Liquidity Level or Liquidity Risk?
A Fresh Look with New Measures

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Abstract

Lou and Sadka (2011) examine the effect of stock liquidity characteristics on stock performance during the 2008-2009 crisis. Their conclusion is that liquidity *risk*, and not the liquidity *level*, explains stock performance during the crisis. Lou and Sadka (2011) measure liquidity via Amihud's (2002) illiquidity measure. I construct a new measure of illiquidity, based on transaction-by-transaction price changes and conduct a similar analysis to that in Lou and Sadka. My findings show that, controlling for liquidity risk, the level of liquidity has incremental explanatory power for stock performance during the crisis. My analysis suggests that the level of liquidity and liquidity risk are both important facets of stock liquidity and that there might be an interaction or overlap between the two.

JEL classification: *G12*, *G14*
Keywords: *Asset Pricing*, *Liquidity*, *Financial Crisis*

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I. Introduction

Liquidity is playing an increasingly important role in asset pricing models. Amihud and Mendelson (1986) suggest that a positive association exists between stock returns and transaction costs, and subsequent studies have broadened the scope of the inquiry to examine the role of liquidity (e.g. Brennan and Subrahmanyam, 1996). While there is general agreement about the importance of liquidity in explaining price movements, there is less agreement about the way liquidity is characterized. Specifically, liquidity can be described in terms of its *level* (e.g. bid-ask spread, price impact) or by its *risk*—the comovement of stock returns with aggregate market liquidity. Recent work suggests that liquidity risk is the more important determinant of stock returns. This paper finds that the level of liquidity, when accurately measured using high-frequency data, performs as well as liquidity risk in explaining stock returns.

Amihud (2002) suggests that stock excess returns provide compensation for, not only broad risk exposures, but also for stock illiquidity risks (i.e. illiquidity premium) and for their illiquidity (e.g. higher brokerage fees and wider bid-ask spreads than more liquid securities). A recent paper by Lou and Sadka (2011) examines the effect of stock liquidity characteristics on their performance during the 2008-2009 crisis. In that study, stock liquidity is described either by its liquidity level or by its liquidity risk, based on pre-crisis data. The authors run cross-sectional regressions of stock returns during the crisis on stock market beta, liquidity beta, and liquidity, and find that the coefficient of liquidity is not significant, while the coefficient on liquidity beta is. Thus, stocks with different liquidity levels did *not* experience differential performance during the crisis once their liquidity risk is controlled for. Rather, they attribute the difference in performance to liquidity risk, although they recommend that the roles of liquidity and liquidity risk in an asset allocation problem be examined.

In contrasting liquidity level and liquidity risk, Lou and Sadka (2011) use Amihud's (2002) price impact measure for the former, and exposure to either the Sadka (2006) or the Pastor and Stambaugh (2003) liquidity factor for the latter. Amihud's (2002) price impact measure is based on daily data, and constructed by dividing the absolute daily return for a stock by that day's trading volume. A potential problem with this measure is that it does not reflect intra-day price volatilities when price movements are in opposing directions. Therefore, this price impact measure is likely to underestimate the true illiquidity level of stocks. For instance, I find several instances where stocks have daily price changes (closing price minus opening price) as low as 0.1% of the sum of their intra-day price changes.

In fact, Amihud (2002) himself suggests that his daily price impact measure can be improved upon by using transaction-level data. On the other hand, Sadka's (2006) liquidity factor is based on intra-day data, as the slope coefficient from a regression of transaction-by-transaction stock returns on signed (i.e. considering the trade direction) trading volume, which is then averaged across stocks.

In this paper, I also compare the performance of liquidity risk and that of liquidity level, but using measures that are more consistent. To ensure consistency between the two liquidity measures, I use transaction-by-transaction price changes to calculate the price impact measure of Amihud rather than the regular daily Amihud's price impact measure. I denote the high-frequency Amihud's price impact measure by *Amihud_HF*, whereas the regular Amihud's measure is denoted by *Amihud*.

The intraday measurement of liquidity should reflect the true magnitude of price movements associated with trading activity and result in more precise measurement of liquidity. This should

be especially important for illiquid stocks, which are likely to be characterized by price reversals within the day. The greater variability in *Amihud_HF* should therefore be helpful in explaining cross-sectional differences in returns during the 2008-2009 crisis. This paper has two main contributions. First, it highlights differences between the regular and high-frequency price impact measures and points to situations where using a daily price impact measure to reflect stock illiquidity levels can be problematic. Second, it reexamines the evidence in Lou and Sadka (2011) on the importance of stock liquidity and liquidity risk during crisis.

The objective of this paper, however, is not to critique Amihud's measure nor to promote an alternative, as there are numerous papers that thoroughly discussed its performance and attempted to offer more advanced alternatives[1]. My modification to Amihud's measure only aims to introduce the high-frequency angle to it but keeps its nature and construction otherwise intact. The changes I introduce to the measure are necessary to improve the comparability between liquidity level and liquidity risk measures and to investigate whether the absence of a high-frequency measurement from *Amihud* is the reason behind the lack of performance that this measure exhibits in Lou and Sadka (2011).

My results show that *Amihud_HF* and *Amihud* are only loosely correlated (correlation is 13%). In addition, when liquidity is measured by *Amihud*, my results mirror those documented by Lou and Sadka (2011) in that liquidity risk alone is important in explaining stock returns during the financial crisis. However, when liquidity is measured by *Amihud_HF*, it also explains, though not as strongly as liquidity risk does, the crisis performance of stocks. That is, a portfolio of

[1] For instance, Lou and Shou (2017) show that Amihud's measure is priced due to the volume component of it, not the return component. Drienko et al. (2019) confirm this finding by Lou and Shou (2017) and further mention that the performance of Amihud's measure drop significantly out-of-sample. Florackis et al. (2011) propose alternative price impact measure based on turnover. Finally, Amihud (2019) comments on the performance of his price impact measure and builds a pricing factor based on it.

liquid / low liquidity risk stocks outperforms a portfolio of illiquid / high liquidity risk stocks when liquidity is measured by *Amihud_HF*. When the crisis return is related to liquidity risk and *Amihud_HF* or *Amihud*, via cross-sectional regressions, liquidity risk and *Amihud_HF* are both usually associated with a statistically significant negative coefficient, whereas the coefficient of *Amihud* is insignificant and frequently associated with a non-intuitive positive coefficient.

