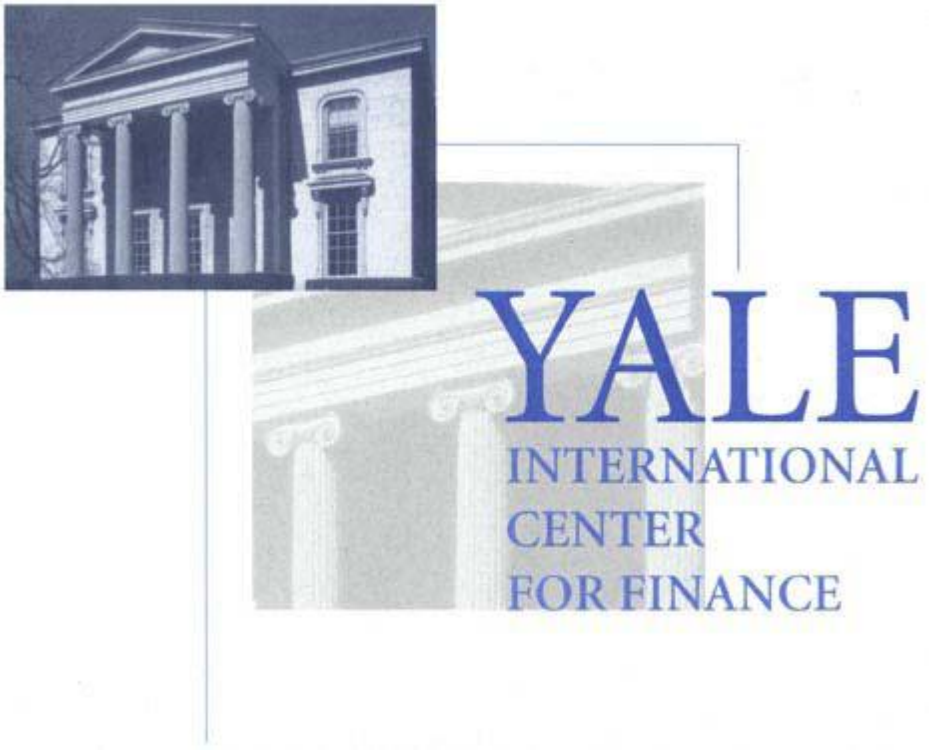

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The Liquidity Style of Mutual Funds

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Abstract

Recent literature indicates that a liquidity investment style – the process of investing in relatively less liquid stocks within the liquid universe of publicly traded stocks – has led to excess returns relative to size and value. While previously documented at the security level, we examine whether this style can be uncovered at the mutual fund level. In aggregate and across a wide range of mutual fund categories, we find that on average mutual funds that held less liquid stocks significantly outperformed mutual funds that held more liquid stocks. This demonstrates that the liquidity premium is sufficiently strong to show up in portfolios where the managers are most likely not directly focusing on liquidity. Surprisingly, the outperformance of the mutual funds that held less liquid stocks was primarily due to superior performance in down markets, especially market crashes.

Introduction

It is relatively well known that less liquid investments tend to outperform more liquid investments. The same holds true within the relatively liquid universe of publicly traded stocks. The generally accepted rationale for a liquidity premium is that all else equal, investors prefer greater liquidity; thus, in order to induce investors to hold less liquid assets, they must have the expectation (but not the guarantee) of a return premium. Using today's nomenclature, one could think of less liquidity as a risk factor, an exotic beta, or a structural alpha related to its extra costs.

Recent literature indicates that the liquidity investment style – the process of investing in relatively less liquid stocks within the liquid universe of publicly traded stocks – produced risk-adjusted returns that rival or exceed those of the three best-known market anomalies: small minus large, value minus growth, and high minus low momentum. For example, Amihud and Mendelson (1986) use the quoted bid-ask spread as a measure of liquidity and tested the relationship between stock returns and liquidity during the period of 1961-1980. They found evidence consistent with the notion of a liquidity premium. Datar, Naik, and Radcliffe (1998) use the turnover rate (number of shares traded as a fraction of the number of shares outstanding) as a proxy for liquidity and find that stock returns are strongly negatively related to their turnover rates, confirming the notion that less liquid stocks provide higher average returns. Overall, the results support the relationship between less liquidity and higher stock returns. Pástor and Stambaugh (2003) demonstrate that market-wide liquidity appears to be a state variable that is important for pricing common stocks. They find that expected stock returns are related cross-sectionally to the sensitivities of stock returns to aggregate liquidity. According to their measure, smaller stocks are less liquid and thus have high sensitivities to aggregate liquidity. In addition, Li, Mooradian, and Zhang (2007) support the hypothesis that market-wide liquidity is an important risk factor and significantly affects expected returns. Recently, Lou and Sadka (2011) document the importance of distinguishing between liquidity level as measured by the illiquidity measure of Amihud (2002) and liquidity risk, which measures sensitivity to changes in market wide liquidity, finding that liquidity risk is a better predictor of stock prices during a crisis than liquidity level.

While stock level liquidity has been explored by academics as an important explanatory "risk factor" and as an ongoing concern for portfolios that need immediate liquidity, it is only recently that it has been explored as an investment style similar to how one might prefer funds with a small-cap. or value bias. To that end and perhaps most importantly for our purposes, using monthly data for the largest 3,500 U.S. stocks by capitalization, starting in 1972, Ibbotson, Chen, and Hu (2011) sort stocks into equally-weighted quartiles based on liquidity. The results clearly show that annually-rebalanced composites of relatively less liquid stocks significantly outperform composites of more liquid stocks after controlling for size, valuation, and momentum. They characterize liquidity as the missing style.[1] Despite these powerful stock level liquidity finds, we are practically unaware of any mutual fund managers that actively seeking less liquid stocks.

Might this emerging investment style and risk factor be present and economically significant among mutual funds? If so, methods of knowingly or unknowingly constructing portfolios of less liquid stocks,

[1] The results of Ibbotson, Chen, and Hu (2011) as well as earlier versions are so compelling that results are documented and updated each year in *Ibbotson's Stocks, Bonds, Bills and Inflation Annual Year Book*. In our opinion, the results of Ibbotson, Chen, and Hu (2011) coupled with the results reported in this paper suggest the ubiquitous four factor model – market, size, valuation, and momentum – should be expanded to include liquidity as a fifth factor. We leave direct testing of this five factor model for further research.

might be beneficial for not only creating mutual funds, but also for selecting mutual funds that are more likely to outperform their peers. If the liquidity style exists in mutual funds, our research might encourage fund managers to avoid trading very liquid (heavily traded) stocks and discourage unnecessary trading. This might be economically meaningful in mitigating the "dark side of trading" described in Dichev, Huang, and Zhou (2011), in which they concluded that excessive stock trading can lead to high market volatility.

