) and, for monthly regressions, convert the annual series into a monthly series by keeping the annual value constant for the 12 months of the current year (y_t). Note that this approach contrasts with our method that estimates the measures month by month by averaging the daily values within each month. We do not use the log-transformed version of the measure, censoring it at the 1st and 99th percentiles in order to preserve comparability with BKW.[16]

The results are reported in Table A2 of the Appendix for different subperiods and using the two different estimators of the Amihud (2002) measure. The results in Panels A and C are obtained using the measure computed by our method (monthly estimation), while those in Panels B and D are obtained using the method followed by BKW (annual estimation). Panel A shows that the turnover-version Amihud measure (A_{win}) is strongly priced over the entire period (1971:07–2009:12) for NYAM stocks. It is interesting to see that, while other effects such as the book-to-market and momentum effects all tend to disappear in subperiod 3, the illiquidity effect still remains significant. When the turnover-version Amihud measure is estimated annually as in BKW (see Panel B), the patterns shown in Panel A continue to obtain. For NASDAQ stocks, the results shown in Panels C and D confirm the significance of the Amihud variable in all three subperiods, although the coefficient becomes much smaller in subperiod 3.[17]

Thus the turnover-version Amihud (2002) measure remains statistically significant even in the recent time period. We note that there are several differences between BKW and our study. First, they adjust the Amihud measure for inflation, while we do not.[18] BKW use the original dollar-volume version of the measure rather than the turnover version that we employ.

16 Note that our procedure of taking natural logarithms in the main analysis of the paper mitigates the need to censor extreme observations.

17 Similar results are obtained with the log-transformed (turnover-based) measure and with the dollar volume-based measure.

18 By using the turnover-version Amihud measure, we eliminate the need to adjust for inflation.

They use raw returns as the dependent variable for regressions, but we use excess (and FF3-adjusted) returns. BKW exclude low-priced stocks from their sample, whereas we do not. We also use a trading activity threshold for our sample, given that we need adequate data to reliably compute order imbalances.[19] Analyses reveal that a pertinent driver of the differences between our results and those of BKW is their exclusion of low-priced stocks. However, unreported analyses show that our principal result of differential pricing of the up and down Amihud components is not sensitive to the price filter. Our stronger result is consistent with Chordia, Huh, and Subrahmanyam (2009), who employ a square-root transformation to the Amihud measure (see Table 9 in their study). Huh (2012) also documents stronger results for the Amihud (2002) measure when it is Winsorized (see Tables 12 and 14 in his study).

In order to distinguish between the effects of (il)liquidity on down days and on up days, $\ln(A)$ in Equation (12) is now replaced by the two half-Amihud measures, $\ln(A^{+})$ and $\ln(A^{-})$:

$$Y_{jt} = c_0 + \phi_1 \ln(A^{+})_{jt-2} + \phi_2 \ln(A^{-})_{jt-2} + \phi_3 \ln(S)_{jt-2} + \sum_{n=1}^{5} c_n Z_{njt-2} + e_{jt}. \quad (13)$$

The parameter estimates reported in Table 5 are striking. For NYAM stocks in Panel A, the coefficient of the half-Amihud for up days, $\ln(A^{+})$, is nowhere significant, while that for down days, $\ln(A^{-})$, is highly significant in all specifications. The point estimate of ϕ_1 is small (0.01 to 0.06), while that of ϕ_2 ranges from 0.16 to 0.26. A value for ϕ_2 of 0.26 implies that an increase of one standard deviation in $\ln(A^{-})$ is associated with 0.30% higher monthly (excess) returns. The t-statistics for the difference between the estimates of ϕ_2 and ϕ_1 in the two FF3-adjusted specifications with control variables are greater than 2.80, and when the dependent variable is R^{e2}, the estimate of ϕ_2 is larger than that of ϕ_1 by a factor of 7. Thus there is strong evidence that the asymmetry between the effects of buy-liquidity and sell-liquidity on expected returns reported by Brennan et al. (2010) is mirrored in an asymmetry between the effects of liquidity on up and down days on expected returns. The absolute value of the coefficient of $\ln(S)$, which continues to be highly significant, is now only about one third that of $\ln(A^{-})$ in the specifications using the FF3-adjusted returns.

Panel B of Table 5 shows that for the NASDAQ sample the coefficient of the half-Amihud for up days, $\ln(A^{+})$, is nowhere significant, while that for down days, $\ln(A^{-})$, is highly significant in the specifications that use the FF3-adjusted returns. The estimated coefficient of $\ln(S)$ continues to be larger in absolute value than the coefficient of $\ln(A^{-})$.

[19] For more details about our sample filtering, see Section 2.

Table 5
Pricing of the half-Amihud measures

Panel A: Pricing of the Half-Amihud Measures for NYAM Stocks (1971:07–2009:12)

Explanatory Variables	R^e		R^{e1}		R^{e2}	
	5a	6a	5a	6a	5a	6a
Intercept	2.413**	1.640**	0.742	0.372	0.629	0.460
	2.89	*2.46*	*1.83*	*1.25*	*1.48*	*1.41*
ln(A⁺)	0.048	0.066	0.033	0.063	0.009	0.036
	0.85	*1.28*	*0.72*	*1.45*	*0.18*	*0.70*
ln(A⁻)	0.160**	0.210**	0.184**	0.217**	0.219**	0.258**
	3.42	*4.95*	*4.44*	*5.55*	*4.37*	*5.41*
ln(S)	−0.161**	−0.141**	−0.084**	−0.082**	−0.075*	−0.081**
	−3.08	*−3.38*	*−2.88*	*−3.89*	*−2.46*	*−3.61*
BTM		0.273**		0.182**		0.107
		3.22		*2.67*		*1.48*
MOM1		0.885**		0.910**		0.868**
		3.06		*3.69*		*3.15*
MOM2		0.986**		0.978**		0.814**
		3.70		*4.32*		*3.20*
MOM3		1.296**		1.248**		1.099**
		5.58		*6.14*		*4.49*
MOM4		0.181		0.186		0.013
		0.88		*1.01*		*0.06*
Avg R-sqr	0.025	0.051	0.011	0.029	0.012	0.033
Avg Obs	1752.1	1592.5	1749.6	1591.9	1752.1	1592.5

Panel B: Pricing of the Half-Amihud Measures for NASDAQ Stocks (1983:01–2009:12)

Explanatory Variables	R^e		R^{e1}		R^{e2}	
	5b	6b	5b	6b	5b	6b
Intercept	3.777**	3.330**	2.865**	2.465**	2.700*	2.505**
	2.59	*2.82*	*2.62*	*2.79*	*2.31*	*2.65*
ln(A⁺)	0.091	0.065	0.045	0.043	0.050	0.041
	1.44	*1.31*	*1.00*	*1.06*	*1.03*	*0.95*
ln(A⁻)	0.061	0.085	0.087*	0.113**	0.134**	0.161**
	1.04	*1.69*	*2.27*	*3.02*	*2.83*	*3.59*
ln(S)	−0.271**	−0.281**	−0.244**	−0.251**	−0.238**	−0.255**
	−2.83	*−3.71*	*−2.98*	*−3.84*	*−2.72*	*−3.65*
BTM		0.734**		0.598**		0.595**
		5.35		*5.67*		*5.19*
MOM1		0.783**		0.773**		0.723*
		2.66		*3.21*		*2.47*
MOM2		0.830**		0.734**		0.708*
		3.04		*3.23*		*2.56*
MOM3		0.750**		0.551**		0.529*
		3.16		*2.70*		*2.11*
MOM4		0.095		0.091		0.022
		0.44		*0.48*		*0.09*
Avg R-sqr	0.019	0.038	0.012	0.023	0.013	0.028
Avg Obs	2156.8	1996.0	2155.2	1994.7	2156.8	1996.0

This table reports the results of monthly Fama-MacBeth (1973) cross-sectional regressions that include the two (log-transformed) half-Amihud measures, ln(A^+) and ln(A^-), as well as the logarithm of firm size, ln(S). Panel A contains the result for NYAM-listed from July 1971 to December 2009, while Panel B does the same for NASDAQ-listed stocks from January 1983 to December 2009. The dependent variable is R^e, R^{e1}, or R^{e2}.