The rest of the paper is structured as follows. Data and measures are presented in sections II and III, respectively. Section IV offers some descriptive statistics whereas section V discusses regression model design and presents results and findings. Section VI concludes.

II. Data

In the first part of the study, liquidity level and liquidity risk measures are estimated using pre-crisis data (January 2003 to December 2007). Adopting Lou and Sadka's (2011) approach in estimating measures of liquidity level, I obtain daily (for the regular Amihud's measure; *Amihud*) and intra-daily transaction (for the high-frequency Amihud's measure; *Amihud_HF*) data for the corresponding period, from the Center for Research in Security Prices (CRSP) and the Trades and Quotes database (TAQ), respectively, both provided through the Wharton Research Data Services (WRDS). Liquidity risk measures are estimated from monthly data. Monthly stock and market premium data is also obtained from CRSP. Liquidity risk measures are estimated with respect to either Sadka (2006) or Pastor and Stambaugh (2003) monthly factors. Monthly Market, Sadka, and Pastor and Stambaugh factors are also obtained for the period January 2003 to December 2007 (60 observations)[2].

[2] I thank Lubos Pastor and Ronnie Sadka for making their liquidity factors available on their websites, respectively: http://faculty.chicagobooth.edu/lubos.pastor/research/liq_data_1962_2010.txt, and http://www2.bc.edu/~sadka/Sadka-LIQ-factors-1983-2010-WRDS.xlsx.

I apply similar data cleaning steps to those followed by Lou and Sadka (2011). I exclude data for non-NYSE and non-AMEX stocks. Any observation with zero or unavailable price is deleted. Stocks with prices below $5 and above $1000 (according to their last trading day/transaction in 2007) are also excluded from the dataset. Calculating *Amihud* and *Amihud_HF* involves using lagged prices and division by volume. Therefore, I delete the first observation of each stock and exclude any observation with zero or unavailable volume data. For the estimation of liquidity level (risk) measures, I exclude stocks with less than 100 (24) daily (monthly) observations during 2007 (the period 2003-2007). I exclude observations where intra-day volume departs from daily volume by more than 25% in absolute terms as this may indicate an erroneous observations or inaccurate CRSP-TAQ matching. This last step resulted in the loss of less than 0.9% of the observations. The final dataset includes 2645 stocks for which I estimate the four liquidity measures and examine their performance during the financial crisis (2008-2009), as explained next.

In the second part, stock monthly return data was obtained from CRSP for the period January 2008 to December 2009. The dataset, which includes 61,219 stock-month observations, has been matched with stocks' market return coefficients, liquidity levels, and liquidity risks data obtained from the first part.

III. Measures

Liquidity is a multidimensional concept in that it reflects: trading quantity, trading speed, trading cost, price impact, etc. (Liu, 2006). In line with Lou and Sadka (2011), I emphasize the price impact aspect of liquidity. For each stock, I build a complete liquidity profile that includes its liquidity level and liquidity risk exposure. The former is measured by *Amihud* or *Amihud_HF*,

whereas the latter is measured by β^{Liq}, the coefficient of either Sadka (2006) or Pastor and Stambaugh (2003) liquidity risk factors. Therefore, each stock is described by four liquidity measures. *Amihud* is estimated for each stock using daily data as outlined by Amihud (2002):

$$Amihud_i = \frac{\sum_{d=1}^{D} \frac{|RET_{i,d}|}{DVOL_{i,d}}}{D_i} ; RET_{i,d} = \frac{PRC_{i,d} - PRC_{i,d-1}}{PRC_{i,d-1}}$$

Where $RET_{i,d}$, $DVOL_{i,d}$, and $PRC_{i,d}$ are return, dollar volume, and price, respectively, of stock *i* at day *d*. Note that the daily measure of stock *i* is averaged over the number of trading days (*D*) of stock *i* in the year 2007. Similarly, the high-frequency price impact measure is calculated as follows:

$$Amihud\_HF_i = \frac{\sum_{d=1}^{D} \frac{\sum_{t=1}^{T} |RET_{i,t,d}|}{DVOL_{i,d}}}{D_i} ; RET_{i,t} = \frac{PRC_{i,t} - PRC_{i,t-1}}{PRC_{i,t-1}}$$

Where *t* refers to the time (order) of the transaction. Higher values of *Amihud* and *Amihud_HF* represent higher illiquidity; that is, a certain number of shares traded is associated with a greater price impact is considered as a sign of illiquidity, and vice versa.

Using the monthly data (60 months; January 2003 – December 2007), I obtain the liquidity risk of stocks by running the following regression model using OLS approach:

$$R_{i,m} - R_{f,m} = \alpha_i + \beta_i^{RET(LIQ)}\left(R_{MKT,m} - R_{f,m}\right) + \beta_i^{LIQ} LIQ_m + \varepsilon_{i,m}$$

Where $R_{i,m}$ is the return of stock *i* in month *m*, R_f is the risk-free rate, R_{MKT} is the value-weighted market average return, LIQ_m is a liquidity risk factor—either Sadka's permanent-variable

liquidity factor LIQ^{SADKA}(Sadka, 2006)[3] or Pastor and Stambaugh liquidity factor LIQ^{PS} (Pastor and Stambaugh, 2003), which represents levels of aggregate liquidity, and ε_m is an error term. β_i^{LIQ} is the liquidity risk measure of stock i.

The cross-sectional mean values of the stock-level regular Amihud's measure and the high-frequency Amihud's measure in 2007 are 0.387 and 6.32, respectively, and the mean values are statistically different from each other. The cross-sectional average Pearson's correlation coefficient between the two measures is only 13%. This difference in average values and the low correlation between them show that, while the two measures are very similar in construction, they describe liquidity levels extremely differently. The two measures are similar in that they both represent the average price change or volatility per dollar of trading. However, absolute *daily* returns can be a very noisy estimator of the true latent volatility (Chan and Fong, 2006). Daily returns are computed using opening and closing prices only and the resulting volatility measure may underestimate the true volatility level if, for instance, opening and closing prices are close to each other even in the presence of significant price changes through the day.