Data and Methodology

Investigating whether mutual funds that hold less liquid stocks tend to outperform those that hold more liquid stocks is a data intensive exercise. First, we need an individual stock database that enables us to estimate the liquidity of each individual stock. Next, we need to know the holdings of each individual mutual fund throughout time. Combining data from Morningstar's individual stock database with Morningstar's mutual fund holding database, we are able to build composites of mutual funds based on the weighted average liquidity of the individual stocks held by the mutual funds.

We begin with Morningstar's open-end equity mutual fund universe containing both alive and dead funds. Our primary focus is on the U.S. equity mutual funds, but we also include a sample of non-U.S. equity mutual funds. The Morningstar categories include those of the nine size-valuation style boxes that form the U.S. equity universe, the three valuation-based columns from the style box (value, core, and growth), and the three size-based rows from the style box (large, mid, and small), plus the non-U.S. category.

Morningstar has either monthly or quarterly mutual fund holdings data starting in 1983. However, wide-scale holdings data for most funds were not available until 1995 for the U.S. equity fund universe (and starting in January 2000 for the non-U.S. equity fund universe). For the U.S. equity fund universe, holdings data from January 1995 is used to form the starting composites that we begin tracking in February 1995. The constituents of the composites are based on the previous month's holdings information. This gives us 14 years and 11 months of U.S. performance history, and 9 years and 11 months of non-U.S. performance history. Table 1 summarizes the number of alive funds in the various universes/categories with the required data at the start of the study (Feb. 1995 for U.S. equity categories and Feb. 2000 for the non-U.S. equity fund universe) and at the end of the study.

Table 1: Number of Mutual Funds with Required Data

Morningstar Category	Start Date Number of Funds (Feb 1995)	End Date Number of Funds (Dec 2009)*
Small Value	42	238
Small Core	73	369
Small Growth	123	494
Mid Value	45	229
Mid Core	84	314
Mid Growth	131	527
Large Value	212	719
Large Core	322	1260
Large Growth	262	1048
Small	238	1101
Mid	260	1070
Large	796	3027
Value	299	1186
Core	479	1943
Growth	516	2069
All U.S.	1294	5198
All Non-U.S.**	634	815

*Including defunct funds; **Non-U.S. mutual funds data starts in February 2000.

There are a number of potential measures of liquidity for an individual stock. For simplicity and consistency we focus on the basic stock level "turnover" measure used in Ibbotson, Chen, and Hu (2011): average daily shares traded over the last year divided by the number of shares outstanding. No attempt was made to adjust the number of shares outstanding for free-float. Later, in one of our robustness checks we re-run our analysis using an alternative definition of liquidity.

Bringing the two databases together enables us to estimate each mutual fund's weighted-average liquidity at each point in time. For a given mutual fund, if we did not have a liquidity turnover ratio for a holding, we ignore the position and rescale the other holdings prior to calculating the mutual fund's weighted average liquidity.[2]

Armed with each mutual fund's weighted average stock level liquidity within any given category, we rank order the mutual funds based on their weighted average liquidity and use this information to form monthly-rebalanced, equally-weighted composites (in our case, quintiles) of mutual funds with similar weighted average stock level liquidity scores.[3] Funds with the lowest weighted average liquidity are assigned to the "L1" quintile and funds with the highest weighted average liquidity are assigned to the

[2] In the cases in which we lacked liquidity turnover ratios for more than 40% of the holdings, we ignored the fund completely. For U.S. equity funds, we had stock level liquidity turnover ratios for the vast majority of funds. For non-U.S. equity funds, only about 10% of funds had 60% or more stock level liquidity turnover ratios.

[3] We calculated the total assets under management (AUM) of the composites looking for systematic patterns, somewhat expecting that the L1 (low liquidity) composite may systematically favor smaller mutual funds that can more readily invest in less liquid stocks without a significant market impact. In contrast to what we expected to see, on average the L1 (low liquidity) composite AUM was greater than that of the L5 (high liquidity) composite: L1 = $929.87, L2 = $990.92, L3 = $984.73, L4 = $779.65, and L5 = $510.54. The numbers are in million of dollars, and are averaged across the composite and over the entire periods. A related measure is the volatility of fund flows. If large funds have relatively smaller fund flows, they can afford to hold more illiquid stocks because they can accommodate redemptions with the liquid portion of their portfolios. Indeed, our data show that the volatility of fund flow is the lowest for the L1 (low liquidity) composite and highest for the L5 (high liquidity) composite. The volatility of fund flows were: L1 = 3.65%, L2 = 3.82%, L3 =3.80%, L4 = 4.22%, and L5 = 4.6%, respectively, where the volatility of fund flow is measured as the average absolute net inflow or outflow as a percentage of fund size over all the funds in the respective composite over the 15-year period.

"L5" quintile. The constituent mutual funds in the composite evolve each month, as the weighted average stock level liquidity of the mutual funds evolves.

Results

Table 2 summarizes the striking results for our primary universe of U.S. equity funds. The table displays the annual geometric return, annual arithmetic return, standard deviation, Sharpe ratio, as well as the annualized alpha from a monthly return regression of the composite relative to its category-average composite, and the t-statistic of the alpha.[4] For each category, we show the difference in performance statistics from the lowest liquidity composite (L1) and the highest liquidity composite (L5).

For each of the 16 groupings, the lowest liquidity composite (L1) had a superior annual geometric return, annual arithmetic return, standard deviation, Sharpe ratio, and annualized alpha when compared to the applicable equally-weighted composite for that category. With the exception of the Growth category, the t-statistic of the alpha of the lowest liquidity composite exceeded 2.0, indicating that the alpha was statistically significant at the 95% confidence level. Furthermore, for the vast majority of groupings across the five quintiles, the results are monotonic.

Of note, for all 16 groupings in Table 2, the annualized alpha differential between the lowest and highest liquidity composites exceeded the annual geometric return differential. This is a direct result of the lower standard deviation and lower beta of the lowest liquidity composites relative to the highest liquidity composites. Although the complete results are not reported, we regressed each L1 composite against the corresponding L5 composite and report the t-statistic from the regression.

We highlight the performance of the "All" composites at the bottom of Table 2, representing our entire universe of U.S. equity funds. Comparing "All L1" to "All L5," the annual geometric return was 2.65% higher, the standard deviation was much lower (15.25% vs. 24.83%), while the Sharpe ratio was nearly twice as high (0.43 vs. 0.23).