(continued)

In Table 5, the half-Amihud measures (for up and down days) of a stock are computed using the stock's own returns to distinguish between up and down days. However, investors may be more concerned about selling when the whole market is going down and the values of their entire diversified portfolios are declining. To consider this possibility, we construct the half-Amihud measures using market movements to define up and down days. The new half-Amihud measure for up (down) days is defined as the average of daily $|r|/T$ over the up-market (down-market) days [days with positive (negative) CRSP value-weighted returns] within a month. It is denoted by $A^{+,\,m}$ ($A^{-,\,m}$).

The new regression results corresponding to Equation (13) are reported in Table 6. In both panels the coefficients of $\ln(A^{+,\,m})$ and $\ln(A^{-,\,m})$ are generally smaller and less significant than those on the two corresponding half-Amihud measures in Table 5. However, constructing the half-Amihud measures on the basis of market returns does not alter the basic pattern observed in Table 5. The coefficient of the half-Amihud measure for up days, $\ln(A^{+,\,m})$, is not statistically significant, while that for down days, $\ln(A^{-,\,m})$, is generally significant.

We have seen in Tables 5 and 6 that for the whole sample it is only the half-Amihud for down days, $\ln(A^{-})$, that commands a return premium. To determine whether the effect is consistent across firm size groups, we allocate firms each month to one of three size groups according to the market value at the end of the previous month, estimating the relation between the FF3-adjusted returns and the measures of illiquidity for each group separately. To save space, we report results only for regressions that include the control variables and use R^{e2} as the dependent variable. As can be seen in Panel A of Table A3 in the Appendix, for NYAM stocks, the differential pricing effects between $\ln(A^{+})$ and $\ln(A^{-})$ exist in all three size groups. The coefficient of $\ln(A^{-})$ is positive and highly significant for each group while the coefficient of $\ln(A^{+})$ is insignificant for small- and medium-size firms, becoming negative and significant for the group of large firms (*MV3*). Panel B shows

The definitions of the variables are as follows. R^{e}: the monthly excess return (in excess of the one-month T-bill rate); R^{e1}: the FF3-adjusted excess return, i.e., the constant term plus the residual from the time-series regression of the excess return on the FF three factors using the entire sample range of the data; R^{e2}: the FF3-adjusted excess return using the Fama-French (FF) three factors with factor loadings estimated from the five-year rolling regressions (past monthly returns must be available for at least 24 months); A^{+} (A^{-}): the half-Amihud measure for up (down) days, which is the monthly average of daily ratios of absolute returns to turnover on positive (negative) return days. The other variables are defined in Table 1. The values in the first row for each explanatory variable are estimated coefficients, and the values italicized in the second row of each variable are *t*-statistics computed based on Fama-MacBeth (1973). To survive in the sample, stocks must have five zero-volume days or fewer within a month (for NYAM stocks) or 50 trades or more within a month (on average 2.5 trades or more per day) (for NASDAQ stocks). In addition, for the availability of R^{e2}, stocks must have monthly returns for the past 60 months (at least 24 months). Only common stocks (share code 10 or 11 in CRSP) are used. The sample loses the first two observations in the cross-sectional regressions due to the two-month lagging. The coefficients are all multiplied by 100. *Avg R-sqr* is the average of monthly adjusted R^{2}. *Avg Obs* is the monthly average number of companies used in the cross-sectional regressions. Significance at the 1% and 5% levels is indicated by ** and *, respectively.

Table 6
Pricing of the half-Amihud measures based on market movements

Panel A: Pricing of the Half-Amihud Measures (Based on the Market Movements) for NYAM Stocks (1971:07–2009:12)

Explanatory Variables	R^e		R^{e1}		R^{e2}	
	5c	6c	5c	6c	5c	6c
Intercept	2.665**	1.797*	0.936*	0.456	0.848*	0.585
	3.10	*2.56*	*2.29*	*1.47*	*1.96*	*1.73*
$\ln(A^{+,m})$	0.019	0.063	0.029	0.069	0.018	0.060
	0.38	*1.41*	*0.68*	*1.72*	*0.40*	*1.40*
$\ln(A^{-,m})$	0.105*	0.129**	0.108**	0.133**	0.127**	0.150**
	2.50	*3.28*	*2.80*	*3.54*	*3.02*	*3.75*
ln(S)	−0.174**	−0.150**	−0.097**	−0.090**	−0.089**	−0.091**
	−3.27	*−3.52*	*−3.28*	*−4.20*	*−2.90*	*−4.03*
BTM		0.274**		0.180**		0.107
		3.25		*2.68*		*1.50*
MOM1		0.887**		0.918**		0.889**
		3.01		*3.65*		*3.19*
MOM2		0.973**		0.970**		0.804**
		3.54		*4.18*		*3.10*
MOM3		1.307**		1.241**		1.064**
		5.56		*6.11*		*4.42*
MOM4		0.215		0.212		0.046
		1.02		*1.11*		*0.20*
Avg R-sqr	0.024	0.050	0.010	0.029	0.010	0.031
Avg Obs	1737.1	1580.6	1735.0	1580.2	1737.1	1580.6

Panel B: Pricing of the Half-Amihud Measures (Based on the Market Movements) for NASDAQ Stocks (1983:01–2009:12)

Explanatory Variables	R^e		R^{e1}		R^{e2}	
	5d	6d	5d	6d	5d	6d
Intercept	3.403*	2.940*	2.682*	2.278*	2.474*	2.227*
	2.20	*2.36*	*2.35*	*2.49*	*2.02*	*2.26*
$\ln(A^{+,m})$	0.088	0.045	0.056	0.046	0.087	0.064
	1.40	*0.84*	*1.36*	*1.15*	*1.85*	*1.50*
$\ln(A^{-,m})$	0.070	0.106**	0.068	0.106**	0.097*	0.139**
	1.44	*2.61*	*1.84*	*3.13*	*2.31*	*3.75*
ln(S)	−0.249*	−0.255**	−0.231**	−0.238**	−0.226*	−0.239**
	−2.53	*−3.32*	*−2.77*	*−3.59*	*−2.51*	*−3.37*
BTM		0.689**		0.546**		0.543**
		5.04		*5.18*		*4.78*
MOM1		0.714*		0.678**		0.659*
		2.38		*2.78*		*2.25*
MOM2		0.836**		0.700**		0.707*
		2.99		*2.99*		*2.52*
MOM3		0.640**		0.466*		0.453
		2.68		*2.32*		*1.81*
MOM4		0.059		0.040		−0.023
		0.27		*0.21*		*−0.09*
Avg R-sqr	0.019	0.037	0.012	0.023	0.013	0.028
Avg Obs	2114.5	1961.1	2113.3	1960.0	2114.5	1961.1

This table reports the results of monthly Fama-MacBeth (1973) cross-sectional regressions that include the two (log-transformed) half-Amihud measures, $\ln(A^{+,m})$ and $\ln(A^{-,m})$, which use market returns to define up and down days, as well as the logarithm of firm size, ln(S). Panel A contains the result for NYAM-listed stocks from

(continued)

that for NASDAQ stocks the coefficient of the half-Amihud for down days, ln(A^-), is positive and highly significant for the small-size group (*MV1*), while the coefficient of ln(A^+) is insignificant. On the other hand, there is no significant evidence that either half-Amihud measure is priced for the groups of medium- and large-size firms. We note, however, that the point estimate of the coefficient of ln(A^-) for large firms (0.136) is close to the corresponding estimate for the whole sample reported in Panel B of Table 5 (0.161).

