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Liquidity Level or Liquidity Risk? Evidence from the Financial Crisis

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Although generally considered safe assets, liquid stocks underperformed illiquid stocks during the financial crisis of 2008–2009. The performance of stocks during the crisis can be better explained by their historical liquidity betas (risk) than by their historical liquidity levels. Stocks with different historical liquidity levels did not experience different returns after controlling for liquidity risk. The authors' findings highlight the importance of accounting for both liquidity level and liquidity risk in risk management applications.

"What's your liquidity?" Many investment managers, across various markets and asset classes, continue to face this question in the wake of the recent financial crisis. A savvy manager's typical answer often includes something along the lines of "a significant proportion of our investments are in liquid securities." As important as liquidity may be, does investing in liquid securities offer protection during a crisis? Did large-cap, liquid stocks suffer less than small-cap, illiquid stocks from the fall of 2008 to the end of 2009? How can one anticipate the behavior of stock prices during a crisis?

In our study, we started by highlighting the difference between liquidity level and liquidity risk to ascertain whether the latter is a better predictor of performance during a crisis. We defined the level of a stock's liquidity as the ability to trade large quantities of its shares quickly and at low cost, on average. In contrast, we defined the liquidity risk (beta) of a stock as the covariation of its returns with unexpected changes in aggregate liquidity. The two measures capture different attributes of a stock's liquidity profile. For example, liquidity level may be considered a mean effect, whereas liquidity beta may signify a volatility or correlation effect.

Data and Measures

Our sample consisted of all NYSE- and Amex-listed common stocks whose price was in the $5–$1,000 range at the end of 2007. We used the Amihud illiquidity measure (2002) to ascertain the liquidity level of a given stock. We calculated the Amihud measure, *ILLIQ*, as the daily ratio of the absolute value of the return to the dollar volume, averaged over all trading days in a given period:

$$ILLIQ_i = \frac{1}{D}\sum_{d=1}^{D}\frac{\left|R_{i,d}\right|}{dvol_{i,d}}, \tag{1}$$

where

$R_{i,d}$ = the return of stock i during day d
$dvol$ = the daily dollar volume
D = the number of trading days during the period

Note that a higher value of *ILLIQ* signifies higher illiquidity because a particular dollar volume traded is associated with a relatively high price movement.

In contrast, we calculated the liquidity risk exposure of a given stock by regressing monthly stock returns on the value-weighted return index and an aggregate liquidity risk factor:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i^{Ret}\left(R_{m,t} - R_{f,t}\right) + \beta_i^{Liq}L_{m,t} + \varepsilon_{i,t}, \tag{2}$$

where

$R_{i,t}$ = the return of stock i during month t
$R_{f,t}$ = the monthly risk-free rate
$R_{m,t}$ = the value-weighted market average return
$L_{m,t}$ = a (nontraded) liquidity risk factor
$\varepsilon_{i,t}$ = an error term[1]

The coefficient of the liquidity factor, β_i^{Liq}, measures the return sensitivity of a stock to changes in marketwide liquidity and is the measure of liquidity risk (beta). To estimate liquidity beta, we

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considered two liquidity factors, one proposed by Pástor and Stambaugh (2003) and the other by Sadka (2006).[2] The Pástor–Stambaugh factor is based on daily stock price reversal; the Sadka factor is based on the permanent component of trade-to-trade price impact (see Appendix A for a detailed description of these factors).[3] We estimated both measures monthly at the individual stock level and then averaged them to compose a market measure of liquidity each month. Because price impact measures illiquidity, not liquidity, we added a negative sign to the time series of price impact so that a positive shock could be interpreted as an improvement to market liquidity. Therefore, a higher value of β_i^{Liq} means a lower stock return during a month with a negative liquidity shock (i.e., $L_{m,t}$ is negative). Stocks with higher liquidity betas are more sensitive to market liquidity shocks and are thus considered riskier.[4] Pástor and Stambaugh (2003) reported that liquidity beta typically increases with average stock illiquidity, average volume, and share price and decreases with return volatility and shares outstanding; it has no particular relationship with past performance (momentum).

The Liquidity Level Return Spread

We began our analysis by forming two portfolios on the basis of stock liquidity level. The portfolios were formed only once, at the beginning of 2008, on the basis of liquidity levels measured over 2007. **Table 1** and **Figure 1** report the monthly portfolio returns and cumulative returns for 2008–2009. The spread between the cumulative portfolio return of the illiquid companies and that of the liquid companies was positive throughout most of the crisis

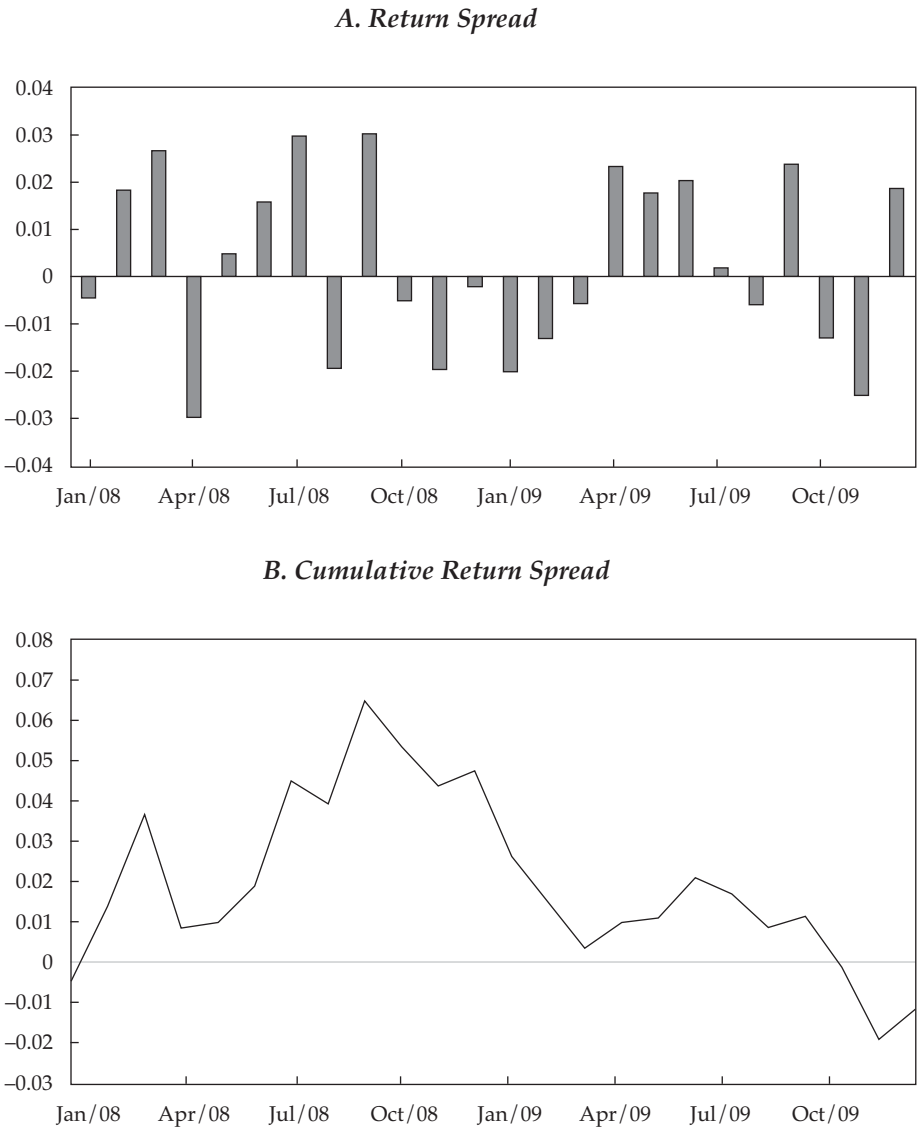
Table 1. Returns of Portfolios Sorted by Liquidity Level, January 2008–December 2009