The average geometric mean for the funds in the small cap category is higher than those in the large cap category over the 15-year period. The largest annualized alpha difference between the L1 (lowest liquidity) and L5 (highest liquidity) quintiles occurred within the Small category (712 basis points), while the smallest annualized alpha difference occurred for the Large Core category (265 basis points). These results, as well as the rest of the results reported in Table 2, are consistent with the stock level results in Ibbotson, Chen and Hu (2011), despite the difference in sample period.

[4] The annualized alpha is estimated using the following formula: (1+Monthly Alpha)^12 – 1.

Table 2: Mutual Fund Liquidity Quintiles – U.S. Equity Universe

Annualized Results from Monthly-Rebalanced Composites
Feb. 1995 – Dec. 2009

	Geometric Mean (%)	Arithmetic Mean (%)	Standard Deviation (%)	Sharpe Ratio	Annualized Alpha Relative to Average (%)	T-Statistic of Alpha Relative to Average	N Periods
Small Value L1 (Low Liquidity)	10.86	12.26	17.61	0.5	1.69	2.69	179
Small Value L2	10.79	12.5	19.55	0.46	0.72	1.46	179
Small Value L3	10.17	11.91	19.63	0.43	0.12	0.26	179
Small Value L4	9.48	11.26	19.81	0.39	-0.60	-1.17	179
Small Value L5 (High Liquidity)	8.09	10.05	20.75	0.31	-2.14	-2.2	179
Small Value Avg	**9.91**	**11.59**	**19.27**	**0.42**	**--**	**--**	**179**
L1 - L5	2.77	2.21	-3.15	0.18	3.91	3.21*	
Small Core L1 (Low Liquidity)	11.25	12.67	17.74	0.51	2.92	3.21	179
Small Core L2	9.48	11.14	19.09	0.4	0.60	0.88	179
Small Core L3	8.81	10.71	20.43	0.35	-0.60	-1.35	179
Small Core L4	8.73	10.93	22.07	0.34	-1.19	-1.76	179
Small Core L5 (High Liquidity)	7.94	10.13	21.98	0.3	-1.90	-2.09	179
Small Core Avg	**9.29**	**11.11**	**20.02**	**0.38**	**--**	**--**	**179**
L1 - L5	3.32	2.54	-4.24	0.21	4.91	3.19*	
Small Growth L1 (Low Liquidity)	9.26	11.15	20.44	0.37	2.80	2.15	179
Small Growth L2	7.88	10.43	23.91	0.29	0.48	0.81	179
Small Growth L3	6.87	9.87	25.93	0.24	-0.96	-1.77	179
Small Growth L4	8.13	11.5	27.84	0.29	0.00	0.01	179
Small Growth L5 (High Liquidity)	6.26	10.04	29.3	0.22	-2.02	-2.58	179
Small Growth Avg	**7.77**	**10.6**	**25.22**	**0.28**	**--**	**--**	**179**
L1 - L5	3.00	1.1	-8.86	0.15	4.91	2.59*	
Mid Value L1 (Low Liquidity)	11.06	12.15	15.52	0.56	2.30	3.66	179
Mid Value L2	9.95	11.28	17.13	0.45	0.48	0.69	179
Mid Value L3	9.76	11.11	17.23	0.44	0.24	0.35	179
Mid Value L4	9.82	11.45	18.92	0.42	-0.48	-0.75	179
Mid Value L5 (High Liquidity)	7.81	9.72	20.39	0.3	-2.84	-2.52	179
Mid Value Avg	**9.73**	**11.14**	**17.56**	**0.43**	**--**	**--**	**179**
L1 - L5	3.25	2.42	-4.87	0.25	5.28	3.92*	
Mid Core L1 (Low Liquidity)	10.66	11.81	15.87	0.52	2.67	2.32	179
Mid Core L2	10.06	11.58	18.29	0.44	0.84	1.13	179
Mid Core L3	10.24	12.02	19.86	0.43	0.36	0.54	179
Mid Core L4	9.22	11.12	20.49	0.37	-0.96	-1.38	179
Mid Core L5 (High Liquidity)	7.47	9.65	21.86	0.28	-2.84	-2.24	179
Mid Core Avg	**9.61**	**11.23**	**18.87**	**0.41**	**--**	**--**	**179**
L1 - L5	3.19	2.16	-5.99	0.24	5.66	2.90*	
Mid Growth L1 (Low Liquidity)	9.82	11.27	17.94	0.43	3.41	2.36	179
Mid Growth L2	9.14	11.26	21.82	0.35	1.33	1.87	179
Mid Growth L3	8.38	11.01	24.38	0.31	-0.12	-0.3	179
Mid Growth L4	7.35	10.39	26.15	0.26	-1.43	-2.32	179
Mid Growth L5 (High Liquidity)	6.63	10.19	28.46	0.23	-2.49	-2.4	179
Mid Growth Avg	**8.38**	**10.82**	**23.39**	**0.31**	**--**	**--**	**179**
L1 - L5	3.18	1.08	-10.52	0.2	6.04	2.72*	
Large Value L1 (Low Liquidity)	8.44	9.41	14.49	0.41	1.57	3.67	179
Large Value L2	7.65	8.75	15.38	0.34	0.48	1.59	179
Large Value L3	7.42	8.61	16.04	0.32	0.00	-0.15	179
Large Value L4	7.07	8.34	16.53	0.29	-0.60	-2.29	179
Large Value L5 (High Liquidity)	6.11	7.52	17.32	0.23	-1.67	-2.98	179
Large Value Avg	**7.35**	**8.52**	**15.88**	**0.31**	**--**	**--**	**179**
L1 - L5	2.33	1.89	-2.83	0.18	3.41	3.76*	
Large Core L1 (Low Liquidity)	7.95	8.95	14.69	0.37	1.69	2.88	179
Large Core L2	6.91	8.1	15.98	0.29	0.12	0.7	179
Large Core L3	6.66	7.97	16.76	0.27	-0.36	-1.21	179
Large Core L4	6.35	7.63	16.56	0.25	-0.60	-2.66	179
Large Core L5 (High Liquidity)	6.3	7.84	18.12	0.24	-0.96	-1.39	179
Large Core Avg	**6.86**	**8.1**	**16.31**	**0.28**	**--**	**--**	**179**
L1 - L5	1.65	1.11	-3.42	0.13	2.80	2.55*	

* Indicates a t-statistic of the alpha from an L1 versus L5 regression.