4.3 Further analysis using signed turnover

The asymmetry between the roles of the half-Amihud measures for up and down days is broadly consistent with the finding by Brennan et al. (2010) that investors price the association between price changes (or returns) and seller-initiated trades. We have found that they price the association between negative returns (returns on down days) and trading volume. Since seller-initiated trades are associated with negative returns, it is natural to consider whether it is the association between negative returns and seller-initiated trading volume that gives rise to the pricing of the half-Amihud measure for down days.

To assess the importance of the relation between seller-initiated trades and the returns on down days, we classify intradaily transactions into buyer-initiated trades or seller-initiated trades using the ISSM/TAQ databases, aggregating them into daily signed volume and turnover (i.e., buyer-initiated turnover, T_B, and seller-initiated turnover, T_S, separately). This allows us to obtain the two directional half-Amihud measures, as well as the two sidedness variables defined in Equation (7). Because of data availability, however, we limit this type of decomposition to NYAM-listed stocks over the period starting from January 1983. For consistency in sampling with the previous analyses, we ensure that stocks have at least 50 trades per month (on average

July 1971 to December 2009, while Panel B does the same for NASDAQ-listed stocks from January 1983 to December 2009. The dependent variable is R^e, R^{e1}, or R^{e2}. The definitions of the variables are as follows. R^e: the monthly excess return (in excess of the one-month T-bill rate); R^{e1}: the FF3-adjusted excess return, i.e., the constant term plus the residual from the time-series regression of the excess return on the FF three factors using the entire sample range of the data; R^{e2}: the FF3-adjusted excess return using the Fama-French (FF) three factors with factor loadings estimated from the five-year rolling regressions (past monthly returns must be available for at least 24 months); $A^{+,\,m}$ ($A^{-,\,m}$): the half-Amihud measure for up (down) days, computed by the average of daily $|r|/T$ over the up-market (down-market) days [days with positive (negative) CRSP value-weighted returns] within a month, where r is daily stock return and T is daily share turnover obtained from CRSP. The other variables are defined in Table 1. The values in the first row for each explanatory variable are estimated coefficients, and the values italicized in the second row of each variable are t-statistics computed based on Fama-MacBeth (1973). To survive in the sample, stocks must have five zero-volume days or fewer within a month (for NYAM stocks) or 50 trades or more within a month (on average 2.5 trades or more per day) (for NASDAQ stocks). In addition, for the availability of R^{e2}, stocks must have monthly returns for the past 60 months (at least 24 months). Only common stocks (share code 10 or 11 in CRSP) are used. The sample loses the first two observations in the cross-sectional regressions due to the two-month lagging. The coefficients are all multiplied by 100. *Avg R-sqr* is the average of monthly adjusted R^2. *Avg Obs* is the monthly average number of companies used in the cross-sectional regressions. Significance at the 1% and 5% levels is indicated by ** and *, respectively.

2.5 trades per day) when processing the ISSM/TAQ data. We then estimate the following equation:

$$Y_{jt} = c_0+\varphi_1 \ln(A_1^+)_{jt-2}+\varphi_2 \ln(A_2^+)_{jt-2}+\varphi_3 \ln(A_1^-)_{jt-2}+\varphi_4 \ln(A_2^-)_{jt-2}+ \varphi_5 \ln(S)_{jt-2}+\sum_{n=1}^{5} c_n Z_{njt-2}+e_{jt}. \tag{14}$$

The parameter estimates are reported in Table 7. As we discussed earlier, to allay concerns about higher classification errors when the Lee and Ready (1991) algorithm is applied to data in the high-frequency-trading era, we also report results that exclude the last four years of the sample (2006–2009) in Table 7 and the two subsequent tables that utilize signed orders.

As can be seen in Panel A of Table 7, the average number of component stocks used in the cross-sectional regressions increases substantially (9%–28%), compared to the previous tables for NYAM-listed stocks (e.g., Panel A in Table 5), because the ISSM database starts more recently, in 1983. Consistent with the results for the half-Amihud measures reported in Table 5, the coefficients of the directional half-Amihud for up days, $\ln(A_1^+)$, are not statistically significant and their point estimates are in the range of 0.03–0.06. When the control variables are included in the regressions (Specification 8), the up-sidedness variable, $\ln(A_2^+)$, does not have any significant impact either, although the point estimates seem large.

In contrast to the case for up days, the coefficients of the directional half-Amihud for down days, $\ln(A_1^-)$, are significant at the 1% level, which is again consistent with the results in Table 5. Thus, as we expect from the above discussion, the relation between negative returns (down-day returns) and seller-initiated turnover is reflected in average returns: the greater the magnitude of the negative return for a given level of seller-initiated turnover, the higher the return premium. This is consistent with Brennan et al. (2010) in that the directional half-Amihud for down days is closely related to the sell side "lambda" calculated using the order flow and price changes.[20]

We find that the coefficients of the down-sidedness variable, $\ln(A_2^-)$, are also significant when the dependent variable is FF3-adjusted (R^{e1} or R^{e2}). This indicates that the significant role of the half-Amihud measure for down days cannot be attributed entirely to the directional half-Amihud component. Indeed, the coefficients of the down-sidedness component are two to three times greater than those of the directional half-Amihud for down days when the dependent variable is FF3-adjusted, although a standard t-test is unable to reject at the 5% level the equality of the coefficients of the two variables that is implied by the Amihud (2002) formulation. The point estimates imply

[20] The Kyle "lambda" is based on the relation between the price change and the order flow of each trade, whereas the directional half-Amihuds depend on the relation between the price change and the daily aggregated order flow.