	Return			Cumulative Return since January 2008		
Month	Liquid	Illiquid	Illiquid – Liquid	Liquid	Illiquid	Illiquid – Liquid
Jan/08	–4.1%	–4.5%	–0.4 pps	–4.1%	–4.5%	–0.4 pps
Feb/08	–3.0	–1.2	1.8	–7.2	–5.8	1.4
Mar/08	–2.6	0.0	2.6	–9.4	–5.6	3.7
Apr/08	5.3	2.3	–3.0	–4.5	–3.6	0.9
May/08	3.3	3.8	0.5	–1.0	0.0	1.0
Jun/08	–9.9	–8.4	1.6	–9.1	–7.2	1.9
Jul/08	–0.7	2.2	2.9	–11.0	–6.4	4.6
Aug/08	4.7	2.8	–1.9	–8.1	–4.1	4.0
Sep/08	–11.7	–8.7	3.0	–18.7	–12.1	6.6
Oct/08	–22.3	–22.8	–0.5	–35.9	–30.5	5.4
Nov/08	–12.0	–13.9	–2.0	–43.0	–38.5	4.5
Dec/08	5.8	5.6	–0.2	–40.9	–36.0	4.8
Jan/09	–7.2	–9.2	–2.0	–45.0	–42.4	2.7
Feb/09	–12.8	–14.1	–1.3	–51.1	–49.6	1.5
Mar/09	11.7	11.1	–0.6	–46.8	–46.4	0.4
Apr/09	24.4	26.7	2.3	–38.4	–37.4	1.0
May/09	7.4	9.1	1.7	–35.9	–34.7	1.1
Jun/09	–0.7	1.3	2.0	–36.1	–34.0	2.1
Jul/09	11.3	11.5	0.2	–29.9	–28.2	1.7
Aug/09	8.0	7.4	–0.6	–26.5	–25.5	0.9
Sep/09	6.0	8.4	2.3	–22.5	–21.3	1.2
Oct/09	–4.7	–6.0	–1.3	–25.6	–25.7	–0.1
Nov/09	4.7	2.2	–2.5	–22.0	–23.9	–1.9
Dec/09	6.0	7.8	1.8	–17.6	–18.7	–1.1

pps = percentage points.

Notes: This table reports the returns and cumulative returns of two portfolios formed on the basis of liquidity level. We computed the cumulative returns over expanding time intervals through each month from January 2008 to December 2009. We measured liquidity level by the average daily Amihud measure (2002) over 2007 for companies with at least 100 nonmissing daily observations. Our sample included NYSE and Amex common stocks whose price was between $5 and $1,000 at the end of 2007.

Figure 1. Return Difference between Illiquid and Liquid Portfolios, January 2008–December 2009



Notes: This figure plots the difference in monthly returns between the illiquid portfolio and the liquid portfolio. We formed two portfolios at the beginning of 2008 on the basis of the liquidity level in 2007, measured by the average daily Amihud measure (2002) over 2007 for companies with at least 100 nonmissing daily observations. The illiquid portfolio contained stocks with the highest Amihud measure in 2007, and the liquid portfolio contained those stocks with the lowest Amihud measure. Our sample included NYSE and Amex common stocks whose price was between $5 and $1,000 at the end of 2007.

period, peaking at 6.6 percentage points at the end of September 2008. These results contrast with the view that the return spread between illiquid and liquid companies represents a premium for liquidity risk because that view would predict that illiquid companies would have underperformed during the liquidity crisis of 2008. The results also suggest that investing in liquid securities does not offer a good hedge against liquidity crises.

The Liquidity Risk–Return Spread

If one is interested in designing a strategy that offers a good hedge against unexpected drops in aggregate liquidity, a more appropriate approach would be to form portfolios on the basis of historical exposure to liquidity risk. With that in mind, we sorted companies into two portfolios on the basis of liquidity beta measured over 2003–2007 (60 months). **Table 2** and **Figure 2** report results for two