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Table 2: Mutual Fund Liquidity Quintiles – U.S. Equity Universe – *continued*

Annualized Results from Monthly-Rebalanced Composites
Feb. 1995 – Dec. 2009

	Geometric Mean (%)	Arithmetic Mean (%)	Standard Deviation (%)	Sharpe Ratio	Annualized Alpha Relative to Average (%)	T-Statistic of Alpha Relative to Average	N Periods
Large Growth L1 (Low Liquidity)	7.61	8.8	16.04	0.33	1.94	2.01	179
Large Growth L2	6.92	8.36	17.64	0.27	0.72	1.24	179
Large Growth L3	5.86	7.48	18.62	0.21	-0.60	-2.01	179
Large Growth L4	6.74	8.63	20.3	0.25	-0.12	-0.44	179
Large Growth L5 (High Liquidity)	5.87	8.6	24.52	0.21	-1.67	-1.38	179
Large Growth Avg	**6.68**	**8.38**	**19.15**	**0.25**	**--**	**--**	**179**
L1 - L5	1.75	0.2	-8.48	0.12	3.78	2.23*	
Small L1 (Low Liquidity)	11.12	12.61	18.19	0.5	4.16	2.45	179
Small L2	9.36	11.19	20.06	0.38	1.45	1.25	179
Small L3	8.4	10.72	22.74	0.32	-0.48	-1.42	179
Small L4	7.76	10.59	25.28	0.28	-1.67	-1.68	179
Small L5 (High Liquidity)	6.75	9.91	26.62	0.24	-2.96	-2.48	179
Small Avg	**8.82**	**11**	**22.01**	**0.34**	**--**	**--**	**179**
L1 - L5	4.37	2.7	-8.42	0.26	7.31	2.84*	
Mid L1 (Low Liquidity)	10.24	11.42	16.08	0.49	3.91	2.13	179
Mid L2	10	11.58	18.7	0.43	2.06	1.91	179
Mid L3	9.25	11.28	21.29	0.36	0.24	0.54	179
Mid L4	7.75	10.34	24.07	0.28	-2.02	-2.63	179
Mid L5 (High Liquidity)	6.91	10.08	26.7	0.25	-3.19	-2.24	179
Mid Avg	**9.01**	**10.94**	**20.69**	**0.36**	**--**	**--**	**179**
L1 - L5	3.33	1.34	-10.62	0.25	7.31	2.62*	
Large L1 (Low Liquidity)	8.34	9.35	14.81	0.39	2.43	2.1	179
Large L2	7.49	8.66	15.92	0.32	0.96	1.46	179
Large L3	6.41	7.71	16.72	0.25	-0.48	-1.29	179
Large L4	6.01	7.44	17.46	0.22	-1.07	-2.84	179
Large L5 (High Liquidity)	6.03	8.11	21.23	0.22	-1.79	-1.21	179
Large Avg	**6.93**	**8.25**	**16.83**	**0.28**	**--**	**--**	**179**
L1 - L5	2.3	1.24	-6.42	0.18	4.28	2.23*	
Growth L1 (Low Liquidity)	8.1	9.38	16.67	0.35	2.43	1.72	179
Growth L2	7.18	8.78	18.61	0.28	0.60	0.8	179
Growth L3	7.34	9.36	21.02	0.28	0.12	0.3	179
Growth L4	7.83	10.5	24.46	0.28	-0.12	-0.18	179
Growth L5 (High Liquidity)	5.85	9.18	27.34	0.21	-2.49	-1.88	179
Growth Avg	**7.4**	**9.44**	**21.17**	**0.28**	**--**	**--**	**179**
L1 - L5	2.26	0.2	-10.67	0.14	4.91	2.12*	
Core L1 (Low Liquidity)	9.12	10.15	15.04	0.44	2.18	2.86	179
Core L2	7.84	9.1	16.54	0.34	0.24	0.42	179
Core L3	7.21	8.57	17.09	0.29	-0.60	-1.28	179
Core L4	7.43	8.9	17.81	0.3	-0.60	-1.44	179
Core L5 (High Liquidity)	7.48	9.39	20.37	0.29	-1.19	-0.89	179
Core Avg	**7.87**	**9.22**	**17.08**	**0.33**	**--**	**--**	**179**
L1 - L5	1.63	0.76	-5.33	0.15	3.29	2.38*	
Value L1 (Low Liquidity)	9.29	10.3	14.86	0.46	1.81	3.28	179
Value L2	8.4	9.56	15.87	0.38	0.36	1.09	179
Value L3	8.27	9.55	16.68	0.36	0.00	-0.22	179
Value L4	7.92	9.26	17.03	0.34	-0.60	-1.91	179
Value L5 (High Liquidity)	7.01	8.59	18.39	0.27	-1.79	-1.96	179
Value Avg	**8.2**	**9.45**	**16.43**	**0.36**	**--**	**--**	**179**
L1 - L5	2.28	1.71	-3.53	0.18	3.54	3.08*	

Summary

All L1 (Low Liquidity)	9.09	10.16	15.25	0.43	2.80	2.05	179
All L2	7.98	9.24	16.56	0.35	0.96	1.06	179
All L3	7.15	8.58	17.58	0.29	-0.36	-0.75	179
All L4	7.58	9.44	20.16	0.29	-0.84	-1.19	179
All L5 (High Liquidity)	6.44	9.22	24.83	0.23	-2.61	-1.33	179
All Avg	**7.80**	**9.33**	**18.2**	**0.32**	**--**	**--**	**179**
L1 - L5	2.65	0.94	-9.58	0.21	5.54	2.36*	

* Indicates a t-statistic of the alpha from an L1 versus L5 regression.

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Many of the key observations from Table 2 are summarized using the nine style box lens in Figure 1, which also enables one to compare the liquidity premium to the value and size premiums. Morningstar categorizes funds into the various styles based on a multi-factor approach in the spirit of the traditional Fama-French factors; thus, by analyzing the performance within these granular categories we have largely accounted for value and growth.[5] Within each style box category, the top number is the annual geometric return for that category's low liquidity L1 composite, the second line is the annual geometric return for that category's average, the third number is the annual geometric return for that category's high liquidity L5 composite, and the final bold number is the difference between the categories' L1 composite and the L5 composite. The bold numbers to the right of the style box show the value minus growth differences for the appropriate size categories while the bold numbers below the style box show small minus large differences for the appropriate valuation categories. The most interesting comparisons are between the bold numbers, in general, the low liquidity minus high liquidity differences (the bold numbers inside the style box) exceed the value minus growth and small minus large differences (the bold number outside the style box).