Table 7
Pricing of the two directional half-Amihud measures and the sidedness components

Pricing of the Two Directional Half-Amihud Measures and the Sidedness Components

Explanatory Variables	Panel A: With the Whole Sample (1983–2009)					
	R^e		R^{e1}		R^{e2}	
	7	8	7	8	7	8
Intercept	2.125**	1.907**	1.480**	1.262**	1.514**	1.609**
	3.44	*2.87*	*3.85*	*3.53*	*3.83*	*4.27*
$\ln(A_1^+)$	0.029	0.064	0.052	0.053	0.037	0.028
	0.50	*1.09*	*1.20*	*1.10*	*0.77*	*0.51*
$\ln(A_2^+)$	0.250	0.277	0.352*	0.307	0.404*	0.303
	1.10	*1.35*	*1.97*	*1.59*	*2.09*	*1.44*
$\ln(A_1^-)$	0.159**	0.131**	0.120**	0.151**	0.132**	0.168**
	2.57	*2.72*	*2.77*	*3.57*	*2.79*	*3.33*
$\ln(A_2^-)$	0.259	0.331*	0.307*	0.386*	0.428**	0.475**
	1.39	*1.96*	*2.21*	*2.47*	*2.83*	*2.88*
ln(S)	−0.120**	−0.124**	−0.112**	−0.115**	−0.105**	−0.123**
	−2.85	*−3.04*	*−3.95*	*−4.92*	*−3.62*	*−4.95*
BTM		0.244*		0.156		0.060
		2.36		*1.87*		*0.66*
MOM1		0.668		0.710*		0.743*
		1.89		*2.34*		*2.29*
MOM2		1.001**		0.988**		0.821**
		3.16		*3.60*		*2.71*
MOM3		1.047**		0.931**		0.750**
		3.51		*3.83*		*2.81*
MOM4		−0.022		−0.045		−0.087
		−0.09		*−0.20*		*−0.33*
Avg R-sqr	0.020	0.049	0.012	0.032	0.012	0.035
Avg Obs	2244.3	1742.4	2244.3	1742.4	2244.3	1742.4

Pricing of the Two Directional Half-Amihud Measures and the Sidedness Components

Explanatory Variables	Panel B: With the Sample up to 2005 Only, Excluding High-Frequency-Trading Years (2006–2009)					
	R^e		R^{e1}		R^{e2}	
	9	10	9	10	9	10
Intercept	2.122**	2.032**	1.449**	1.287**	1.461**	1.642**
	3.17	*2.80*	*3.79*	*3.39*	*3.74*	*4.08*
$\ln(A_1^+)$	0.070	0.072	0.066	0.067	0.044	0.041
	1.30	*1.44*	*1.59*	*1.56*	*0.97*	*0.85*
$\ln(A_2^+)$	0.355	0.222	0.316	0.250	0.334	0.211
	1.80	*1.19*	*1.82*	*1.39*	*1.73*	*1.06*
$\ln(A_1^-)$	0.118	0.122**	0.104*	0.138**	0.113*	0.145**
	1.94	*2.83*	*2.38*	*3.57*	*2.51*	*3.46*
$\ln(A_2^-)$	0.307*	0.330*	0.425**	0.399**	0.530**	0.488**
	1.96	*2.24*	*3.41*	*2.84*	*3.88*	*3.21*
ln(S)	−0.104*	−0.126**	−0.107**	−0.119**	−0.098**	−0.127**
	−2.28	*−2.74*	*−3.55*	*−4.63*	*−3.20*	*−4.62*
BTM		0.387**		0.261**		0.166
		3.76		*3.03*		*1.83*
MOM1		0.778*		0.882**		0.958**
		2.18		*2.86*		*2.88*
MOM2		1.302**		1.240**		1.099**
		4.09		*4.34*		*3.46*

(continued)

Table 7
Continued

Pricing of the Two Directional Half-Amihud Measures and the Sidedness Components

	Panel B: With the Sample up to 2005 Only, Excluding High-Frequency-Trading Years (2006–2009)					
Explanatory Variables	R^e		R^{e1}		R^{e2}	
	7	8	7	8	7	8
MOM3		1.260**		1.106**		0.929**
		4.14		*4.40*		*3.45*
MOM4		0.203		0.172		0.081
		0.78		*0.73*		*0.29*
Avg R-sqr	0.019	0.047	0.011	0.030	0.011	0.033
Avg Obs	2145.0	1697.2	2145.0	1697.2	2145.0	1697.2

This table reports the results of monthly Fama-MacBeth (1973) cross-sectional regressions that include the two directional half-Amihud measures, $\ln(A_1^+)$ and $\ln(A_1^-)$, and the other three components, $\ln(A_2^+)$, $\ln(A_2^-)$, and $\ln(S)$, for NYAM stocks. Panel A uses the data for the whole sample period (January 1983 to December 2009), while Panel B uses the data up to 2005 only [excluding high-frequency-trading years (2006–2009)]. The dependent variable is R^e, R^{e1}, or R^{e2}. A_1^+ (A_1^-,) is the directional half-Amihud measure for up (down) days, which is the monthly average of daily ratios of absolute returns to buyer-initiated (seller-initiated) volume on up (down) days. A_2^+ (A_2^-) is the up-sidedness (down-sidedness) component, which is the monthly average of daily ratios of buyer initiated (sell-initiated) turnover to total turnover on up (down) based on ISSM/TAQ. S is the monthly average of daily market values in \$1,000. The other variables are defined in previous tables. To survive in the sample, stocks must have at least 50 trades per month (on average 2.5 trades per day) in ISSM/TAQ. The values in the first row for each explanatory variable are the estimated coefficients, and the values italicized in the second row of each variable are *t*-statistics computed based on Fama-MacBeth (1973). The sample loses the first two observations in the cross-sectional regressions due to the two-month lagging. The coefficients are all multiplied by 100. *Avg R-sqr* is the average of monthly adjusted R^2. *Avg Obs* is the monthly average number of companies used in the cross-sectional regressions. Significance at the 1% and 5% levels is indicated by ** and *, respectively.

that a tendency for trades to cluster on the sell-side on down days is also a key determinant of returns. As Sarkar and Schwartz (2009) point out, such one-sided clustering of trades is indicative of trading motivated by asymmetric information (see also Easley and O'Hara 1992). It is noteworthy that the estimates of the coefficient of the variable that measures clustering on the buy-side on up days are similar in size to the corresponding coefficient estimates for down days, though the up-sidedness coefficients are generally not significant.

Excluding the last four high-frequency-trading years (2006–2009) from the sample, we find in Panel B of Table 7 that the results on our illiquidity measure and its decompositions are qualitatively similar to those observed in Panel A. However, after deleting recent years' data from the sample, the book-to-market and momentum effects are much stronger in Panel B than in Panel A.

In addition to the decompositions and analyses presented above, we have also attempted to decompose the two half-Amihud measures into the half-Kyle measures and their residuals, as shown in Equations (8) and (9). The half-Kyle measures divide the absolute return for up (down) days by the net buyer-initiated (seller-initiated) turnover, in contrast to the directional half-Amihud measures, which use the gross buyer-initiated (seller-initiated) turnover. Unfortunately, the logarithmic decomposition is infeasible because there are too many days on which the sign of the net order flow is opposite to that of the price change, causing the ratio to be negative.

Two results thus far are noteworthy. First, only the component of the Amihud measure of illiquidity that pertains to down days is important to asset pricing. Second, the two subcomponents of this half-Amihud measure, which correspond to price sensitivity to seller-initiated turnover and the tendency of sell-orders to cluster on down days, both contribute significantly to the explanatory power of the half-Amihud measure.

5. Robustness Tests

5.1 TAQ period (1993–2009) sample

To confirm that our results are not due to problems associated with the ISSM database,[21] the tests are repeated after restricting the sample to the TAQ period (17 years: 1993–2009). Excluding the 10-year non-TAQ period (1983–1992) also allows us to verify that the results are robust to the changes that have taken place in financial markets since then.