The high-frequency price impact measure *Amihud_HF* uses the sum of absolute price changes at the transaction level, which is also a measure of realized volatility. Anderson et al. (2001) show that the resulting volatility measure approaches the true latent volatility when sampling is made at a very high frequency. The objective of this paper is not to critique Amihud's measure nor to highlight its shortcomings, as the author himself warned that it is designed as a crude measure of liquidity that can be useful only when intra-daily data is unavailable (Amihud, 2002). I also do not intend to promote *Amihud_HF* as an improved price impact measure necessarily, but I

[3] Sadka (2006) constructs four liquidity factors but argues that out of them; only the permanent-variable factor is priced. I continue to use the same factor for consistency.

simply want to introduce the intra-daily angle to it, so that it becomes comparable with the intra-daily liquidity risk measures used in this study.

IV. Descriptive Statistics

Using each of the four measures, two portfolios are constructed at a time: high and low liquidity risk portfolios based on stocks' liquidity risk factor coefficients, and illiquid and liquid portfolios based on stock *Amihud* and *Amihud_HF* average values. I find that 834 stocks (about 32% of the sample) switched portfolio membership when *Amihud_HF* is used to form ranking instead of *Amihud*. This indicates that *Amihud* and *Amihud_HF* are not similarly characterizing stock liquidity levels. I have also found that 1036 (about 39% of the sample) have different portfolio membership when the alternative liquidity risk measure is used; also indicating that the two risk measures are capturing different liquidity risk aspects. In addition, using *Amihud_HF* instead of *Amihud* results in more stocks with matching liquidity level and liquidity risk classification (i.e. more stocks that are liquid with low liquidity risk and illiquid with high liquidity risk). The number of such stocks has increased from 864 (944) when liquidity level is described by *Amihud* to 1,383 (1,431) when *Amihud_HF* is used, where liquidity risk is measured with respect to Pastor and Stambaugh (Sadka).

Table 1 presents characteristics of eight portfolios formed in the beginning of 2008: liquid and illiquid stocks where liquidity is measured by *Amihud*, liquid and illiquid stocks where liquidity is measured by *Amihud_HF*, low and high liquidity risk portfolios where risk is defined by Sadka's factor, low and high liquidity risk portfolios where risk is defined by Pastor and Stambaugh's factor. The portfolios are formed with respect to median liquidity level (risk) value obtained from 2007 (2003-2007) data. For each portfolio, I present the equally-weighted

averages of: firm size (log market capitalization in $ millions), Amihud, Amihud_HF, Sadka's liquidity risk measure, and Pastor and Stambaugh's liquidity risk measure.

Looking at firm size in Table 1, we find that there is an obvious association between liquidity level measures and size. Average firm size is 8.94 (4.96) for Amihud's liquid (illiquid) portfolio, and 7.98 (5.84) for Amihud_HF's portfolios. The strong association between *Amihud* and firm size, which is consistent with Amihud (2002), shows that Amihud's price impact measure might overlap with the size effect. While the association with size is also present in Amihud_HF's portfolios, the degree of association between them is much smaller. The firm size pattern across liquidity risk portfolios are even smaller.

Average liquidity level values seem to vary correspondingly with liquidity risk portfolios, and vice versa. That is, liquidity levels are slightly higher in high risk portfolios and lower in low liquidity risk portfolios. Similarly, liquidity risk measures are slightly higher in illiquid portfolios and lower in liquid portfolios. For example, average *Amihud* is 0.354 (0.416) in Sadka's low (high) risk portfolio. This correspondence is more obvious between *Amihud_HF* and liquidity risk. Average *Amihud_HF* is 3.86 (6.54) in Sadka's low (high) risk portfolio. Such observations made from Table 1 show that *Amihud* and *Amihud_HF* behave differently and that *Amihud_HF* might combine features from both liquidity level and liquidity risk measures.

I track monthly and cumulative return for each set of the two portfolios during the crisis (January 2008-December 2009). Results are presented in Table 2, where returns for portfolios sorted by Sadka's risk factor, Pastor and Stambaugh's risk factor, Amihud's liquidity measure, and high-frequency Amihud's liquidity measure are presented in Panels A, B, C, and D of Table 2. The excess return of the high liquidity risk (illiquid) portfolio over the low liquidity risk (liquid)

portfolio is also provided in the table and plotted in Figure 1. The spread between the cumulative return of the two portfolios represents the difference in performance between two investors each of them is holding one of these two distinct portfolios throughout the crisis. Although return figures do not exactly match those of Lou and Sadka (2011), they conform to the general pattern presented in their paper. For the two liquidity risk measures, spreads in cumulative returns indicate that the low risk outperformed the high risk portfolio (high risk minus low risk cumulative return is negative) throughout almost the entire first 18 months of the crisis. This finding shows that the payoff to a low liquidity risk portfolio holder is better than that to a high liquidity risk holder. On the other hand, the liquid portfolio using Amihud's measure has underperformed the illiquid portfolio during that period. However, and consistent with my conjecture, the liquid portfolio when liquidity level is measured by the high-frequency Amihud's measure, did outperform the illiquid portfolio during the crisis. This finding shows that liquidity level also helps to alleviate crisis consequences as much as liquidity risk exposure does, but when liquidity level is measured accurately.

V. Regression Analysis

To make my results consistent with those of Lou and Sadka (2011), I first estimate their regression models and compare my results with theirs before designing my regression model and estimating it. Lou and Sadka's (2011) regression model is as follows:

$$R_{i,m\to m+j} = \lambda_{0,j} + \lambda_{1,j}\beta_i^{RET(LIQ)} + \lambda_{2,j}\beta_i^{LIQ} + \lambda_{3,j}ILLIQ_i + \eta_{i,j}(1),$$ [4]

[4] This regression model includes liquidity level and liquidity risk measures. The two measures might be highly correlated, which could lead to a multicollinearity issue. However, none of the four pair-wise [Sadka-Amihud, Pastor and Stambaugh-Amihud, Sadka-high-frequency Amihud, and Pastor and Stambaugh-High-frequency Amihud] correlation coefficients exceed 10% in absolute terms (results are available upon request). This can be considered as an informal test about multicollinearity between liquidity level and liquidity risk measures, in which these correlation coefficients indicate that this issue may not exist when liquidity level and liquidity risk measures

Where $R_{i,m\rightarrow m+j}$ = cumulative return of stock *i*, for the period from month *m* to month *m+j*, *m* = January 2008, j = 0 to 23, β_i^{LIQ} is the coefficient of either Sadka or Pastor and Stambaugh risk factor from the previous regression, $\beta_i^{RET(LIQ)}$ is from the previous regression where LIQ_m is based on Sadka (Pastor and Stambaugh) if β_i^{LIQ} in (1) is of Sadka (Pastor and Stambaugh), *ILLIQ* is either *Amihud* or *Amihud_HF*, and η is an error term. Therefore, I run 24 cross-sectional regressions during each crisis month for each of the four variations of the model: Sadka-Amihud, Pastor and Stambaugh-Amihud, Sadka-high-frequency Amihud, and Pastor and Stambaugh-high-frequency Amihud.