Figure 1: Style Box Liquidity Performance – U.S. Equity Mutual Fund Universe
Annualized Results from Monthly-Rebalanced Composites
Feb. 1995 – Dec. 2009

Size Spectrum \ Valuation Spectrum	Value	Core	Growth	Value minus Growth
Large	8.41 7.35 6.11 **2.33**	7.95 6.86 6.30 **1.65**	7.61 6.68 5.87 **1.75**	**0.67**
Mid	11.06 9.73 7,81 **3.25**	10.66 9.61 7,47 **3.19**	9.82 8.38 6.63 **3.18**	**1.35**
Small	10.86 9.91 8.09 **2.77**	11.25 9.29 7.94 **3.32**	9.26 7.77 6.26 ***3.00***	**2.14**
Small minus Large	**2.56**	**2.43**	**1.09**	

Low Liquidity Compounded Return
Style Box's Compounded Return
High Liquidity Compounded Return
Low Liquidity Minus High Liquidity

By organizing our study around the style box, we have largely controlled for size and valuation. Later we analyze the "All" composite against a three factor Fama-French model. The relationship between liquidity and the next most significant factor, momentum, is left to further research and is the subject of a follow up study Idzorek, Xiong, and Ibbotson (2011).

[5] For details, see "Morningstar Style Box™ Methodology" available from http://corporate.morningstar.com/us/documents/MethodologyDocuments/MethodologyPapers/MorningstarStyleBox_Methodology.pdf

Observing the nearly 15-year history for the five “All” liquidity quintiles reveals an interesting result (see Figure 2). For the most part, the lower liquidity composites dominate; however, for a brief period corresponding with the height of the technology bubble, the higher liquidity composites (blue and green lines in Figure 2) temporarily dominated. During this irrational period, investors could not get enough of the most liquid stocks benefiting the mutual funds holding these “glamour” stocks. Interestingly, the brief outperformance of high-liquidity composites during the technology bubble is either not as prevalent or nonexistent in the value-oriented categories, as illustrated in Figure 3, showing the growth of a dollar among the mutual fund composites constructed from the value-oriented fund categories. We suspect this noteworthy pattern is less prevalent among value managers, as they were unlikely to hold technology stocks at that time.

Figure 2: “All” Liquidity Performance Comparisons – Growth of $1
Feb. 1995 – Dec. 2009
Mutual Fund Quintiles, where L1 = Lowest Liquidity and L5 = Highest Liquidity

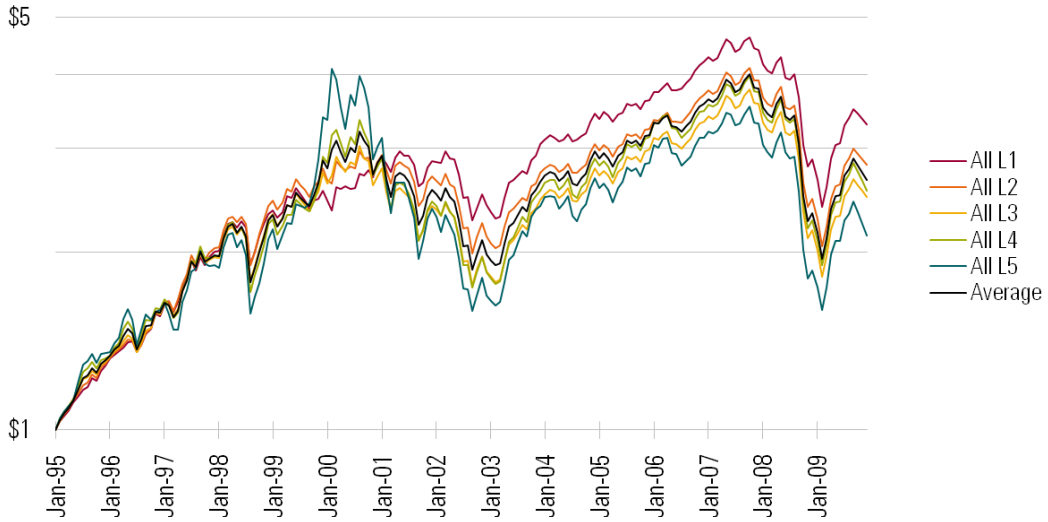

Figure 3: Value Liquidity Performance Comparisons – Growth of $1
Feb. 1995 – Dec. 2009
Mutual Fund Quintiles, where L1 = Lowest Liquidity and L5 = Highest Liquidity

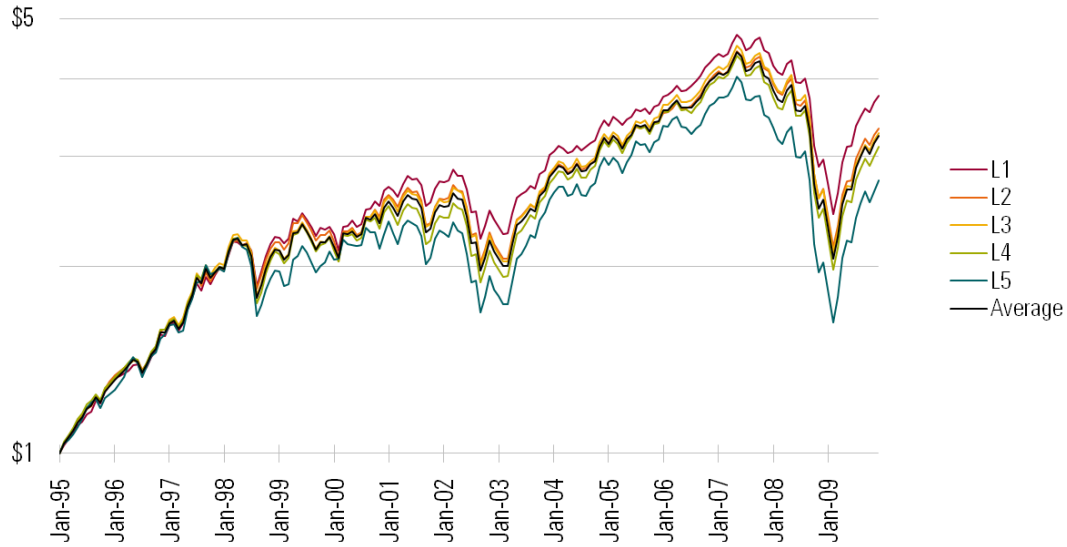

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Table 3 reports various up-side and down-side return capture statistics for our All composites. The superior overall performance of the low liquidity quintile(s) has primarily come from superior performance in down markets, as indicated by the down-market capture. Lower down-market capture means a lower average loss in down markets. In particular, the losses for L1 in the two crisis periods (the 2000 tech crash and the 2008 financial crisis) are significantly lower than the losses for L5. This is consistent with Lou and Sadka (2011) which found that illiquid stocks outperformed liquid stocks during the 2008-2009 financial crisis because liquid stocks are more sensitive to liquidity shocks.