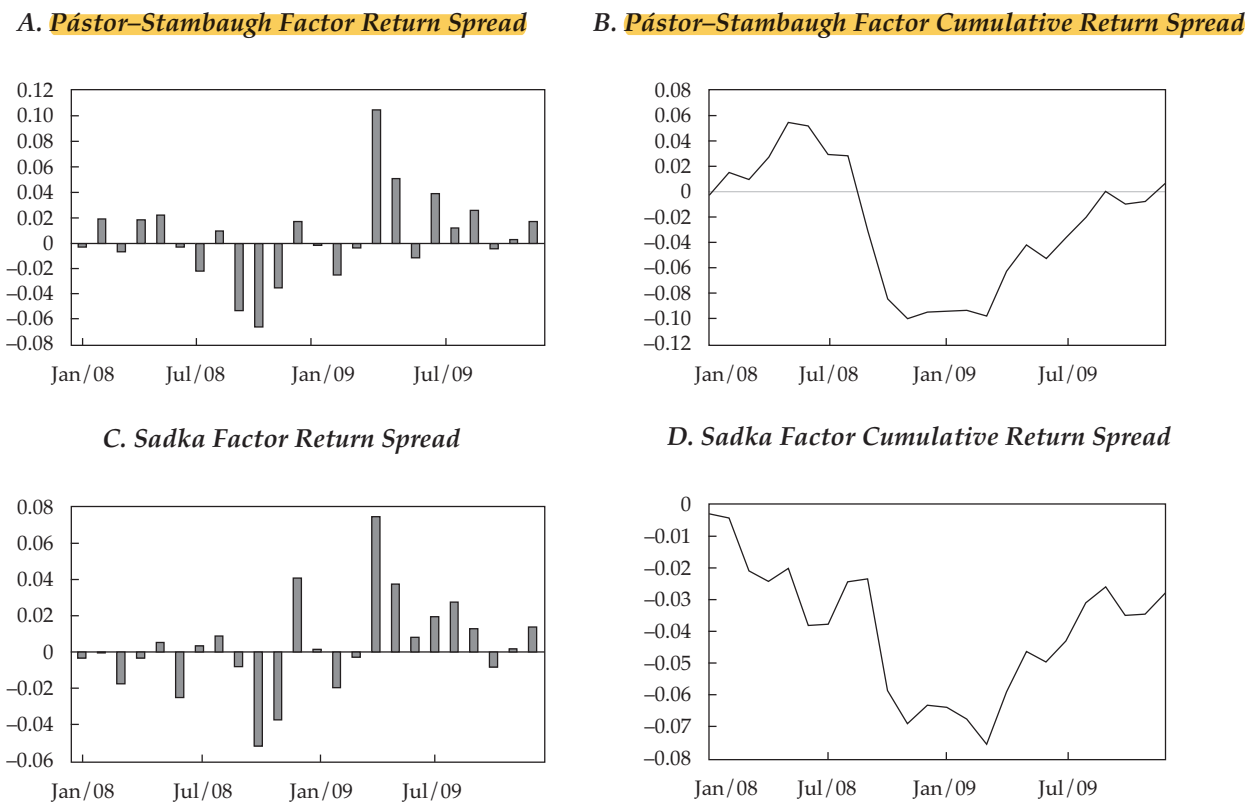
Table 2. Returns of Portfolios Sorted by Liquidity Risk, January 2008–December 2009

	Pástor–Stambaugh Factor			Sadka Factor		
Month	Low Liquidity Risk	High Liquidity Risk	High Risk – Low Risk	Low Liquidity Risk	High Liquidity Risk	High Risk – Low Risk
Return						
Jan/08	–4.0%	–4.2%	–0.2 pps	–3.9%	–4.3%	–0.4 pps
Feb/08	–3.2	–0.9	2.3	–2.0	–2.0	0.0
Mar/08	–0.7	–1.5	–0.9	–0.3	–1.9	–1.6
Apr/08	3.3	5.0	1.8	4.3	3.9	–0.4
May/08	2.1	4.8	2.8	3.2	3.7	0.5
Jun/08	–9.6	–9.3	0.3	–8.3	–10.7	–2.4
Jul/08	2.0	–0.1	–2.1	1.0	0.9	0.0
Aug/08	3.6	4.7	1.1	3.8	4.5	0.7
Sep/08	–7.8	–12.4	–4.6	–9.8	–10.3	–0.5
Oct/08	–19.5	–25.7	–6.2	–20.1	–25.1	–5.0
Nov/08	–11.5	–14.4	–2.9	–11.2	–14.7	–3.4
Dec/08	5.1	6.0	0.9	3.6	7.6	3.9
Jan/09	–8.7	–8.4	0.3	–8.5	–8.5	0.0
Feb/09	–12.6	–14.6	–2.0	–12.6	–14.6	–1.9
Mar/09	11.5	10.8	–0.7	11.5	10.8	–0.6
Apr/09	21.0	30.0	9.0	22.0	29.2	7.2
May/09	5.2	10.0	4.9	5.9	9.4	3.5
Jun/09	0.7	–0.1	–0.8	–0.1	0.8	0.9
Jul/09	9.9	13.3	3.4	10.6	12.5	1.9
Aug/09	7.3	8.2	0.9	6.5	9.0	2.5
Sep/09	5.4	8.1	2.6	6.1	7.4	1.3
Oct/09	–5.3	–5.3	0.0	–4.9	–5.7	–0.8
Nov/09	3.7	3.6	–0.1	3.6	3.7	0.1
Dec/09	5.7	8.0	2.3	6.2	7.6	1.4
Cumulative return						
Jan/08	–4.0%	–4.2%	–0.2 pps	–3.9%	–4.3%	–0.4 pps
Feb/08	–7.2	–5.3	1.9	–6.0	–6.5	–0.4
Mar/08	–7.7	–6.6	1.1	–6.2	–8.2	–2.0
Apr/08	–4.9	–2.1	2.8	–2.3	–4.7	–2.4
May/08	–2.9	2.8	5.7	0.9	–1.0	–1.9
Jun/08	–11.0	–5.1	6.0	–6.3	–9.9	–3.6
Jul/08	–10.2	–6.6	3.6	–6.5	–10.4	–3.9
Aug/08	–7.3	–3.8	3.6	–4.2	–6.9	–2.7
Sep/08	–14.0	–15.9	–1.9	–13.8	–16.1	–2.3
Oct/08	–29.4	–36.8	–7.4	–30.2	–36.0	–5.7
Nov/08	–36.6	–45.3	–8.7	–37.6	–44.2	–6.6
Dec/08	–34.5	–42.9	–8.4	–35.7	–41.7	–6.0
Jan/09	–40.0	–48.2	–8.1	–41.0	–47.2	–6.2
Feb/09	–46.8	–54.9	–8.1	–47.5	–54.1	–6.6
Mar/09	–42.5	–51.2	–8.7	–43.2	–50.7	–7.5
Apr/09	–35.1	–40.7	–5.6	–35.0	–41.0	–6.0
May/09	–33.7	–37.4	–3.7	–33.1	–38.0	–4.9
Jun/09	–32.9	–37.6	–4.7	–32.7	–37.8	–5.1
Jul/09	–27.3	–30.6	–3.3	–26.7	–31.2	–4.5
Aug/09	–25.0	–26.7	–1.7	–24.2	–27.5	–3.4
Sep/09	–22.2	–21.5	0.8	–20.4	–23.3	–2.9
Oct/09	–25.4	–25.3	0.1	–23.5	–27.3	–3.7
Nov/09	–22.7	–22.4	0.3	–20.7	–24.4	–3.7
Dec/09	–18.7	–17.0	1.7	–16.4	–19.3	–2.9

pps = percentage points.

Notes: This table reports the returns and cumulative returns of two portfolios sorted by liquidity beta. We computed the cumulative returns over expanding time intervals through each month from January 2008 to December 2009. Using monthly data from January 2003 to December 2007, we estimated a company's liquidity beta by regressing its monthly excess returns on the market risk premium and a liquidity factor—either the Pástor–Stambaugh factor (2003) or the Sadka factor (2006). We included in the portfolios only companies with at least 24 monthly return observations to estimate liquidity beta. Our sample included NYSE and Amex common stocks whose price was between $5 and $1,000 at the end of 2007.