Results for these four variations are presented in Table 3, in Panels A, B, C, and D, respectively. As expected, and largely consistent with Lou and Sadka's (2011) results, liquidity risk measures are associated with a negative and statistically significant coefficients (λ_2). In Panels A and B, where liquidity level is measured by *Amihud*, its coefficients (λ_3) are statistically insignificant and frequently have the unintuitive sign (positive). However, in Panels C and D, where liquidity level is measured by *Amihud_HF*, its coefficients (λ_3) are mostly statistically significant and have the intuitive negative sign. Liquidity level when measured by *Amihud_HF* are as successful as liquidity risk measures in explaining stock returns during the financial crisis period 2008-2009.

VI. Conclusion

Lou and Sadka (2011) examine the effect of stock liquidity characteristics on their performance during the 2008-2009 crisis. Stock liquidity is described by either its liquidity level or its

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are both included as independent variables in a regression model. This result is confirmed when VIF values are calculated and found to be slightly above 1. I thank Pari Veeren for pointing out this potential problem.

liquidity risk, based on pre-crisis data. Lou and Sadka find that stocks with different liquidity levels did *not* experience different performance during the crisis when their liquidity risk is controlled for. Their conclusion is that liquidity risk, not liquidity level, is what explains stock performance during crisis. Lou and Sadka (2011) measure liquidity level by Amihud's (2002) price impact measure, which is a crude measure of liquidity.

The findings of Lou and Sadka (2011) conflict with those of a similar study (Amihud et al., 1990) about the 1987 stock market crash in which they relate price recovery of stocks to their liquidity levels. Therefore, the surprising evidence found by Lou and Sadka (2011), coupled with their use of inconsistent level and risk measures, motivate me to conduct a similar study that employs the transaction-based measure of illiquidity level.

My findings show that the evidence documented by Lou and Sadka (2011) does not hold when liquidity is measured accurately using the transaction-based measure. The portfolio of liquid stocks underperformed the portfolio of illiquid stocks when liquidity is measured by *Amihud*, but when liquidity is measured by *Amihud_HF*, liquid stocks outperformed illiquid stocks. When return during crisis is regressed on liquidity risk and *Amihud_HF*, both liquidity risk and *Amihud_HF* are associated with statistically-significant coefficients. Overall, accurate liquidity level measure seems to be as good as liquidity risk measures in explaining stock performance during the crisis period of 2008-2009. This similarity in performance between liquidity level and liquidity risk measures opens the door to further study the sources of this overlap in the explanatory power of both classes of liquidity measures. This will improve our understanding of the way liquidity matters for the performance of stocks and whether liquidity level and liquidity risk capture similar stock characteristics.

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Figure 1: Cumulative return during the crisis period

This figure plots the spread in cumulative return during 2008 and 2009 between high and low liquidity risk portfolios, where liquidity risk is the coefficient of either Sadka or Pastor and Stambaugh liquidity factors obtained from regressing pre-crisis (2003-2007) monthly return data on the market risk premium and either of these factors. The figure also plots spread in cumulative return during 2008 and 2009 between illiquid and liquid portfolios, where liquidity is measured either by the 2007 average price impact using daily opening and closing prices (Amihud's measure) or the average 2007 transaction-by-transaction price changes (high-frequency Amihud's measure). Therefore, plotted lines represent the outperformance of high liquidity risk (illiquid) portfolio over the low liquidity risk (liquid) portfolio. Stocks with less than 100 trading days during 2007 or with less than 24 monthly observations during the period 2003-2007 are excluded from the analysis. I only include NYSE and AMEX stocks whose prices are between $5 and $1000 as per their last trading day during the pre-crisis period. The data is subject to further cleaning steps that are detailed in the "Data" section. The final sample includes 2645 stocks.

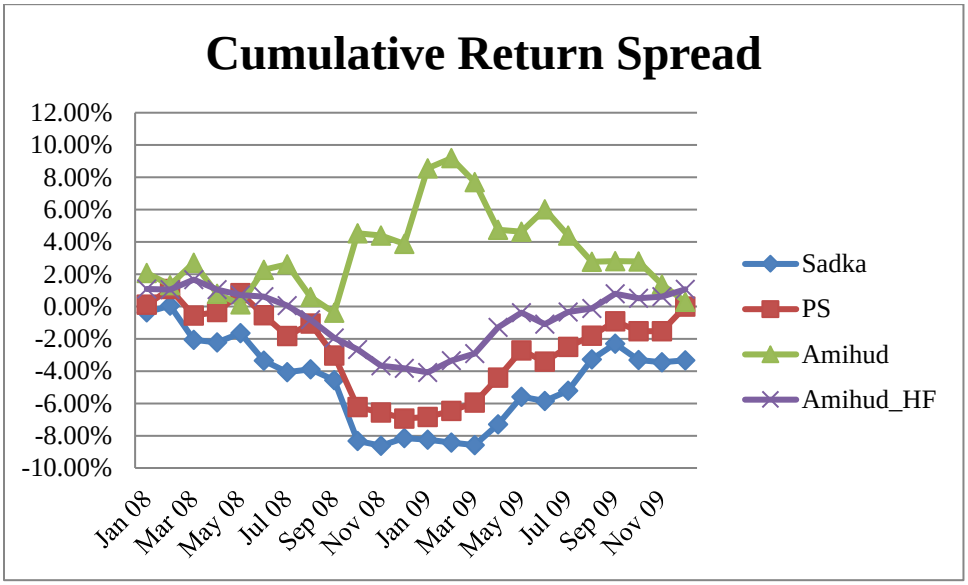

Table 1: Characteristics of portfolios sorted by liquidity level and liquidity risk measures