Table 3: Monthly Up-side / Down-side Capture Statistics – U.S. Equity Mutual Fund Universe
Feb. 1995 – Dec. 2009
Mutual Fund Quintiles, where L1 = Lowest Liquidity and L5 = Highest Liquidity

	Up Periods	Down Periods	Average Up Market Return	Average Down Market Return	Up-Market Capture	Down-Market Capture	Up-Market Down-Market Ratio	Loss from April 2000 to Dec. 2001	Loss from Sept. 2008 to Feb. 2009
All L1 (Low Liquidity)	117	62	3.03	-3.09	86.31	75.93	1.14	11.0%	-40.3%
All L2	112	67	3.3	-3.75	93.91	91.88	1.02	-5.9%	-42.3%
All L3	109	70	3.47	-4.19	98.73	102.57	0.96	-17.4%	-43.5%
All L4	107	72	3.89	-4.75	110.45	116.32	0.95	-24.5%	-43.5%
All L5 (High Liquidity)	106	73	4.37	-5.63	123.01	138.71	0.89	-39.6%	-45.1%
All Average	**109**	**70**	**3.61**	**-4.28**	**102.78**	**104.85**	**0.98**	**-17.7%**	**-42.8%**

Monthly Up-side / Down-side Capture statistics are from Morningstar EnCorr. Up Periods and Down Periods simply report the total number of up and down monthly returns in the sample of 179 months. The Average Up Market Return and Average Down Market Return report similar statistics based on the performance of the "market," which in this case is defined as the Russell 3000. The Up-Market Capture and Down-Market Capture identify the percentage of the market's up and down movements that are captured, respectively, where numbers greater than 100 indicate more sensitivity than the Russell 3000. The Up-Market Down-Market Ratio divides Up-Market Capture by Down-Market Capture.

We repeated the monthly up-side / down-side capture analysis for the rest of our 15 categories. The results paint a similar picture; in all cases the low liquidity (L1) composite had a superior up-market / down market capture ratio relative to the corresponding high liquidity (L5) composite.

Many people find these results puzzling as their intuition tells them that in down markets, less liquid stocks (and the funds that hold them) should suffer the steepest declines. We posit that one cause of the superior downside performance of the low liquidity quintile relates to the type of strategies typically used by low liquidity (L1) managers versus high liquidity (L5) managers. We suspect that, on average, the funds that find themselves in L1 have less "holdings-turnover" than those in L5, reflecting a general preference for a longer holding period strategy. In contrast, L5 managers likely have higher holdings-turnover and, on average, use strategies that involve more frequent trading. Funds that trade frequently pay greater attention to trading costs and are more likely to use liquidity-based measures, such as bid-ask spreads, to screen out relatively less liquid stocks. Furthermore, during periods of turmoil, L5 managers may be more likely to trade; thus, the most liquid stocks may, in fact, suffer the steepest declines because there is a greater propensity for their owners to trade them. We confirmed this by analyzing the standard holdings-turnover statistic for the mutual funds that make up the composites. The average annual holdings-turnover across the composite and over time for L1 was 59% for the mutual funds with the less liquid stocks and 124% for the L5 mutual funds with the most liquid stocks for the entire U.S. mutual fund universe.[6]

[6] Holdings-turnover is a measure of how much a mutual fund turns over its portfolio and should not to be confused with our liquidity turnover measure, which measures the average liquidity of the individual stock holdings. We confirmed that the average holdings-turnover ratio of the mutual funds in the L5 composite was significantly higher than the average holdings-turnover ratio of the mutual funds in the L1 composite by calculating the average holdings-turnover of each composite at each point in time and then taking the average through time.

Switching back to our liquidity measure, the average liquidity measure for the five quintiles for U.S. equity funds over the almost 15 years are shown in Table 4. Once again, the liquidity of a stock is measured as its average daily shares traded over the last year divided by the number of shares outstanding. The liquidity of a fund is then calculated as the weighted average liquidity of the stocks it holds. Multiplying the daily figures by 250 (representing the approximate number of trading days per year) produces annualized figures. The small growth category had the largest liquidity difference between composite L5 and L1, 932% (=1095%–163%). Thus, every outstanding share of stock traded approximately 10.95 times per year for the L5 composite and 1.63 times per year for the L1 composite.

The large value category had the smallest liquidity difference, 127% (=220%–93%).[7] In general, small funds and growth funds have larger liquidity differences than large funds and value funds, respectively, indicating that small categories and growth categories tend to hold relatively heavily traded stocks. The liquidity measure for the "All U.S." sample with the L1 (lowest liquidity) mutual funds contained stocks that had average turnover of 110% per year. All but two categories in Table 4 (large value and value) had average stockholdings with annual turnover rates exceeding 100% per year.

Table 4: Annual Average Stock Turnover within Funds Categories – U.S. Equity Mutual Fund Universe
Feb. 1995 – Dec. 2009
Mutual Fund Quintiles, where L1 = Lowest Liquidity and L5 = Highest Liquidity

	Annual Stock Turnover				
Category	L1	L2	L3	L4	L5
Small Value	108%	143%	168%	208%	545%
Small Core	118%	163%	200%	263%	793%
Small Growth	163%	228%	290%	380%	1095%
Mid Value	110%	138%	163%	203%	493%
Mid Core	118%	165%	208%	260%	610%
Mid Growth	158%	218%	273%	355%	808%
Large Value	93%	113%	130%	150%	220%
Large Core	105%	135%	150%	168%	270%
Large Growth	128%	160%	188%	230%	450%
Small	125%	180%	233%	315%	928%
Mid	128%	183%	233%	308%	728%
Large	105%	135%	155%	185%	343%
Value	95%	120%	138%	163%	328%
Core	110%	140%	160%	195%	455%
Growth	135%	178%	223%	295%	725%
All US	110%	145%	175%	230%	573%

[7] Somewhat curiously, even though the stocks in the large value category seemed to have the smallest liquidity difference in Table 2, the alpha of the L1 composite for the large value category had the highest t-statistic.

Robustness Checks

To test the robustness of the results reported in Table 2 we carried out a number of tests. We begin by comparing the performance of our five U.S equity "All" composites relative to the Fama-French three factor model. Next we looked at four separate permutations – a quarterly implementation delay, a switch from monthly rebalanced composites to annually rebalanced composites, an alternative definition of liquidity, and finally, a non-U.S. equity fund universe.