Figure 2. Return Difference and Cumulative Return Difference between High Liquidity Risk and Low Liquidity Risk Portfolios, January 2008–December 2009



Notes: This figure plots the difference in monthly returns between the high liquidity risk portfolio and the low liquidity risk portfolio, which we formed at the beginning of 2008 on the basis of liquidity beta. Using monthly data from January 2003 to December 2007, we estimated a company's liquidity beta by regressing its monthly excess returns on the market risk premium and a liquidity factor—either the Pástor–Stambaugh factor (2003) or the Sadka factor (2006). We included in the portfolios only companies with at least 24 monthly return observations to estimate liquidity beta. Our sample included NYSE and Amex common stocks whose price was between $5 and $1,000 at the end of 2007.

sets of portfolio sorts, each using a different liquidity factor to measure liquidity risk. For both liquidity factors, we can see that the return spread between high liquidity risk stocks and low liquidity risk stocks sharply declined around the crisis period, followed by a rebound after the first quarter of 2009. Note that the liquidity risk measure is based on the historical sensitivity of stock returns to the liquidity factor. Thus, these results highlight the out-of-sample predictability of liquidity risk. When a liquidity crisis hits the market, the high liquidity risk stocks drop more than the low liquidity risk stocks. Therefore, one would pursue the opposite strategy to hedge against liquidity risk (i.e., go long the low liquidity risk stocks and short the high liquidity risk stocks).

Double Sorts

To better understand the relationship between liquidity level and liquidity risk during the 2008–09 crisis, we constructed a 2-by-2 portfolio sort on liquidity level and liquidity risk (we formed the portfolios independently by each variable). **Table 3** reports the equal-weighted averages of liquidity level, liquidity risk, and market capitalization (in logs) for the stocks in each portfolio. As expected, the liquid portfolios seem to include larger stocks, on average, than do the illiquid portfolios. Yet, there is no substantial difference in company size across portfolios with different liquidity risks. This finding suggests that some large-cap companies, although liquid, entail significant liquidity risk and that some small-cap, illiquid stocks bear a low liquidity risk exposure.

Table 3. Characteristics of Portfolios Sorted by Liquidity Level and Liquidity Risk, January 2003–December 2007

	Liquid Low Risk	Liquid High Risk	Illiquid Low Risk	Illiquid High Risk
Pástor–Stambaugh factor				
Amihud measure (10^{-3})	0.279	0.365	272.9	106.2
Liquidity risk	–0.079	0.257	–0.116	0.279
Log(market cap in $ millions)	9.032	8.514	6.110	6.023
Sadka factor				
Amihud measure (10^{-3})	0.313	0.328	205.8	168.1
Liquidity risk	–1.379	2.224	–1.969	2.921
Log(market cap in $ millions)	8.865	8.698	6.230	5.900

Notes: This table reports characteristics of four portfolios formed on the basis of liquidity level and liquidity risk. We measured liquidity level by the average daily Amihud measure (2002) over 2007 for companies with at least 100 nonmissing daily observations. Using monthly data from January 2003 to December 2007, we estimated liquidity risk by regressing a company's monthly excess returns on market excess returns and a liquidity factor—either the Pástor–Stambaugh factor (2003) or the Sadka factor (2006). We included in the portfolios only companies with at least 24 monthly return observations to estimate liquidity beta. Our sample included NYSE and Amex common stocks whose price was between $5 and $1,000 at the end of 2007.

To demonstrate that not all liquid stocks behaved in the same way during the crisis, we first investigated the liquidity dynamics of two portfolios: the liquid, high liquidity risk stocks and the liquid, low liquidity risk stocks. For each portfolio, we calculated its average monthly liquidity from August 2008 to December 2009. We calculated the monthly liquidity of each stock by using the Amihud measure (2002) computed over the trading days of each month. The results are plotted in **Figure 3**, which shows that the portfolios were fairly liquid in August 2008, as indicated by values very close to zero. After September 2008, both portfolios exhibited a drop in liquidity, as shown by the increase in the Amihud illiquidity measure. But their liquidity deteriorated to different extents. In general, the liquid stocks with high liquidity risk had a more significant drop in liquidity than the liquid stocks with low liquidity risk—with the exception of November 2008 in Panel A, when the Pástor–Stambaugh (2003) liquidity factor was used to estimate liquidity risk. These results suggest that among the liquid stocks during the crisis, those with high liquidity risk became less liquid than those with low liquidity risk.

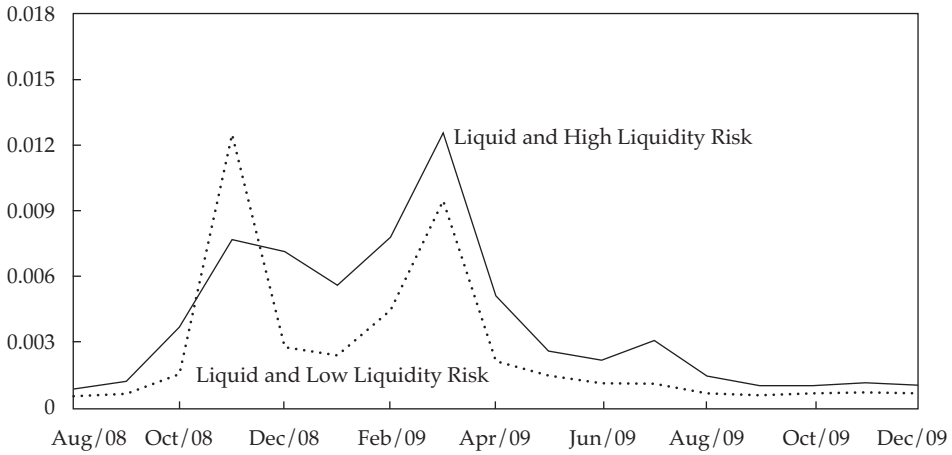
A different and arguably more important question concerns the performance of the portfolios during the crisis period. **Table 4** and **Figure 4** track the performance of the portfolios from September 2008 to December 2009. Table 4 reports the cumulative returns for the four portfolios sorted by liquidity level and liquidity risk that we estimated by using the Pástor–Stambaugh (2003) liquidity factor (Panel A) and the Sadka (2006) liquidity factor (Panel B). The return values are all negative, which suggests that all portfolios experienced a price decline over the sample period. Figure 4 depicts the gross cumulative returns of the portfolios over the sample period, all of which are below 1, reflecting the poor performance of the stock market during the crisis. The four portfolios appear to fall into two distinct groups that are based on liquidity risk. The two high liquidity risk portfolios lie well below the two low liquidity risk portfolios. In each liquidity risk group, the differences between the two portfolios with different pre-crisis liquidity levels appear to be small. These results suggest that although all four portfolios experienced a price decline over the sample period, the high liquidity risk portfolios, both liquid and illiquid, exhibited a more significant drop than the low liquidity risk portfolios. In both liquidity risk groups, the differences between liquid and illiquid stocks seem insignificant. Some stocks that were considered liquid by historical measures suffered more than other liquid stocks. In some cases, the price of liquid stocks dropped more than that of illiquid stocks. This finding suggests that liquidity risk is more appropriate than liquidity level for predicting performance during crisis periods. We obtained similar results by using market capitalization as of the end of 2007 instead of liquidity level to form the portfolios.