This table presents average firm size (log market capitalization in $ millions), regular price impact measure Amihud, high-frequency price impact measure Amihud_HF, Sadka's liquidity risk measure, and Pastor and Stambaugh's liquidity risk measure. Stocks are sorted into portfolios of liquid/illiquid or low/high liquidity risk once in the beginning of 2008 based on median values of the measure. In the case of liquidity level measures *Amihud* and *Amihud_HF*, stocks are classified into portfolios based on the average value of the measure during the year 2007. In the case of liquidity risk measures *Sadka* and *Pastor and Stambaugh*, stocks are classified into portfolios based on their coefficient of the respective liquidity factor resulting from monthly time-series regressions using 60 months of data from January 2003 to December 2007. After sorting stocks into the eight portfolios, equally-weighted average value of characteristics are then calculated and provided in the table for each of the portfolios. Stocks with less than 100 trading days during 2007 or with less than 24 monthly observations during the period 2003-2007 are excluded from the analysis. I only include NYSE and AMEX stocks whose prices are between $5 and $1,000 as per their last trading day during the pre-crisis period. The data is subject to further cleaning steps that are detailed in the "Data" section. The final sample includes 2,645 stocks.

	Liquidity Level				Liquidity Risk			
	Amihud		Amihud_HF		Sadka		Pastor and Stambaugh	
Characteristic	Liquid	Illiquid	Liquid	Illiquid	Low	High	Low	High
Size	8.94	4.96	7.98	5.84	7.05	6.96	7.37	6.82
Amihud	0.181	0.632	0.267	0.513	0.354	0.416	0.366	0.412
Amihud_HF	4.78	7.03	2.83	7.92	3.86	6.54	3.71	6.57
Sadka	0.78	1.52	0.21	1.79	-1.75	2.43	-1.31	2.14
Pastor and Stambaugh	0.05	0.17	0.01	0.19	-0.15	0.24	-0.18	0.29

Table 2: Crisis monthly and cumulative return

This table presents monthly return and cumulative return during 2008 and 2009 of two portfolios sorted by liquidity risk; the coefficient of either Sadka (Panel A) or Pastor and Stambaugh (Panel B) liquidity factors obtained from regressing pre-crisis (2003-2007) monthly return data on the market risk premium and either of these factors. Return and cumulative return during 2008 and 2009 is also presented for two portfolios sorted by liquidity level; the 2007 average price impact using either daily opening and closing prices (Amihud's measure, Panel C) or the average 2007 transaction-by-transaction price changes (high-frequency Amihud's measure, Panel D). Stocks with less than 100 trading days during 2007 or with less than 24 monthly observations during the period 2003-2007 are excluded from the analysis. I only include NYSE and AMEX stocks whose prices are between $5 and $1000 as per their last trading day during the pre-crisis period. The data is subject to further cleaning steps that are detailed in the "Data" section. The final sample includes 2645 stocks.

Panel A: *Liquidity-risk sorted portfolios using Sadka's liquidity factor*

	Return			Cumulative Return		
Month	Low risk (1)	High risk (2)	Spread (2) – (1)	Low risk (1)	High risk (2)	Spread (2) – (1)
Jan 08	-2.58%	-2.94%	**-0.36%**	-2.58%	-2.94%	**-0.36%**
Feb 08	-2.28%	-1.87%	**0.41%**	-4.80%	-4.75%	**0.05%**
Mar 08	-0.11%	-2.33%	**-2.22%**	-4.90%	-6.96%	**-2.06%**
Apr 08	4.56%	4.48%	**-0.08%**	-0.57%	-2.79%	**-2.23%**
May 08	2.57%	3.22%	**0.65%**	1.99%	0.33%	**-1.65%**
Jun 08	-7.44%	-9.25%	**-1.81%**	-5.60%	-8.95%	**-3.35%**
Jul 08	-0.06%	-0.86%	**-0.80%**	-5.66%	-9.73%	**-4.07%**
Aug 08	1.84%	2.12%	**0.28%**	-3.92%	-7.82%	**-3.89%**
Sep 08	-11.05%	-12.24%	**-1.18%**	-14.54%	-19.09%	**-4.56%**
Oct 08	-17.32%	-22.95%	**-5.63%**	-29.34%	-37.66%	**-8.32%**
Nov 08	-11.23%	-13.20%	**-1.97%**	-37.27%	-45.89%	**-8.62%**
Dec 08	5.51%	7.25%	**1.74%**	-33.81%	-41.97%	**-8.15%**
Jan 09	-3.69%	-4.37%	**-0.68%**	-36.26%	-44.50%	**-8.25%**
Feb 09	-10.73%	-12.64%	**-1.91%**	-43.10%	-51.52%	**-8.42%**
Mar 09	8.16%	9.24%	**1.08%**	-38.46%	-47.04%	**-8.58%**
Apr 09	17.91%	23.25%	**5.34%**	-27.43%	-34.73%	**-7.29%**
May 09	7.23%	10.64%	**3.41%**	-22.19%	-27.78%	**-5.59%**
Jun 09	0.18%	-0.16%	**-0.34%**	-22.05%	-27.90%	**-5.85%**
Jul 09	9.27%	10.90%	**1.64%**	-14.82%	-20.04%	**-5.22%**
Aug 09	4.94%	7.70%	**2.76%**	-10.61%	-13.88%	**-3.27%**
Sep 09	6.00%	7.35%	**1.34%**	-5.25%	-7.55%	**-2.31%**
Oct 09	-3.99%	-5.17%	**-1.18%**	-9.02%	-12.33%	**-3.31%**
Nov 09	3.94%	3.92%	**-0.02%**	-5.43%	-8.89%	**-3.46%**
Dec 09	4.93%	5.26%	**0.33%**	-0.77%	-4.10%	**-3.33%**

Panel B: *Liquidity-risk sorted portfolios using Pastor and Stambaugh liquidity factor*