Fama-French Three Factor Regression Analysis

We began our checks by regressing each of our five "All" composites against three factors – the total market return (adjusted for average U.S. mutual fund expenses), small minus big (SMB), and high minus low (HML), which most practitioners know as value (high book to market ratio) minus growth (low book to market ratio). The starting returns for these factors were from Ken French's web site. Table 5 contains the regression coefficients for the various factors, the annualized alphas, the corresponding t-statistics of the alphas, and R-square from the regression. In the final row, we report the results of regressing L1 minus L5 against the three factors. All but one of the regression coefficients was significant at the standard 95% confidence level. In general, these results are consistent with the summary results at the bottom of Table 2.

Table 5: Fama-French Three Factor Regression – U.S. Equity Mutual Fund Universe
Annualized Results from Monthly-Rebalanced Composites
Feb. 1995 – Dec. 2009

	Market	SMB	HML	Annualized Alpha	T-Statistic of Alpha	R-Square
All L1 (Low Liquidity)	0.82	-0.05	0.22	2.83%	3.14	94.12%
All L2	0.92	*-0.02*	0.13	1.16%	1.85	97.58%
All L3	1.02	0.34	-0.08	-0.26%	-0.34	98.05%
All L4	1.02	0.34	-0.08	-0.26%	-0.34	97.57%
All L5 (High Liquidity)	1.12	0.60	-0.26	-1.87%	-1.51	95.67%
L1 - L5	-0.30	-0.65	0.48	4.78%	2.79	82.54%

* *Italicized* coefficient was not significant at the 95% confidence level.

Quarterly Implementation Delay

To test the sensitivity of our results to an implementation delay due to the availability of timely holdings data or to account for a potential lag effect due to stale pricing (which should be a none issue), we repeated the analysis under the assumption of a one-quarter implementation delay. The results were quantitatively and qualitatively similar to Table 2. Due to space considerations, we only present the results for our entire U.S. equity universe "All" composites (see Table 6). The quarterly implementation lag decreased our data points to 176 from 179, but the key statistics in Table 6 are very similar to the statistics for the corresponding "All" composite listed at the bottom of Table 2. If anything, the implementation lag slightly enhanced performance. Notice that with no implementation delay (bottom of Table 2), the Geometric Mean return for the "All" L1 composite exceed that of the "All" L5 composite by 2.65%. With the 3-month implementation delay (Table 6) the difference surprisingly increased to 3.26%.

Table 6: Mutual Fund Liquidity Quintiles – Quarterly Implementation Delay – U.S. Equity Mutual Fund Universe
Annualized Results from Monthly-Rebalanced Composites
April 1995 – Dec. 2009

	Geometric Mean (%)	Arithmetic Mean (%)	Standard Deviation (%)	Sharpe Ratio	Annualized Alpha Relative to Average (%)	T-Statistic of Alpha Relative to Average	N Periods
All L1 (Low Liquidity)	8.83	9.89	15.17	0.42	3.04	2.19	176
All L2	7.74	9.00	16.48	0.33	1.21	1.29	176
All L3	6.68	8.14	17.7	0.26	-0.36	-0.61	176
All L4	6.76	8.66	20.28	0.25	-0.96	-1.59	176
All L5 (High Liquidity)	5.58	8.34	24.69	0.2	-2.73	-1.48	176
All Avg	**7.26**	**8.80**	**18.24**	**0.29**	**--**	**--**	**176**
L1 - L5	3.26	1.55	-9.52	0.23	5.91	2.44*	--

* Indicates a t-statistic of the alpha from an L1 versus L5 regression.

Annual Rebalancing

For our monthly rebalanced composites, on average, about 40% of the funds from a given composite remain in the same composite in the following month; thus, for all practical purposes, buying and selling numerous different mutual funds each month or each quarter in order to hold the mutual funds with the least liquid stock holdings is impractical. Although one would expect it to be a less pure way of gathering exposure to low liquidity stocks, would simply buying an annually-rebalanced basket of mutual funds each year with the lowest average weighted average liquidity measure in the previous year produce similar results? To test this, we calculated the performance of annually-rebalanced composites of mutual funds. Table 7 contains the results.

Table 7: Mutual Fund Liquidity Quintiles – Annual Rebalancing – U.S. Equity Mutual Fund Universe
Annualized Results from Annually-Rebalanced Composites
Jan. 1996 – Dec. 2009

	Geometric Mean (%)	Arithmetic Mean (%)	Standard Deviation (%)	Sharpe Ratio	Annualized Alpha Relative to Average (%)	T-Statistic of Alpha Relative to Average	N Periods
All L1 (Low Liquidity)	7.86	8.92	15.17	0.36	2.43	1.84	168
All L2	6.61	7.86	16.33	0.27	0.60	0.64	168
All L3	6.39	7.83	17.57	0.25	-0.12	-0.18	168
All L4	6.53	8.42	20.28	0.25	-0.72	-1.07	168
All L5 (High Liquidity)	5.81	8.42	24.03	0.21	-1.79	-0.97	168
All Avg	**6.77**	**8.29**	**18.09**	**0.27**	**--**	**--**	**168**
L1 - L5	2.05	0.50	-8.87	0.16	4.28	1.96*	--

* Indicates a t-statistic of the alpha from an L1 versus L5 regression.

Like the monthly-rebalanced results reported earlier in Table 2, the annually-rebalanced results in Table 7 are extremely positive. Again, due to space considerations, we only present the results for our entire U.S. equity universe “All” composites; however, for each of the 16 groupings, the lowest liquidity composite (L1) had a superior annual arithmetic return, annual geometric return, standard deviation, Sharpe ratio, and annualized alpha when compared to the applicable equally-weighted composite for that category.

An Alternative Definition of Liquidity

Thus far our analyses have focused on one of the simplest liquidity *level* measures – turnover, which we define as the average daily shares traded over the last year divided by the number of shares outstanding. The literature has demonstrated other liquidity level measures, such as the measure proposed in Amihud (2002), also have significant impact on the performance; thus, we repeated our initial analysis with the Amihud measure. A fund's Amihud measure is defined as the weighted average of the Amihud measure associated with each holding, where the Amihud measure of a give holding is computed as:

$$\ln\left(\frac{1}{D}\sum_{d=1}^{D}\frac{|R_{i,d}|}{P_{i,d}Vol_{i,d}}\right)$$

D is the number of trading days during the month(t). $R_{i,d}$ is the stock's return on day *d*. $P_{i,d}$ is the adjusted price on day *d*. Finally, $Vol_{i,d}$ is the trading volume on day *d*. For a given stock to be included during the month, we required a minimum of 10 days of corresponding price and volume data. Notice that the Amihud measure calculates the absolute average return associated with dollar trading volume, and as such should be thought of as a measure of "illiquidity" – low averages indicate small absolute returns associated with high dollar volumes and high averages indicate large absolute returns associated with low dollar volumes. Given the denominator of price multiplied by volume, the Amihud measure can be thought of as an illiquidity measure that does not adjust for size and thus a stock's size has a large impact on the outcome. In contrast, the turnover measure used in the rest of the paper adjusts for size. In order to re-run our analysis, the Amihud measure for each fund is then recalculated each month throughout the study. Based on the Amihud measure of illiquidity, we once again formed monthly-rebalanced liquidity composites, in which L1 represents the lowest liquidity (highest Amihud measure). The results for our entire U.S. equity universe "All" composites are reported in Table 8.