Regression Analysis

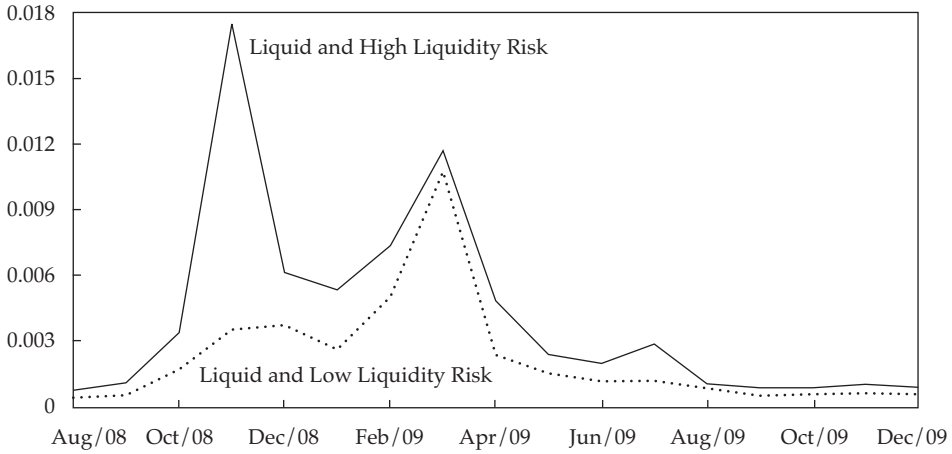
To gauge the statistical significance of our findings, we ran cross-sectional regressions of the form

Figure 3. Liquidity of Portfolios Sorted by Liquidity Level and Liquidity Risk, September 2008–December 2009

A. Pástor–Stambaugh Factor



B. Sadka Factor



Notes: This figure plots the monthly Amihud liquidity measure (2002), scaled by 10^{-6}, for four portfolios formed on the basis of liquidity level and liquidity risk. We measured liquidity level by the average daily Amihud measure over 2007 for companies with at least 100 nonmissing daily observations. Using monthly data from January 2003 to December 2007, we estimated liquidity risk by regressing a company's monthly excess returns on market excess returns and a liquidity factor—either the Pástor–Stambaugh factor (2003) or the Sadka factor (2006). We included in the portfolios only companies with at least 24 monthly return observations to estimate liquidity beta. Our sample included NYSE and Amex common stocks whose price was between $5 and $1,000 at the end of 2007.

$$R_{i,t\to t+j} = \lambda_{0,j} + \lambda_{1,j}\beta_i^{Ret} + \lambda_{2,j}\beta_i^{Liq} + \lambda_{3,j} ILLIQ_i + \eta_{i,j}, \quad (3)$$

where

$R_{i,t\to t+j}$ = the cumulative return of stock i for the period t through $t + j$

t = September 2008

j = 0 through 15

β_i^{Ret}, β_i^{Liq} = the market return beta and the liquidity beta estimated jointly as in Equation 2 for 2003–2007

$ILLIQ_i$ = the illiquidity measure calculated as in Equation 1 for 2007

$\eta_{i,j}$ = an error term

The results, including the regression coefficients, t-statistics, and R^2s, are reported in **Table 5**. We considered 16 time intervals, all beginning in

Table 4. Cumulative Returns of Portfolios Sorted by Liquidity Level and Liquidity Risk, September 2008–December 2009

	Pástor–Stambaugh Factor				Sadka Factor			
Month	Liquid Low Risk	Liquid High Risk	Illiquid Low Risk	Illiquid High Risk	Liquid Low Risk	Liquid High Risk	Illiquid Low Risk	Illiquid High Risk
Sep/08	–8.6%	–14.6%	–5.9%	–10.6%	–11.3%	–11.8%	–7.8%	–8.8%
Oct/08	–25.6	–36.5	–24.0	–33.8	–28.7	–33.2	–26.1	–31.9
Nov/08	–32.1	–45.1	–33.2	–43.3	–35.6	–41.3	–34.2	–42.7
Dec/08	–30.0	–42.4	–30.8	–40.5	–33.4	–38.8	–32.2	–39.4
Jan/09	–34.9	–46.9	–37.7	–46.8	–38.6	–43.0	–38.7	–46.1
Feb/09	–42.2	–53.2	–45.1	–54.6	–45.2	–50.1	–46.1	–53.9
Mar/09	–37.3	–48.7	–40.8	–51.4	–40.0	–46.0	–42.1	–50.4
Apr/09	–30.1	–36.9	–30.9	–40.5	–31.7	–35.3	–32.5	–39.2
May/09	–27.9	–33.2	–30.3	–36.1	–29.4	–31.6	–31.2	–35.3
Jun/09	–27.0	–34.5	–29.3	–34.6	–29.4	–32.0	–30.1	–33.8
Jul/09	–21.1	–26.3	–22.9	–26.8	–23.1	–24.3	–23.6	–26.2
Aug/09	–17.2	–21.4	–21.2	–22.6	–19.0	–19.5	–21.8	–22.0
Sep/09	–14.2	–15.7	–17.6	–17.1	–15.3	–14.6	–17.4	–17.3
Oct/09	–17.4	–20.4	–21.9	–22.5	–18.8	–19.0	–21.1	–23.4
Nov/09	–13.0	–17.1	–20.5	–19.9	–14.6	–15.3	–19.8	–20.6
Dec/09	–9.6	–10.7	–15.0	–13.9	–10.7	–9.6	–14.7	–14.2

Notes: This table reports the cumulative returns of four portfolios formed on the basis of liquidity level and liquidity risk. We computed the returns over expanding time intervals through each month from September 2008 to December 2009. We measured liquidity level by the average daily Amihud measure (2002) over 2007 for companies with at least 100 nonmissing daily observations. Using monthly data from January 2003 to December 2007, we estimated liquidity risk by regressing a company's monthly excess returns on market excess returns and a liquidity factor—either the Pástor–Stambaugh factor (2003) or the Sadka factor (2006). Our sample included NYSE and Amex common stocks whose price was between $5 and $1,000 at the end of 2007.