	Return			Cumulative Return		
Month	Low risk (1)	High risk (2)	Spread (2) – (1)	Low risk (1)	High risk (2)	Spread (2) – (1)
Jan 08	-2.81%	-2.70%	**0.11%**	-2.81%	-2.70%	**0.11%**
Feb 08	-2.58%	-1.57%	**1.01%**	-5.32%	-4.23%	**1.09%**
Mar 08	-0.35%	-2.08%	**-1.72%**	-5.65%	-6.22%	**-0.57%**
Apr 08	4.39%	4.65%	**0.26%**	-1.51%	-1.85%	**-0.34%**
May 08	2.29%	3.49%	**1.21%**	0.74%	1.58%	**0.83%**
Jun 08	-7.70%	-8.99%	**-1.30%**	-7.01%	-7.56%	**-0.55%**
Jul 08	0.24%	-1.16%	**-1.39%**	-6.79%	-8.63%	**-1.83%**
Aug 08	1.54%	2.43%	**0.89%**	-5.36%	-6.41%	**-1.05%**
Sep 08	-10.53%	-12.77%	**-2.25%**	-15.32%	-18.36%	**-3.04%**
Oct 08	-17.84%	-22.42%	**-4.57%**	-30.43%	-36.66%	**-6.23%**
Nov 08	-11.40%	-13.03%	**-1.63%**	-38.36%	-44.92%	**-6.56%**
Dec 08	6.34%	6.41%	**0.07%**	-34.45%	-41.39%	**-6.93%**
Jan 09	-3.88%	-4.18%	**-0.30%**	-37.00%	-43.83%	**-6.84%**
Feb 09	-11.33%	-12.02%	**-0.69%**	-44.13%	-50.59%	**-6.45%**
Mar 09	7.68%	9.73%	**2.05%**	-39.84%	-45.78%	**-5.94%**
Apr 09	18.16%	22.98%	**4.82%**	-28.92%	-33.32%	**-4.40%**
May 09	7.42%	10.45%	**3.03%**	-23.64%	-26.35%	**-2.71%**
Jun 09	0.47%	-0.46%	**-0.92%**	-23.29%	-26.69%	**-3.40%**
Jul 09	9.25%	10.92%	**1.67%**	-16.19%	-18.68%	**-2.49%**
Aug 09	5.80%	6.82%	**1.02%**	-11.33%	-13.14%	**-1.81%**
Sep 09	6.10%	7.25%	**1.15%**	-5.92%	-6.84%	**-0.92%**
Oct 09	-4.22%	-4.92%	**-0.70%**	-9.89%	-11.42%	**-1.53%**
Nov 09	3.89%	3.97%	**0.08%**	-6.38%	-7.90%	**-1.52%**
Dec 09	4.25%	5.97%	**1.72%**	-2.41%	-2.41%	**0.00%**

Panel C: *Liquidity level sorted portfolios using Amihud's (daily) price impact measure*

	Return			Cumulative Return		
Month	Liquid (1)	Illiquid (2)	Spread (2) – (1)	Liquid (1)	Illiquid (2)	Spread (2) – (1)
Jan 08	-3.79%	-1.72%	**2.07%**	-3.79%	-1.72%	**2.07%**
Feb 08	-1.72%	-2.43%	**-0.72%**	-5.44%	-4.11%	**1.33%**
Mar 08	-1.94%	-0.48%	**1.46%**	-7.28%	-4.57%	**2.71%**
Apr 08	5.60%	3.43%	**-2.17%**	-2.09%	-1.29%	**0.79%**
May 08	3.23%	2.55%	**-0.69%**	1.08%	1.22%	**0.14%**
Jun 08	-9.40%	-7.27%	**2.13%**	-8.43%	-6.14%	**2.28%**
Jul 08	-0.64%	-0.27%	**0.37%**	-9.01%	-6.40%	**2.62%**
Aug 08	3.11%	0.85%	**-2.26%**	-6.19%	-5.60%	**0.58%**
Sep 08	-11.17%	-12.12%	**-0.96%**	-16.66%	-17.04%	**-0.38%**
Oct 08	-23.02%	-17.19%	**5.83%**	-35.84%	-31.31%	**4.54%**
Nov 08	-12.52%	-11.90%	**0.62%**	-43.87%	-39.48%	**4.39%**
Dec 08	7.05%	5.70%	**-1.35%**	-39.92%	-36.03%	**3.89%**
Jan 09	-7.93%	-0.13%	**7.79%**	-44.68%	-36.11%	**8.57%**
Feb 09	-13.03%	-10.32%	**2.71%**	-51.89%	-42.71%	**9.18%**
Mar 09	10.86%	6.53%	**-4.34%**	-46.66%	-38.97%	**7.70%**
Apr 09	24.51%	16.58%	**-7.93%**	-33.59%	-28.85%	**4.74%**
May 09	9.30%	8.52%	**-0.77%**	-27.42%	-22.78%	**4.63%**
Jun 09	-0.92%	0.95%	**1.86%**	-28.08%	-22.05%	**6.03%**
Jul 09	11.56%	8.58%	**-2.98%**	-19.77%	-15.36%	**4.40%**
Aug 09	7.45%	5.14%	**-2.31%**	-13.79%	-11.01%	**2.78%**
Sep 09	6.75%	6.58%	**-0.17%**	-7.97%	-5.15%	**2.81%**
Oct 09	-4.62%	-4.51%	**0.11%**	-12.22%	-9.43%	**2.79%**
Nov 09	4.79%	3.07%	**-1.72%**	-8.02%	-6.65%	**1.37%**
Dec 09	5.71%	4.47%	**-1.24%**	-2.77%	-2.48%	**0.29%**

Panel D: *Liquidity level sorted portfolios using high-frequency Amihud's (transaction-based) price impact measure*