Table 8 reports the results from monthly Fama-MacBeth regressions in which the dependent variable is R^{e1}, the FF3-adjusted excess return using factor loadings estimated from the whole sample. For brevity, we do not report the results with R^{e2}, but the patterns are virtually the same. To facilitate comparisons with the results reported in the previous sections, the specifications are labeled as 2e (2f), 4e (4f), 6e (6f), and 8e (10f), which correspond to Specifications 2a, 4a, 6a, and 8 (10), respectively, in the previous tables that use the whole sample (or the sample up to 2005). Panel A shows the results with the Amihud (2002) measure, $\ln(A^0)$, and its components that do not involve signing trades, $\ln(A)$, $\ln(A^+)$, $\ln(A^-)$, and $\ln(S)$. From this point on, the turnover ratio [to be used for computing $\ln(A)$, $\ln(A^+)$, and $\ln(A^-)$] is calculated using the transaction-level data (not the CRSP file) for robustness tests and comparison purposes; that is, T^* is used instead of T in Panel A, as Panel B uses TAQ-based turnover. Panel B reports the results for the components that depend on signed volume computed using the TAQ database, $\ln(A_1^+)$, $\ln(A_2^+)$, $\ln(A_1^-)$, and $\ln(A_2^-)$. As we see in the specifications using the whole sample (1993–2009), exclusion of the first 10 years (the ISSM period) increases the average number of stocks in the cross-sectional regressions from around 1,740 (in Table 7) to almost 1,950.

In the first three specifications (2e, 4e, and 6e) of Panel A, we find that the size effect remains significant but that the book-to-market and momentum effects disappear or become much weaker [note that this is similar to the result

[21] In the early years of ISSM the data were entered by hand, which could have caused errors. Also some condition codes of TAQ trade types are not exactly the same as those of ISSM.

Table 8
With the sample from the TAQ-period (1993–2009) only

With the Sample from the TAQ-Period Only (Dep. Var. = R^{e1})

	Panel A: With CRSP-based Components						Panel B: With TAQ-based Components		
Explana. Variables	1993–2009			1993–2005			Explana. Variables	1993–2009	1993–2005
	2e	4e	6e	2f	4f	6f		8e	10f
Intercept	1.172**	0.744	0.633	1.315**	0.789	0.581	Intercept	0.920*	1.277*
	3.49	*1.83*	*1.42*	*3.79*	*1.67*	*1.16*		*2.05*	*2.31*
ln(A^0)	0.114**			0.132**			ln(A_1^+)	−0.001	−0.015
	4.32			*4.66*				*−0.01*	*−0.23*
ln(A)		0.169**			0.198**		ln(A_2^+)	−0.009	0.127
		4.08			*4.67*			*−0.03*	*0.45*
ln(A^+)			−0.027			0.001	ln(A_1^-)	0.199**	0.203**
			−0.34			*0.02*		*3.36*	*3.33*
ln(A^-)			0.238**			0.261**	ln(A_2^-)	0.428	0.609**
			3.05			*4.03*		*1.95*	*2.85*
ln(S)		−0.091**	−0.078**		−0.104**	−0.082*	ln(S)	−0.092**	−0.094**
		−3.26	*−2.58*		*−3.22*	*−2.41*		*−3.21*	*−2.57*
BTM	0.127	0.134	0.140	0.308**	0.316**	0.318**	BTM	0.120	0.209
	1.19	*1.26*	*1.32*	*2.71*	*2.75*	*2.79*		*1.14*	*1.75*
MOM1	0.516	0.529	0.555	0.769	0.779	0.813	MOM1	0.512	0.712
	1.27	*1.30*	*1.37*	*1.79*	*1.81*	*1.89*		*1.26*	*1.53*
MOM2	0.621	0.625	0.610	0.896*	0.905*	0.902*	MOM2	0.613	0.684
	1.78	*1.80*	*1.77*	*2.36*	*2.40*	*2.41*		*1.77*	*1.66*
MOM3	0.972**	0.984**	0.975**	1.243**	1.259**	1.260**	MOM3	0.935**	1.038**
	3.26	*3.32*	*3.31*	*4.05*	*4.12*	*4.20*		*3.19*	*3.09*
MOM4	−0.481	−0.472	−0.478	−0.225	−0.222	−0.220	MOM4	−0.477	−0.263
	−1.84	*−1.80*	*−1.85*	*−0.80*	*−0.78*	*−0.78*		*−1.86*	*−0.71*
Avg R-sqr	0.028	0.029	0.030	0.025	0.026	0.027	Avg R-sqr	0.031	0.031
Avg Obs	1948.5	1948.5	1948.1	1938.0	1938.0	1937.6	Avg Obs	1944.9	1933.3

This table reports the results of monthly Fama-MacBeth (1973)-type cross-sectional regressions for NYAM stocks over the TAQ-period: 1993–2009. Panel A contains the results using the Amihud (2002) measure, ln(A^0), and its CRSP-based components, ln(A), ln(A^+), and ln(A^-), while Panel B does the same using the TAQ-based components, ln(A_1^+), ln(A_2^+), ln(A_1^-), and ln(A_2^-). Each panel also reports the results using the data up to 2005 only [excluding high-frequency-trading years (2006–2009)]. For robustness tests and comparison purposes, TAQ-based turnover (T^*) is used in both panels (where applicable). The dependent variable is R^{e1}, which is the FF3-adjusted excess return, i.e., the constant term plus the residual from the time-series regression of the excess return on the FF three factors using the *entire* sample range of the data. The other variables are defined in previous tables. The values in the first row for each explanatory variable are estimated coefficients, and the values italicized in the second row of each variable are t-statistics computed based on Fama-MacBeth (1973). To survive in the sample, stocks must have five zero-volume days or fewer within a month in CRSP, or 50 trades or more within a month (on average 2.5 trades or more per day) in TAQ. The sample loses the first two observations in the cross-sectional regressions due to the two-month lagging. The coefficients are all multiplied by 100. *Avg R-sqr* is the average of monthly adjusted R^2. *Avg Obs* is the monthly average number of companies used in the cross-sectional regressions. Significance at the 1% and 5% levels is indicated by ** and *, respectively.

of subperiod 3 (1996:01–2009:12) reported in Panel A of Table A2]. However, the basic patterns observed in the previous sections obtain. As we see in Specification 2e, the original Amihud (2002) measure, ln(A^0), is priced significantly for the 1993–2009 period. When the Amihud (2002) measure is decomposed into its turnover version and size components (Specification 4e), the turnover-version Amihud, ln(A), again plays a strong role, with its coefficient being substantially larger than that of the original measure, ln(A^0). When the turnover-version measure is decomposed into the two half-Amihud measures in Specification 6e, only the coefficient of ln(A^-), the half-Amihud for down days, is statistically significant, consistent with our earlier results. When we exclude the four high-frequency-trading years (see Specifications 2f, 4f, and 6f), the effects of the Amihud measure and its components on returns are similar. However, the book-to-market and momentum effects become much stronger.

The two specifications (8e and 10f) in Panel B of Table 8 show that when each of the two half-Amihuds is decomposed into the directional half-Amihud and sidedness components, the coefficient of the directional half-Amihud for down days, $\ln(A_1^-)$, is statistically significant, but that for up days, $\ln(A_1^+)$, is not. This is also consistent with the results shown in the previous tables. Now there is no evidence that up-sidedness, $\ln(A_2^+)$, is priced, but the coefficient on down-sidedness, $\ln(A_2^-)$, tends to be significant as in Table 7. We continue to observe the size effect in Panel B, but the other effects mostly fade away.