September 2008 and ending in each of the subsequent months through December 2009. In connection with our earlier discussion of the liquidity level return spread, we also report regression results from using $ILLIQ_i$ as a single explanatory variable.

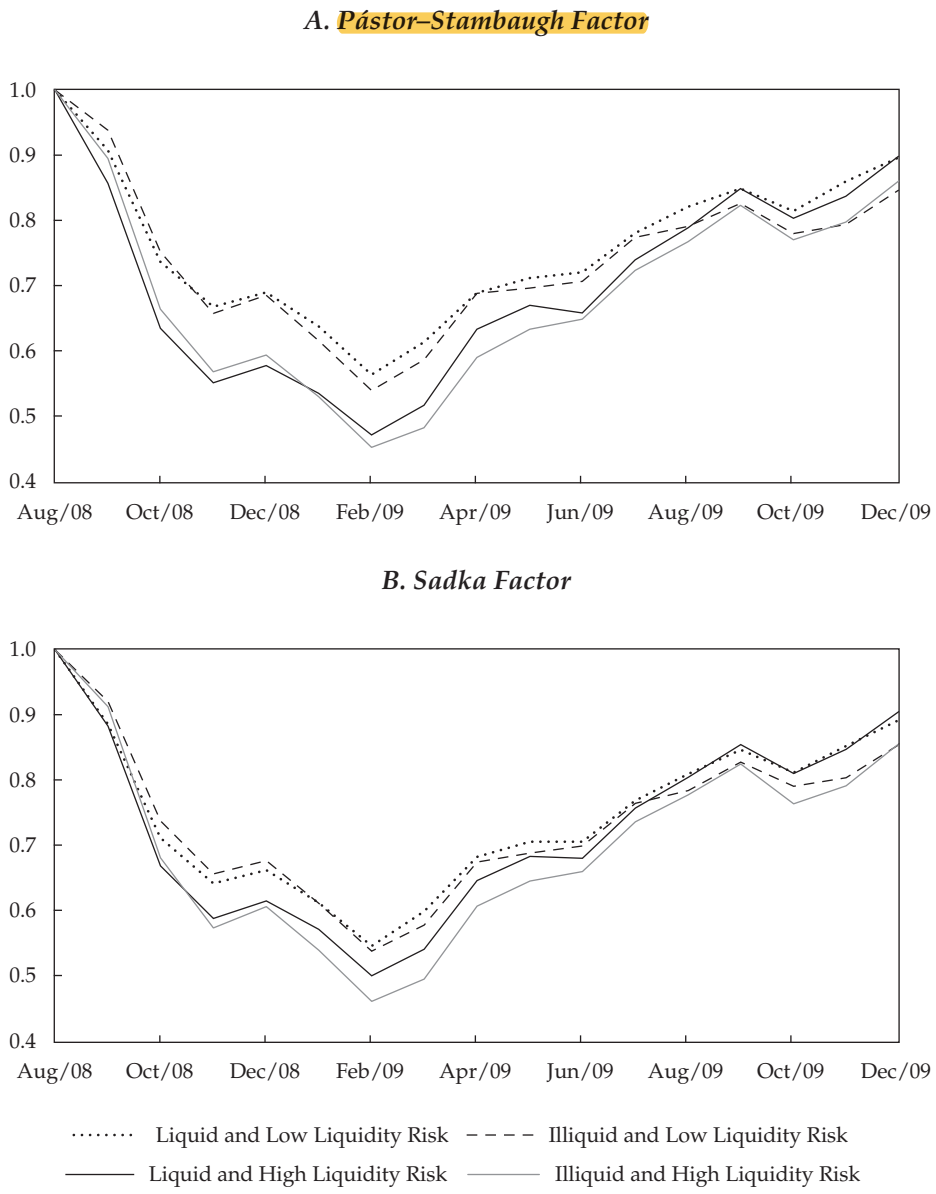
Several interesting findings emerged. First, when considered as a single explanatory variable, the illiquidity of a stock generally assumes a positive (and sometimes significant) coefficient, which is consistent with the results of Table 1 and Figure 1. Second, market return betas have significant coefficients, which is consistent with the market return index's capturing some systematic return variation among stocks. Third, liquidity betas are also significant through about mid-2009, which suggests that liquidity risk has incremental risk-relevant information. Fourth, even though the illiquidity of a stock is generally positive when considered as a single variable, it turns out to be insignificant after controlling for both market return beta and liquidity beta. Finally, the regression R^2s seem relatively high given that we performed the regressions on individual companies, which implies that market return beta and liquidity beta explain a significant proportion of the cross-sectional variation in stock returns during the financial crisis. Overall, the results of our regression analysis are consistent with those of our portfolio analysis and provide further evidence for the predictive power of liquidity risk—and liquidity level's lack thereof—vis-à-vis stock returns in periods of crisis.

Liquidity Level and Risk over Time

Thus far, our findings suggest little correlation between the liquidity level return spread and liquidity risk—that is, the performance of illiquid stocks relative to liquid stocks is not highly related to the overall liquidity conditions in the market. The implication is that liquid stocks do not necessarily serve as a valuable hedging tool against liquidity crises.

To study this relationship more closely, we tracked the monthly liquidity level return spread for 1968–2008 by sorting stocks into two portfolios at the beginning of each year on the basis of the Amihud measure calculated over the previous year and comparing their returns over the following year. We ran a time-series regression of the monthly liquidity level return spread on each liquidity factor (the Sadka factor is available from

Figure 4. Gross Cumulative Returns of Portfolios Sorted by Liquidity Level and Liquidity Risk, September 2008–December 2009



Notes: This figure plots the gross cumulative returns of four portfolios formed on the basis of liquidity level and liquidity risk. We computed the cumulative returns over expanding time intervals through each month from September 2008 to December 2009. We measured liquidity level by the average daily Amihud measure (2002) over 2007 for companies with at least 100 nonmissing daily observations. Using monthly data from January 2003 to December 2007, we estimated liquidity risk by regressing a company's monthly excess returns on market excess returns and a liquidity factor—either the Pástor–Stambaugh factor (2003) or the Sadka factor (2006). We included in the portfolios only companies with at least 24 monthly return observations to estimate liquidity beta. Our sample included NYSE and Amex common stocks whose price was between $5 and $1,000 at the end of 2007.

1983 on). To allow for some response time, we also included two monthly lags of each factor in the regressions. The results are reported in **Table 6**. Although the regression coefficients are generally positive—and even significant for the Sadka factor—the regression R^2s are lower than 3.5 percent, which suggests a very low correlation between the liquidity level return spread and market liquidity. Thus, our results for the recent liquidity crisis seem to extend to a longer sample period.