	Return			Cumulative Return		
Month	Liquid (1)	Illiquid (2)	Spread (2) – (1)	Liquid (1)	Illiquid (2)	Spread (2) – (1)
Jan 08	-3.30%	-2.21%	**1.09%**	-3.30%	-2.21%	**1.09%**
Feb 08	-2.07%	-2.08%	**-0.02%**	-5.30%	-4.25%	**1.05%**
Mar 08	-1.54%	-0.88%	**0.66%**	-6.76%	-5.09%	**1.67%**
Apr 08	5.09%	4.35%	**-0.74%**	-2.01%	-0.96%	**1.05%**
May 08	2.98%	2.60%	**-0.38%**	0.90%	1.61%	**0.71%**
Jun 08	-8.67%	-8.71%	**-0.04%**	-7.84%	-7.24%	**0.60%**
Jul 08	-0.78%	-1.36%	**-0.59%**	-8.56%	-8.51%	**0.05%**
Aug 08	2.40%	1.46%	**-0.95%**	-6.36%	-7.17%	**-0.81%**
Sep 08	-11.88%	-13.21%	**-1.33%**	-17.48%	-19.43%	**-1.95%**
Oct 08	-18.84%	-20.18%	**-1.34%**	-33.02%	-35.69%	**-2.67%**
Nov 08	-12.67%	-14.75%	**-2.08%**	-41.51%	-45.18%	**-3.67%**
Dec 08	5.97%	6.08%	**0.11%**	-38.02%	-41.84%	**-3.82%**
Jan 09	-4.17%	-4.88%	**-0.71%**	-40.60%	-44.68%	**-4.08%**
Feb 09	-12.09%	-11.66%	**0.42%**	-47.78%	-51.13%	**-3.35%**
Mar 09	9.42%	10.96%	**1.55%**	-42.86%	-45.77%	**-2.91%**
Apr 09	18.90%	22.88%	**3.98%**	-32.07%	-33.37%	**-1.30%**
May 09	7.84%	9.38%	**1.54%**	-26.74%	-27.12%	**-0.38%**
Jun 09	0.47%	-0.50%	**-0.97%**	-26.40%	-27.48%	**-1.08%**
Jul 09	9.64%	10.80%	**1.17%**	-19.30%	-19.64%	**-0.34%**
Aug 09	5.95%	6.25%	**0.29%**	-14.50%	-14.63%	**-0.13%**
Sep 09	5.87%	6.97%	**1.10%**	-9.48%	-8.68%	**0.80%**
Oct 09	-4.44%	-4.70%	**-0.27%**	-13.49%	-12.97%	**0.52%**
Nov 09	3.33%	3.42%	**0.09%**	-10.61%	-10.00%	**0.61%**
Dec 09	4.86%	5.33%	**0.47%**	-6.27%	-5.20%	**1.07%**

Table 3: Results of monthly cross-sectional regressions

This table presents estimates of the following regression model:

$$R_{i,m\to m+j} = \lambda_{0,j} + \lambda_{1,j}\beta_i^{RET(LIQ)} + \lambda_{2,j}\beta_i^{LIQ} + \lambda_{3,j}ILLIQ_i + \eta_{i,j}(1),$$

Where $R_{i,m\to m+j}$ = cumulative return of stock *i*, for the period from month *m* to month *m+j*, *m* = January 2008, *j* = 0 to 23, $\beta_i^{LIQ}$is the coefficient of either Sadka or Pastor and Stambaugh risk factor from the previous regression, $\beta_i^{RET(LIQ)}$is from the previous regression with LIQ_m is based on Sadka (Pastor and Stambaugh) if β_i^{LIQ} in (1) is of Sadka (Pastor and Stambaugh), *ILLIQ* is the either *Amihud* or *Amihud_HF*, and η is an error term. The model is estimated cross-sectionally each of the 24 crisis months. Four variations of the model are considered: Sadka-Amihud (Panel A), Pastor and Stambaugh-Amihud (Panel B), Sadka-high-frequency Amihud (Panel C), and Pastor and Stambaugh-high-frequency Amihud (Panel D). When *ILLIQ=Amihud*, $\lambda_{3,j}$ is divided by 1000 for convenience. Stocks with less than 100 trading days during 2007 or with less than 24 monthly observations during the period 2003-2007 are excluded from the analysis. I only include NYSE and AMEX stocks whose prices are between $5 and $1000 as per their last trading day during the pre-crisis period. The data is subject to further cleaning steps that are detailed in the "Data" section. The final sample includes 2645 stocks. P-values between 5% and 10%, between 1% and 5%, and less than 1%, are indicated by *, **, and ***, respectively.

Panel A: $\beta_i^{RET(LIQ)} = \beta_i^{RET(Sadka)}$, $\beta_i^{LIQ} = \beta_i^{Sadka}$, *and* $ILLIQ_i = Amihud_i$

Month	$\lambda_{0,j}$	$\lambda_{1,j}$	$\lambda_{2,j}$	$\lambda_{3,j}$
Jan 08	0.0028	-0.0301***	0.0003	1.8014*
Feb 08	-0.0394***	-0.0108***	-0.0006	4.7354***
Mar 08	-0.0387***	-0.0210***	-0.0058***	4.6959***
Apr 08	0.0010	-0.0132**	-0.0078***	1.0096
May 08	0.0250***	-0.0089	-0.0081***	2.0360
Jun 08	-0.0355***	-0.0316***	-0.0124***	6.6960**
Jul 08	-0.0295***	-0.0401***	-0.0125***	2.8819
Aug 08	-0.0142	-0.0352***	-0.0101***	0.9059
Sep 08	-0.1088***	-0.0560***	-0.0120***	2.0094
Oct 08	-0.2072***	-0.1520***	-0.0171***	3.9754
Nov 08	-0.2944***	-0.1849***	-0.0202***	4.1223
Dec 08	-0.2567***	-0.1596***	-0.0148***	-3.0120
Jan 09	-0.2280***	-0.2257***	-0.0134***	0.9961
Feb 09	-0.3073***	-0.2588***	-0.0128***	0.7663
Mar 09	-0.2772***	-0.2053***	-0.0138***	-0.7912
Apr 09	-0.1897***	-0.0934***	-0.0074**	-1.8732
May 09	-0.1298***	-0.0675***	0.0000	-0.9467
Jun 09	-0.1167***	-0.0801***	0.0002	0.1832
Jul 09	-0.0378**	-0.0538***	0.0030	-6.0843
Aug 09	-0.0077	-0.0251**	0.0092***	-4.2992
Sep 09	0.0346**	-0.0009	0.0107***	-5.7928
Oct 09	0.0146	-0.0246**	0.0096***	-5.1306
Nov 09	0.0411**	-0.0125	0.0102***	-5.5798
Dec 09	0.0709***	0.0081	0.0111***	-6.2991

Panel B: $\beta_i^{RET(LIQ)} = \beta_i^{RET(PS)}$, $\beta_i^{LIQ} = \beta_i^{PS}$, *and* $ILLIQ_i = Amihud_i$