5.2 Corrections for microstructure biases: WLS regressions

Asparouhova, Bessembinder, and Kalcheva (2010) suggest the use of weighted least-squares (WLS) estimation to reduce biases caused by the bid-ask bounce or temporary price pressures due to order imbalances. Therefore, we perform WLS regressions using one plus the previous month return as a weighting variable. The Fama-MacBeth regression results with WLS estimation are presented in Table 9. To save space, only the results with R^{e2} as the dependent variable are reported. Specifications 2 g (2 h), 4 g (4 h), 6 g (6 h), and 8 g (10 h) correspond to Specifications 2a, 4a, 6a, and 8 (10) in the previous tables that use the whole sample (or the sample up to 2005). The turnover ratio [used for computing $\ln(A)$, $\ln(A^+)$, and $\ln(A^-)$] in Panel A is again calculated using the ISSM/TAQ databases as in Panel B.

Both panels again confirm our earlier results. The original Amihud (2002) measure (in Specifications 2 g and 2 h of Panel A in Table 9) as well as its turnover version (in Specifications 4 g and 4 h) is priced in the cross-section of stock returns. Specifications 6 g and 6 h also show that only the half-Amihud measure for down days, $\ln(A^-)$, is significantly positively related to returns. When the half-Amihud measures are further decomposed into the ISSM/TAQ-based components in Panel B, the directional half-Amihud for down days, $\ln(A_1^-)$, is priced, but that for up days, $\ln(A_1^+)$, is not. In addition, there is a significant pricing effect associated with the down-sidedness component, $\ln(A_2^-)$. As one would expect, by eliminating the four recent years from the sample, the size, book-to-market, and momentum effects all remain strong even with the WLS correction (see Specification 10 h).

Table 9
WLS regressions to correct for microstructure biases

WLS Regressions (Dep. Var. = R^{e2})

	Panel A: With CRSP-based Components						Panel B: With ISSM/TAQ-based Components		
Explana. Variables	1993–2009			1993–2005			Explana. Variables	1993–2009	1993–2005
	2 g	4 g	6 g	2 h	4 h	6 h		8 g	10 h
Intercept	1.222**	1.215**	0.694	1.338**	1.325**	0.700	Intercept	1.638**	1.712**
	4.43	*3.35*	*1.82*	*4.96*	*3.35*	*1.75*		*4.26*	*4.22*
$\ln(A^0)$	0.118**			0.133**			$\ln(A_1^+)$	0.036	0.034
	5.51			*6.09*				*0.64*	*0.72*
$\ln(A)$		0.137**			0.153**		$\ln(A_2^+)$	0.357	0.242
		3.85			*4.26*			*1.61*	*1.14*
$\ln(A^+)$			0.013			0.014	$\ln(A_1^-)$	0.126*	0.118**
			0.19			*0.26*		*2.48*	*2.88*
$\ln(A^-)$			0.221**			0.253**	$\ln(A_2^-)$	0.438*	0.485**
			3.33			*4.91*		*2.54*	*3.06*
ln(S)		−0.120**	−0.085**		−0.134**	−0.091**	ln(S)	−0.122**	−0.129**
		−4.92	*−3.33*		*−5.09*	*−3.39*		*−4.85*	*−4.68*
BTM	0.093	0.091	0.098	0.198*	0.197*	0.202*	BTM	0.082	0.187*
	0.99	*0.98*	*1.04*	*2.10*	*2.08*	*2.13*		*0.88*	*2.02*
MOM1	1.064**	1.092**	1.097**	1.278**	1.305**	1.315**	MOM1	1.039**	1.244**
	3.32	*3.41*	*3.44*	*3.91*	*3.99*	*4.04*		*3.27*	*3.83*
MOM2	1.001**	1.007**	1.041**	1.233**	1.240**	1.287**	MOM2	0.994**	1.249**
	3.32	*3.35*	*3.50*	*3.87*	*3.90*	*4.08*		*3.32*	*3.97*
MOM3	0.907**	0.919**	0.936**	1.079**	1.092**	1.123**	MOM3	0.857**	1.046**
	3.35	*3.40*	*3.48*	*3.96*	*4.01*	*4.17*		*3.21*	*3.89*
MOM4	0.018	0.032	0.055	0.134	0.143	0.179	MOM4	−0.021	0.095
	0.07	*0.12*	*0.21*	*0.47*	*0.50*	*0.63*		*−0.08*	*0.34*
Avg R-sqr	0.032	0.033	0.034	0.030	0.031	0.033	Avg R-sqr	0.035	0.033
Avg Obs	1746.4	1746.4	1746.3	1705.0	1705.0	1705.0	Avg Obs	1742.4	1697.2

This table reports the results of monthly Fama-MacBeth (1973)-type cross-sectional regressions using the weighted least-squares (WLS) estimation method for NYAM stocks over the 276 months: 1983–2009. Following Asparouhova, Bessembinder, and Kalcheva (2010), the prior-month gross return (one plus the return of month *t*-1) is used as a weighting variable for the WLS regressions. Panel A contains the results using the Amihud (2002) measure, $\ln(A^0)$, and its CRSP-based components, $\ln(A)$, $\ln(A^+)$, and $\ln(A^-)$, while Panel B does the same using the ISSM/TAQ-based components, $\ln(A_1^+)$, $\ln(A_2^+)$, $\ln(A_1^-)$, and $\ln(A_2^-)$. Each panel also reports the results using the data up to 2005 only [excluding high-frequency-trading years (2006–2009)]. For robustness tests and comparison purposes, ISSM/TAQ-based turnover (T^*) is used in both panels (where applicable). The dependent variable is R^{e2}, which is the FF3-adjusted excess return using the Fama-French (FF) three factors with factor loadings estimated from the five-year rolling regressions. The other variables are defined in the previous tables. The values in the first row for each explanatory variable are the time-series averages of coefficients obtained from the month-by-month cross-sectional regressions, and the values italicized in the second row of each variable are *t*-statistics computed based on Fama-MacBeth (1973). To survive in the sample, stocks must have five zero-volume days or fewer within a month in CRSP, or 50 trades or more within a month (on average 2.5 trades or more per day) in ISSM/TAQ. The sample loses the first two observations in the cross-sectional regressions due to the two-month lagging. The coefficients are all multiplied by 100. *Avg R-sqr* is the average of monthly adjusted R^2. *Avg Obs* is the monthly average number of companies used in the cross-sectional regressions. Significance at the 1% and 5% levels is indicated by ** and *, respectively.

6. Conclusion

In this paper we have first confirmed that the Amihud (2002) measure of illiquidity is reliably priced in the cross-section of asset returns, using a broad and long data sample starting from the early 1970s. A subperiod analysis shows that the Amihud measure also commands a return premium during a more recent time period. We have also shown that the return premium is captured better when turnover (instead of dollar volume) is used to construct the Amihud measure and firm size effects are accounted for separately.

When we decompose the Amihud measure into components related to positive (up) and negative (down) return days, we find that only the half-Amihud corresponding to down days is priced. When this half-Amihud was further decomposed into an element corresponding to the sensitivity of the price change to seller-initiated turnover and an element that measures the clustering of sell-orders on down days, both elements contribute significantly to the return premium associated with illiquidity. The pricing of the first element is consistent with the finding by Brennan et al. (2010) that only the Kyle lambda for seller-initiated trades is priced. The pricing of the second element is consistent with the findings by Sarkar and Schwartz (2009), who associate market sidedness with the presence of asymmetric information. Our results are robust to several experiments, including the analyses with the sample that eliminates data for recent high-frequency-trading years.