Table 5. Explaining the Cross Section of Stock Returns, September 2008–December 2009
(*t*-statistics in brackets)

	Illiquidity Only		Pástor–Stambaugh Factor				Sadka Factor			
Month	Illiquidity	R^2	Market Risk	Liquidity Risk	Illiquidity	R^2	Market Risk	Liquidity Risk	Illiquidity	R^2
Sep/08	0.003	0.000	–0.037	–0.083	–0.024	0.053	–0.043	0.000	–0.024	0.039
	[0.13]		[–6.22]	[–4.99]	[–1.13]		[–7.19]	[–0.22]	[–1.15]	
Oct/08	0.071	0.005	–0.076	–0.169	0.017	0.123	–0.085	–0.006	0.020	0.098
	[2.44]		[–9.69]	[–7.73]	[0.62]		[–10.79]	[–3.24]	[0.71]	
Nov/08	0.046	0.001	–0.097	–0.186	–0.019	0.129	–0.106	–0.010	–0.015	0.114
	[1.32]		[–10.61]	[–7.30]	[–0.57]		[–11.57]	[–4.41]	[–0.46]	
Dec/08	–0.004	0.000	–0.090	–0.175	–0.064	0.098	–0.099	–0.008	–0.062	0.084
	[–0.11]		[–9.05]	[–6.30]	[–1.79]		[–9.97]	[–3.22]	[–1.72]	
Jan/09	0.020	0.000	–0.100	–0.162	–0.046	0.115	–0.108	–0.008	–0.042	0.105
	[0.56]		[–10.39]	[–5.98]	[–1.34]		[–11.30]	[–3.29]	[–1.21]	
Feb/09	0.081	0.004	–0.094	–0.158	0.019	0.113	–0.101	–0.008	0.024	0.104
	[2.32]		[–9.97]	[–5.98]	[0.57]		[–10.81]	[–3.68]	[0.70]	
Mar/09	0.034	0.001	–0.087	–0.197	–0.025	0.098	–0.095	–0.011	–0.019	0.084
	[0.90]		[–8.44]	[–6.83]	[–0.69]		[–9.33]	[–4.29]	[–0.52]	
Apr/09	0.057	0.002	–0.055	–0.156	0.015	0.047	–0.062	–0.008	0.020	0.038
	[1.45]		[–5.07]	[–5.15]	[–0.39]		[–5.75]	[–3.28]	[0.53]	
May/09	0.084	0.004	–0.058	–0.093	0.044	0.039	–0.062	–0.004	0.047	0.036
	[2.25]		[–5.51]	[–3.14]	[–1.17]		[–5.97]	[–1.71]	[1.24]	
Jun/09	0.088	0.004	–0.066	–0.111	0.042	0.042	–0.071	–0.003	0.045	0.036
	[2.12]		[–5.67]	[–3.40]	[1.02]		[–6.20]	[–1.06]	[1.07]	
Jul/09	0.047	0.001	–0.059	–0.099	0.006	0.026	–0.064	–0.001	0.008	0.021
	[1.02]		[–4.56]	[–2.73]	[0.13]		[–5.01]	[–0.36]	[0.16]	
Aug/09	0.021	0.000	–0.045	–0.072	–0.010	0.014	–0.051	0.005	–0.012	0.014
	[0.45]		[–3.45]	[–1.95]	[–0.22]		[–3.90]	[1.47]	[–0.25]	
Sep/09	0.003	0.000	–0.036	–0.010	–0.020	0.006	–0.039	0.007	–0.024	0.009
	[0.05]		[–2.55]	[–0.26]	[–0.39]		[–2.77]	[2.18]	[–0.46]	
Oct/09	0.004	0.000	–0.060	–0.022	–0.034	0.019	–0.062	0.002	–0.035	0.019
	[0.08]		[–4.67]	[–0.61]	[–0.72]		[–4.87]	[0.77]	[–0.74]	
Nov/09	–0.005	0.000	–0.058	–0.028	–0.042	0.016	–0.060	0.002	–0.042	0.016
	[–0.10]		[–4.18]	[–0.71]	[–0.82]		[–4.40]	[0.66]	[–0.84]	
Dec/09	0.010	0.000	–0.043	–0.006	–0.016	0.007	–0.046	0.006	–0.020	0.009
	[0.18]		[–2.77]	[–0.13]	[–0.29]		[–2.98]	[1.72]	[–0.36]	

Notes: This table reports the results from the cross-sectional regressions of cumulative returns on market beta, liquidity beta, and the Amihud measure of illiquidity (2002): $[Cumulative\ return]_{i,t\to t+j} = \lambda_{0,j} + \lambda_{1,j}[Market\ risk]_i + \lambda_{2,j}[Liquidity\ risk]_i + \lambda_{3,j}[Illiquidity]_i + \eta_{i,j}$. We estimated each company's market risk and liquidity risk from a time-series regression of the company's monthly excess returns on monthly market excess returns and a liquidity factor—either the Pástor–Stambaugh factor (2003) or the Sadka factor (2006)—from January 2003 to December 2007. We included in the portfolios only companies with at least 24 monthly return observations to estimate liquidity beta. We measured illiquidity by the average daily Amihud measure (2002) over 2007 for companies with at least 100 nonmissing daily observations. Our sample included NYSE and Amex common stocks whose price was between $5 and $1,000 at the end of 2007.

Conclusion

In sum, our findings emphasize the importance of distinguishing between a stock's liquidity level and its liquidity risk. We showed that liquidity risk, rather than liquidity level, can explain the cross section of stock returns during the financial crisis of 2008–2009. We also showed that liquid stocks suffered as much as—in some cases, more than—illiquid stocks during the crisis. With some benefit of hindsight, these results are perhaps not particularly surprising. After all, which stocks are more likely to suffer during a liquidity crisis? We suggest that portfolio managers should worry about liquid stocks with high liquidity risk because their liquidity is likely to dry up during a crisis whereas the illiquid stocks will continue to be illiquid. Liquidity beta offers a way to measure this type of risk. Furthermore, because variances are more persistent than means, liquidity beta, albeit an estimate itself, could provide more accurate out-of-sample

Table 6. Liquidity Return Spread and Liquidity Risk over Long Time Horizons, 1968–2008
(*t*-statistics in brackets)