Month	$\lambda_{0,j}$	$\lambda_{1,j}$	$\lambda_{2,j}$	$\lambda_{3,j}$
Jan 08	0.0027	-0.0303***	0.0020	1.8318*
Feb 08	-0.0388***	-0.0124***	0.0335***	4.6341***
Mar 08	-0.0373***	-0.0247***	0.0056	3.9532**
Apr 08	0.0028	-0.0175***	-0.0072	0.0306
May 08	0.0270***	-0.0140**	0.0174	1.0001
Jun 08	-0.0330***	-0.0383***	-0.0070	5.1571*
Jul 08	-0.0275***	-0.0456***	-0.0398	1.3617
Aug 08	-0.0124***	-0.0403***	-0.0078	-0.3267
Sep 08	-0.1079***	-0.0596***	-0.0796**	0.5963
Oct 08	-0.2069***	-0.1550***	-0.1952***	1.9991
Nov 08	-0.2936***	-0.1884***	-0.2457***	1.8025
Dec 08	-0.2575***	-0.1595***	-0.2510***	-4.6101
Jan 09	-0.2282***	-0.2270***	-0.2142***	-0.5190
Feb 09	-0.3075***	-0.2600***	-0.2179***	-0.6885
Mar 09	-0.2761***	-0.2086***	-0.1751***	-2.4231
Apr 09	-0.1884***	-0.0970***	-0.0316	-2.7952
May 09	-0.1293***	-0.0703***	0.0775*	-1.0031
Jun 09	-0.1165***	-0.0821***	0.0513	0.1685
Jul 09	-0.0377**	-0.0552***	0.0751*	-5.7696
Aug 09	-0.0088	-0.0242**	0.1231***	-3.2042
Sep 09	0.0336**	-0.0002	0.1564***	-4.5120
Oct 09	0.0137	-0.0242*	0.1412***	-3.9601
Nov 09	0.0401**	-0.0116	0.1349***	-4.3212
Dec 09	0.0704***	0.0079	0.1861***	-4.9845

Panel C: $\beta_i^{RET(LIQ)} = \beta_i^{RET(Sadka)}$, $\beta_i^{LIQ} = \beta_i^{Sadka}$, *and* $ILLIQ_i = Amihud\_HF_i$

Month	$\lambda_{0,j}$	$\lambda_{1,j}$	$\lambda_{2,j}$	$\lambda_{3,j}$
Jan 08	0.0050	-0.0312***	0.0004**	-2.7681
Feb 08	-0.035***	-0.0128***	-0.0003**	-0.2953*
Mar 08	-0.034***	-0.0229***	-0.0055***	-1.8559***
Apr 08	0.0019	-0.0135**	-0.0077**	-0.9549**
May 08	0.0266***	-0.0096	-0.0080	-2.6656*
Jun 08	-0.030***	-0.0335***	-0.0121**	-2.1481*
Jul 08	-0.027***	-0.0409***	-0.0124**	-4.6341**
Aug 08	-0.0142	-0.0350***	-0.0101**	-5.8262**
Sep 08	-0.108***	-0.0563***	-0.0120**	-5.8012***
Oct 08	-0.204***	-0.1535***	-0.0169**	-2.5750***
Nov 08	-0.290***	-0.1867***	-0.0199**	-0.3646***
Dec 08	-0.259***	-0.1588***	-0.0149**	-4.8777***
Jan 09	-0.226***	-0.2266***	-0.0133**	-5.6386***
Feb 09	-0.305***	-0.2599***	-0.0126**	-8.6268***
Mar 09	-0.277***	-0.2053***	-0.0138**	-3.9492**
Apr 09	-0.191***	-0.0931***	-0.0074*	-5.6189*
May 09	-0.130***	-0.0675***	0.0000	-4.9193*
Jun 09	-0.116***	-0.0807***	0.0003	-5.8966*
Jul 09	-0.043***	-0.0520***	0.0027	-7.5178
Aug 09	-0.0104	-0.0242**	0.0091**	-9.6076*
Sep 09	0.0307**	0.0005	0.0105**	-11.7832**
Oct 09	0.0118	-0.0239*	0.0095**	-14.6316*
Nov 09	0.0377**	-0.0114	0.0101**	-12.9166**
Dec 09	0.0666***	0.0097	0.0108***	-11.4908***

Panel D: $\beta_i^{RET(LIQ)} = \beta_i^{RET(PS)}$, $\beta_i^{LIQ} = \beta_i^{PS}$, *and* $ILLIQ_i = Amihud\_HF_i$

Month	$\lambda_{0,j}$	$\lambda_{1,j}$	$\lambda_{2,j}$	$\lambda_{3,j}$
Jan 08	0.0049	-0.0312***	0.0022	-2.7531
Feb 08	-0.0342	-0.0143***	0.0333*	-0.0765**
Mar 08	-0.0335	-0.0262***	0.0054	-1.7135***
Apr 08	0.0029	-0.0175***	-0.0072	-0.8257**
May 08	0.0277	-0.0143***	0.0172	-2.4370**
Jun 08	-0.0292	-0.0396***	-0.0081	-1.4318**
Jul 08	-0.0266	-0.0459***	-0.0402	-3.0249***
Aug 08	-0.0134	-0.0398***	-0.0082	-4.4016***
Sep 08	-0.1080	-0.0594***	-0.0800*	-4.4465**
Oct 08	-0.2050	-0.1557***	-0.1954**	-2.9568***
Nov 08	-0.2915	-0.1893***	-0.2456**	-0.2032**
Dec 08	-0.2610	-0.1582***	-0.2503**	-5.8983**
Jan 09	-0.2277	-0.2274***	-0.2136**	-5.7128***
Feb 09	-0.3068	-0.2606***	-0.2169*	-8.6457**
Mar 09	-0.2776	-0.2081***	-0.1745*	-4.2806*
Apr 09	-0.1901	-0.0965***	-0.0308	-6.6073*
May 09	-0.1295	-0.0704***	0.0781*	-5.3627*
Jun 09	-0.1154	-0.0827***	0.0518	-6.1937*
Jul 09	-0.0421	-0.0536***	0.0761*	-7.5722
Aug 09	-0.0105	-0.0238**	0.1241*	-8.9654*
Sep 09	0.0309	0.0006	0.1578**	-11.0819***
Oct 09	0.0120	-0.0240*	0.1428*	-14.0268*
Nov 09	0.0378	-0.0110	0.1363**	-12.1922**
Dec 09	0.0673	0.0088	0.1874**	-10.8787**