Appendix

Table A1

Up days vs. down days: ISSM/TAQ-based (il)liquidity measures for NYAM stocks

Up Days vs. Down Days: ISSM/TAQ-based (Il)liquidity Measures for NYAM Stocks (1983:01–2009:12)

Variables	Up/Down Days	Whole Sample		MV1		MV2		MV3	
		mean	t-value	mean	t-value	mean	t-value	mean	t-value
%QSPR	Up Days	1.524	*−2.80*	3.247	*−1.86*	0.876	*−2.31*	0.455	*−0.71*
	Down Days	1.546		3.275		0.904		0.463	
DDepth	Up Days	77.26	*4.02*	16.36	*6.62*	52.07	*4.00*	163.09	*2.52*
	Down Days	76.24		15.81		51.18		161.54	
ComposIlliq	Up Days	5.630	*−5.65*	16.144	*−5.49*	0.647	*−4.02*	0.125	*−3.21*
	Down Days	6.013		17.233		0.681		0.141	

This table reports the mean values of three ISSM/TAQ-based (il)liquidity measures (*%QSPR*, *DDepth*, and *ComposIlliq*) for up days and down days separately as well as the *t*-statistics to test the null hypothesis that the difference between the two mean values (up-day mean minus down-day mean) is equal to zero, using NYAM-listed stocks over the 324 months (27 years) from January 1983 to December 2009. To obtain the monthly averaged values for the three (il)liquidity measures, each intradaily trade is first matched with relevant ask and bid quotes via the Lee and Ready (1991) algorithm; the intradaily values of the three measures are calculated within each day; the daily average values are obtained by averaging the intradaily values; and then the daily values for up days and down days are separately averaged within each month. The three (il)liquidity measures are defined as follows: *%QSPR*: the monthly mean proportional quoted spread (in %), obtained by averaging the daily mean values (within a month), which are in turn computed by averaging the intradaily values of [(ask price – bid price)/quote midpoint] × 100 within a day; *DDepth*: the monthly mean dollar depth (in $1,000), obtained by averaging the daily mean values (within a month), which are in turn computed by averaging the intradaily values of [(bid lot size × 100 × price + ask lot size × 100 × price)/2]/1,000 within a day; *ComposIlliq*: the monthly mean composite illiquidity, obtained by averaging the daily mean values (within a month), which are in turn computed by averaging the intradaily equivalents of (%QSPR/DDepth) within a day. All six series (3 measures × 2 categories) are Winsorized each month at the 0.5^{th} and 99.5^{th} percentiles. To form the tercile portfolios (*MV1-MV3*), each month the component stocks are split into three equal-numbered portfolios after being sorted on the previous month-end market value (*MV*: stock price times the number of shares outstanding) in ascending order. So *MV1* consists of smallest stocks. For the pooled sample *t*-test, the total number of firm-months for the whole sample ranges from 491,969 to 511,269, while that for the tercile portfolios ranges from 163,814 to 170,195.

Table A2

Pricing of the turnover-version Amihud (2002) measure by sub-period

Pricing of the Turnover-version Amihud (2002) Measure by Sub-period for NYAM Stocks: Dep. Var. = R^{e1}

Explanatory Variables	Panel A: With the Monthly Average				Panel B: With the Annual Average			
	Entire Period 1971:07–2009:12	Sub-period 1 1971:07–1982:12	Sub-period 2 1983:01–1995:12	Sub-period 3 1996:01–2009:12	Entire Period 1971:07–2009:12	Sub-period 1 1971:07–1982:12	Sub-period 2 1983:01–1995:12	Sub-period 3 1996:01–2009:12
Intercept	0.860**	1.228**	0.893*	0.535	0.691*	1.162*	0.800	0.214
	3.06	*2.74*	*2.07*	*0.98*	*2.48*	*2.51*	*1.87*	*0.40*
A_{win}	0.006**	0.005**	0.006**	0.007**	0.006**	0.005**	0.005**	0.008**
	6.93	*3.23*	*4.32*	*4.39*	*6.54*	*3.17*	*2.94*	*5.30*
ln(S)	−0.092**	−0.131**	−0.094**	−0.060	−0.080**	−0.126**	−0.085**	−0.038
	−4.55	*−3.47*	*−3.16*	*−1.60*	*−3.97*	*−3.27*	*−2.95*	*−1.04*
BTM	0.176**	0.291**	0.162	0.099	0.166*	0.277**	0.145	0.095
	2.64	*4.01*	*1.42*	*0.72*	*2.48*	*3.86*	*1.29*	*0.69*
MOM1	0.890**	1.329**	1.217**	0.237	0.738**	1.216**	1.050**	0.068
	3.53	*2.95*	*3.30*	*0.50*	*2.91*	*2.69*	*2.79*	*0.14*
MOM2	0.959**	1.051**	1.369**	0.505	0.838**	0.945*	1.241**	0.378
	4.15	*2.81*	*3.57*	*1.19*	*3.56*	*2.47*	*3.11*	*0.89*
MOM3	1.249**	1.870**	1.267**	0.738*	1.150**	1.811**	1.158**	0.616
	6.16	*5.11*	*3.70*	*2.16*	*5.56*	*4.92*	*3.27*	*1.77*
MOM4	0.199	0.491	0.918**	−0.701*	0.145	0.473	0.824*	−0.748*
	1.05	*1.46*	*2.83*	*−2.27*	*0.75*	*1.36*	*2.46*	*−2.41*
Avg R-sqr	0.029	0.027	0.029	0.031	0.029	0.027	0.029	0.030
Avg Obs	1580.5	1596.7	1545.2	1600.4	1580.5	1596.7	1545.2	1600.4

Pricing of the Turnover-version Amihud (2002) Measure by Sub-period for NASDAQ Stocks: Dep. Var. = R^{e1}

Explanatory Variables	Panel C: With the Monthly Average			Panel D: With the Annual Average		
	Entire Period 1983:01–2009:12	Sub-period 2 1983:01–1995:12	Sub-period 3 1996:01–2009:12	Entire Period 1983:01–2009:12	Sub-period 2 1983:01–1995:12	Sub-period 3 1996:01–2009:12
Intercept	2.135**	1.536	2.673*	2.065*	1.723	2.373
	2.64	*1.63*	*2.09*	*2.51*	*1.79*	*1.82*
A_{win}	0.005**	0.009**	0.002**	0.006**	0.009**	0.002**

(continued)

Table A2
Continued

Pricing of the Turnover-version Amihud (2002) Measure by Sub-period for NASDAQ Stocks: Dep. Var. = R^{e1}

Explanatory Variables	Panel C: With the Monthly Average			Panel D: With the Annual Average		
	Entire Period 1983:01–2009:12	Sub-period 2 1983:01–1995:12	Sub-period 3 1996:01–2009:12	Entire Period 1983:01–2009:12	Sub-period 2 1983:01–1995:12	Sub-period 3 1996:01–2009:12
ln(S)	*−0.21***	*−0.19***	*−0.23**	*−0.21***	*−0.20***	*−0.21**
	−3.47	*−2.60*	*−2.41*	*−3.31*	*−2.71*	*−2.14*
BTM	0.530**	0.832**	0.258	0.519**	0.825**	0.244
	5.00	*5.53*	*1.77*	*4.90*	*5.51*	*1.66*
MOM1	0.654**	1.661**	−0.251	0.451	1.348**	−0.355
	2.67	*5.51*	*−0.69*	*1.87*	*4.51*	*−0.98*
MOM2	0.680**	1.430**	0.006	0.530*	1.216**	−0.085
	2.90	*4.72*	*0.02*	*2.27*	*3.99*	*−0.25*
MOM3	0.469*	1.091**	−0.090	0.346	0.905**	−0.157
	2.32	*4.16*	*−0.30*	*1.72*	*3.41*	*−0.53*
MOM4	0.044	0.506	−0.371	−0.036	0.393	−0.422
	0.23	*1.66*	*−1.65*	*−0.19*	*1.27*	*−1.89*
Avg R-sqr	0.023	0.022	0.023	0.022	0.021	0.023
Avg Obs	1961.0	1293.7	2560.7	1961.0	1293.7	2560.7