Pástor–Stambaugh Factor					Sadka Factor				
Intercept	Market Liquidity Shock	First Lag	Second Lag	R^2	Intercept	Market Liquidity Shock	First Lag	Second Lag	R^2
1968–2008					1983–2008				
0.005	0.029			0.002	0.001	0.727			0.017
[2.51]	[0.94]				[0.28]	[2.28]			
0.005	0.028	0.056		0.009	0.001	0.725	0.056		0.017
[2.54]	[0.92]	[1.82]			[0.29]	[2.27]	[0.18]		
0.005	0.028	0.057	–0.003	0.009	0.001	0.715	0.048	0.293	0.020
[2.53]	[0.92]	[1.82]	[–0.11]		[0.32]	[2.23]	[0.15]	[0.92]	
1968–2007					1983–2007				
0.005	0.038			0.003	0.000	1.097			0.030
[2.50]	[1.16]				[0.14]	[3.00]			
0.005	0.035	0.062		0.011	0.000	1.099	0.246		0.031
[2.51]	[1.09]	[1.92]			[0.15]	[3.00]	[0.68]		
0.005	0.035	0.062	–0.017	0.011	0.000	1.100	0.253	0.263	0.033
[2.51]	[1.10]	[1.94]	[–0.51]		[0.15]	[3.00]	[0.69]	[0.73]	

Notes: $Liquidity\ return\ spread(t) = a + bLiq(t) + b_1Liq(t-1) + b_2Liq(t-2) + e(t)$. This table presents the estimation results of regressing the monthly illiquidity return spread on the monthly aggregate liquidity shock over 1968–2008 for the Pástor–Stambaugh factor (2003) and over 1983–2008 for the Sadka factor (2006). At the beginning of each year, we formed 10 portfolios on the basis of the illiquidity level in the previous year, measured by the average daily Amihud measure (2002) over the year, for companies with at least 100 nonmissing daily observations. The most illiquid portfolio contained stocks with the highest Amihud measure in the previous year, and the most liquid portfolio contained stocks with the lowest Amihud measure. We defined the monthly illiquid return spread as the return difference between the most illiquid portfolio and the most liquid portfolio. Our sample included NYSE and Amex common stocks whose price was between $5 and $1,000 over 1968–2008.

signals for risk management than could liquidity level. Finally, the U.S. SEC and the U.S. Commodity Futures Trading Commission recently published a report on the "flash crash" of 6 May 2010.[5] Once again, large companies, such as Procter & Gamble and Accenture, were among those most affected by that event, which lends our argument further support. Because the correlation between stock liquidity variations has been increasing over the past few decades (see Kamara, Lou, and Sadka 2010), these results highlight the importance of accounting for liquidity risk in risk management applications.

We gratefully acknowledge the comments of Robert Korajczyk.

This article qualifies for 1 CE credit.

Appendix A. Estimation Procedures for Liquidity Factors

This appendix summarizes the estimation procedures that we used for the Pástor and Stambaugh (2003) and Sadka (2006) liquidity factors.

Pástor and Stambaugh (2003). Using daily data, we estimated the following regression per company per month:

$$r^e_{i,d+1,t} = \theta_{i,t} + \phi_{i,t} r_{i,d,t} + \gamma_{i,t} sign\left(r^e_{i,d,t}\right) v_{i,d,t} + \varepsilon_{i,d+1,t}, \quad \text{(A1)}$$

where

$r_{i,d,t}$ = the return on stock i on day d in month t

$r^e_{i,d,t} = r_{i,d,t} - r_{m,d,t}$

$r_{m,d,t}$ = the CRSP value-weighted market return on day d in month t

$v_{i,d,t}$ = the dollar volume for stock i on day d in month t

$\varepsilon_{i,d+1,t}$ = an error term

The measure γ represents the dimension of liquidity associated with temporary price changes that accompany order flow. Capturing a price-reversal effect, it is typically negative, and the more negative its value, the more illiquid the stock.

After estimating γ per company per month, we averaged it across companies monthly, thereby creating an aggregate time series. We implemented two final adjustments to obtain the liquidity risk factor. First, we made an adjustment to

capture the significant change in company market capitalization over time, which affects this measure of liquidity. Second, because the time series exhibits significant persistence, we calculated liquidity shocks as the error terms from a model similar to an autoregressive model of order 2.

Sadka (2006). Using intraday data, we estimated the following regression per company per month:

$$\Delta p_t = \Psi D_t + \lambda D_t V_t + \bar{\Psi} \Delta D_t + \bar{\lambda} \Delta D_t V_t + y_t, \quad \text{(A2)}$$

where

Δp_t = the change in transaction price
V_t = the order flow (trade size)
D_t = an indicator variable that receives a value of 1 for a buyer-initiated trade and –1 for a seller-initiated trade
y_t = the unobservable pricing error

We classified a trade as buyer (seller) initiated if the trade price was above (below) the midpoint of the quoted bid and ask as of one second before the transaction occurred (trades priced exactly at the midpoint were discarded from the estimation). We further adjusted Equation A2 to account for predictability in order flow and block trades. Specifically, we replaced $D_t V_t$ with unanticipated order flow, calculated as the fitted error term from a five-lag autocorrelation regression of $D_t V_t$ (we also replaced D_t with its unanticipated component), and we included a dummy variable for each of the four terms to separate trades of more than 10,000 shares.

The regression thus separates four components of price impact: fixed effects unrelated to trade size (ψ and $\bar{\psi}$ [permanent and transitory, respectively]) and variable costs (λ and $\bar{\lambda}$ [permanent and transitory, respectively]). A permanent price effect carries on to the next trade; a transitory effect concerns only the current trade price.

After estimating the four components of price impact per company per month, we averaged each component across companies monthly, thereby creating four aggregate time series. We implemented two final adjustments to obtain liquidity risk factors. First, because price impacts measure illiquidity rather than liquidity, we added a negative sign to each time series so that negative values could represent a deterioration in market liquidity. Second, because the time series exhibit significant persistence, we calculated liquidity shocks as the error terms from an autoregressive model of order 2 applied to each time series. Sadka (2006) showed that of the four aggregate price-impact factors, only the permanent-variable liquidity factor, λ, is priced in the cross section of stocks. Therefore, we used that factor for our tests throughout our study.

Notes

1. We thank Ken French for providing the risk-free rate and market return on his website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html).
2. We thank Lubos Pástor for providing the Pástor–Stambaugh aggregate measure (2003) on his website (http://faculty.chicagobooth.edu/lubos.pastor/research).
3. Sadka (2006) estimated four components of price impact: permanent-fixed, transitory-fixed, permanent-variable, and transitory-variable. He showed that only the permanent-variable component is priced in the cross section of stocks. Therefore, we used that component as a liquidity factor.
4. The nondiversifiability of market liquidity shocks remains a subject of research. Korajczyk and Sadka (2008) reported that systematic liquidity variations capture 20–60 percent of individual company liquidity variation, depending on the liquidity measure used. Moreover, shocks to assets' liquidity have a common component across measures, which accounts for most of the explained variation in individual liquidity measures.
5. See www.sec.gov/news/studies/2010/marketevents-report.pdf.

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