This table reports the results of monthly Fama-MacBeth (1973)-type cross-sectional regressions (by sub-period) that include the turnover-version Amihud (2002) measure (not log-transformed but Winsorized), A_{win}. Panels A and B show the results for NYAM-listed stocks over the entire period (462 months: 197107-200912) as well as its three sub-periods [Sub-period 1 (197107-198212), Sub-period 2 (198301-199512), and Sub-period 3 (199601-200912)], while Panels C and D do the same for NASDAQ-listed stocks over the entire period (324 months: 198301-200912) as well as its two sub-periods [Sub-period 2 (198301-199512) and Sub-period 3 (199601-200912)]. Panels A and C use the monthly average of daily turnover-version Amihuds within a month; and Panels B and D use the annual average of daily turnover-version Amihuds within a year (converted to a monthly series by filling the 12 months of the following year with the previous year's annual average value). The dependent variable is R^{e1}. The definitions of the variables are as follows. R^{e1}: the FF3-adjusted excess return, i.e., the constant term plus the residual from the time-series regression of the excess return on the FF three factors using the entire sample range of the data; and A_{win}: the Winsorized (at the 1st and 99th percentiles) turnover-version Amihud measure, computed by the average of daily $|r|/T$ within a month (Panels A and C) or within a year (Panels B and D), where r is the daily stock return and T is daily share turnover based on CRSP. The other variables are defined in Table 1. The values in the first row for each explanatory variable are the time-series averages of coefficients obtained from the month-by-month cross-sectional regressions, and the values italicized in the second row of each variable are t-statistics computed based on Fama-MacBeth (1973). To survive in the sample, stocks must have five zero-volume days or fewer within a month (for NYSE/AMEX stocks), or 50 trades or more within a month (on average 2.5 trades or more per day) (for NASDAQ stocks). In addition, for the availability of R^{e2}, stocks must have monthly returns for the past 60 months (at least 24 months). Only common stocks (share code 10 or 11 in CRSP) are used. The sample loses the first two observations in the cross-sectional regressions due to the two-month lagging. The coefficients are all multiplied by 100. *Avg R-sqr* is the average of monthly adjusted R^2. *Avg Obs* is the monthly average number of companies used in the cross-sectional regressions. Significance at the 1% and 5% levels is indicated by ** and *, respectively.

Table A3
Pricing of the half-Amihud measures in portfolios formed by sorting on market value

Pricing of the Half-Amihud Measures in Portfolios Formed by Sorting on MV: Dep. Var. = R^{e2}

Explanatory Variables	Panel A: NYAM Stocks (1971:07–2009:12)			Panel B: NASDAQ Stocks (1983:01–2009:12)		
	MV1	MV2	MV3	MV1	MV2	MV3
Intercept	6.838**	−3.639**	−0.691	16.553**	−7.342**	−1.274
	6.09	*−4.62*	*−1.54*	*8.11*	*−3.67*	*−1.69*
ln(A^+)	0.103	−0.003	−0.209**	0.098	0.084	−0.065
	1.76	*−0.04*	*−2.84*	*1.61*	*1.52*	*−0.72*
ln(A^-)	0.207**	0.236**	0.304**	0.362**	0.051	0.136
	3.83	*3.33*	*4.18*	*5.35*	*0.88*	*1.58*
ln(S)	−0.693**	0.254**	0.029	−1.772**	0.607**	0.083
	−6.96	*4.31*	*1.10*	*−9.23*	*3.58*	*1.55*
BTM	0.150	0.002	−0.052	0.455**	0.441**	0.209
	1.68	*0.02*	*−0.56*	*2.99*	*2.93*	*1.20*
MOM1	1.491**	0.822**	0.057	0.937*	1.443**	0.742*
	4.59	*2.59*	*0.16*	*2.52*	*4.58*	*2.07*
MOM2	0.925**	0.830**	0.856**	0.996**	1.089**	0.782**
	2.97	*2.80*	*2.87*	*2.68*	*3.45*	*2.61*
MOM3	1.158**	1.151**	1.359**	0.434	1.116**	0.502
	3.89	*4.37*	*4.28*	*1.33*	*3.67*	*1.64*
MOM4	0.036	0.073	0.369	0.338	−0.044	0.048
	0.13	*0.28*	*1.19*	*1.01*	*−0.17*	*0.16*
Avg R-sqr	0.036	0.038	0.057	0.028	0.028	0.036
Avg Obs	512.6	535.6	544.4	660.3	657.0	678.7

This table reports the results of monthly Fama-MacBeth (1973)-type cross-sectional regressions that include the two half-Amihud measures (log-transformed), ln(A^+) and ln(A^-), as well as the logarithm of firm size, ln(S), presenting the detailed analyses for the three portfolios formed by sorting on market capitalization. Panel A contains the result for NYAM-listed stocks over the 462 months (38.5 years) from July 1971 to December 2009, while Panel B does the same for NASDAQ-listed stocks over the 324 months (27 years) from January 1983 to December 2009. Each month the component stocks are split into three equal-numbered portfolios (*MV1-MV3*) after being sorted on the previous month-end market value (*MV*: stock price times the number of shares outstanding) in ascending order. So *MV1* consists of smallest stocks. The dependent variable is R^{e2}. The definitions of the variables are as follows. R^{e2}: the FF3-adjusted excess return using the Fama-French (FF) three factors with factor loadings estimated from the five-year rolling regressions (past monthly returns should be available for at least 24 months); ln(A^+): the natural logarithm of A^+, which is the half-Amihud measure for up days, computed by the average of daily r^+/T (within a month), where $r^+ = \max[0, r]$, T is daily share turnover obtained from CRSP, and r is a daily stock return; ln(A^-): the natural logarithm of A^-, which is the half-Amihud measure for down days, computed by the average of daily $-r^-/T$ (within a month), where $r^- = \min[r, 0]$; ln(S): the natural logarithm of S, which is the average of daily market values (daily stock price times the total number of shares outstanding) (within a month) in $1,000. The other variables are defined in Table 1. The values in the first row for each explanatory variable are the time-series averages of coefficients obtained from the month-by-month cross-sectional regressions, and the values italicized in the second row of each variable are t-statistics computed based on Fama-MacBeth (1973). To survive in the sample, stocks must have five zero-volume days or fewer within a month (for NYAM stocks), or 50 trades or more within a month (on average 2.5 trades or more per day) (for NASDAQ stocks). In addition, for the availability of R^{e2}, stocks must have monthly returns for the past 60 months (at least 24 months). Only common stocks (share code 10 or 11 in CRSP) are used. The sample loses the first two observations in the cross-sectional regressions due to the two-month lagging. The coefficients are all multiplied by 100. *Avg R-sqr* is the average of monthly adjusted R^2. *Avg Obs* is the monthly average number of companies used in the cross-sectional regressions. Significance at the 1% and 5% levels is indicated by ** and *, respectively.

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