Table 8: Amihud Liquidity Quintiles – U.S. Equity Mutual Fund Universe
Annualized Results from Monthly-Rebalanced Composites
Feb. 1995 – Dec. 2009

	Geometric Mean (%)	Arithmetic Mean (%)	Standard Deviation (%)	Sharpe Ratio	Annualized Alpha Relative to Average (%)	T-Statistic of Alpha Relative to Average	N Periods
All L1 (Low Liquidity)	9.03	11.06	21.20	0.35	1.21	0.54	179
All L2	9.07	10.94	20.28	0.37	1.17	1.00	179
All L3	7.49	8.87	17.26	0.31	0.15	0.25	179
All L4	6.52	7.86	16.94	0.26	-0.49	-0.87	179
All L5 (High Liquidity)	6.35	7.85	17.95	0.24	-0.62	-0.73	179
All Avg	7.78	9.31	18.21	0.32	--	--	--
L1 - L5	2.67	3.21	3.25	0.11	1.82	1.19*	--

* Indicates a t-statistic of the alpha from an L1 versus L5 regression.

The "All" results from Table 8 should be compared with the "All" results in the final section of Table 2. Like Table 2, in Table 8 the geometric mean and arithmetic mean are similar with the lowest liquidity composite (L1) producing returns that significantly outperform the highest liquidity composite (L5). This

is where the dramatic similarities between the two sets of results end. The superior return of lowest liquidity composite (L1) was accompanied with the highest standard deviation. The alphas and t-statistics in Table 8 are much less compelling. Although the details of the 15 other sub-categories are not reported, the results are similar – better returns for the lower liquidity composites accompanied with higher standard deviations and insignificant alphas. Seemingly the Amihud measure of liquidity is measuring a dimension of liquidity that is distinct from the one captured from our basic turnover measure.[8]

Non-U.S. Equity Fund Universe

Finally, going beyond the universe of U.S. equity funds, we repeated our analysis (without the implementation delay and with monthly rebalancing) using a universe of non-U.S. equity funds (see Table 9). Unfortunately, our sample size was much smaller, as we lacked the required individual stock data and / or the holdings data for a relatively large number of funds. Therefore, this small sample may not represent non-U.S. equity funds well. Due to the lack of data availability, our start date was moved from Feb. 1995 to Feb. 2000, and we did not break the universe into sub-categories. Overall, this nearly 10-year period was not particularly good for stocks. The results are less compelling than those of the U.S. mutual fund universe. The Non-US "All" L2 quartile has the highest Sharpe ratio. The Geometric Mean return of L1 continued to trump that of L5, but in this case it was mostly due to the dismal return of L5 rather than standout performance of L1. Although the non-U.S. equity fund results were consistent with the U.S. equity fund results, none of the alphas were significant for this smaller and shorter non-U.S. sample.

Table 9: Mutual Fund Liquidity Quintiles – Non-U.S. Equity Mutual Fund Universe
Feb. 2000 – Dec. 2009
Mutual Fund Quintiles, where L1 = Lowest Liquidity and L5 = Highest Liquidity

	Geometric Mean (%)	Arithmetic Mean (%)	Standard Deviation (%)	Sharpe Ratio	Annualized Alpha Relative to Average (%)	T-Statistic of Alpha Relative to Average	N Periods
All L1 (Low Liquidity)	1.5	3.28	19.16	0.03	0.48	0.4	119
All L2	2.69	4.07	16.9	0.08	1.69	1.28	119
All L3	1.58	2.97	16.92	0.01	0.60	0.37	119
All L4	0.74	2.37	18.27	-0.02	-0.24	-0.15	119
All L5 (High Liquidity)	-1.63	1.13	23.84	-0.07	-2.14	-0.77	119
All Avg	**1.15**	**2.76**	**18.19**	**0**	**--**	**--**	**119**
L1 - L5	3.13	2.15	-4.69	0.1	2.67	0.85*	

* Indicates a t-statistic of the alpha from an L1 versus L5 regression.

[8] Although the results are not reported, we tested a third definition of liquidity: the liquidity *beta* risk factor from Pastor and Stambaugh (2003). Using monthly returns and rolling five-year returns we calculated the liquidity beta for each mutual fund following Equation 2 of Lou and Sadka (2011). First, only about 10% of the US equity funds have significant liquidity beta coefficients at the 5% level. Next, consistent with Lou and Sadka (2011) we found that the lowest liquidity beta quintile outperformed the highest liquidity beta quintile by 5% cumulatively from Sep. 2008 to Feb. 2009. However, somewhat surprisingly the lowest liquidity beta quintile underperformed the highest liquidity beta quintile by about 40% cumulatively from April 2000 to Dec. 2001, a period that included the tech crash.

Conclusions

This study applies the liquidity style to mutual funds. We show that mutual funds that hold relatively less liquid stocks from within the liquid universe of publicly-traded stocks outperform mutual funds that hold relatively more liquid stocks by 2.65% (annualized geometric mean over nearly the last 15 years). After adjusting for the consistently lower betas of the funds with the less liquid holdings, the relative alpha difference is an annualized 5.54%.

The results were confirmed by the monthly-rebalanced mutual fund composites for our universe of U.S. equity mutual funds, as well as for each of the nine size-valuation style boxes, the three valuation-based columns from the style box (value, core, and growth), and the three size-based rows from the style box (large, mid, and small). More specifically, for each of the 16 groupings, the lowest liquidity composite (L1) had a superior annual geometric return, annual arithmetic return, standard deviation, Sharpe ratio, and annualized alpha when compared to the applicable highest liquidity composite (L5). For all but the Growth category, the t-statistic of the alpha of the lowest liquidity composite was statistically significant.

Surprisingly, the outperformance of the mutual funds that hold less-liquid stocks was primarily due to superior performance in down markets. One possibility is that during periods of turmoil, L5 (high liquidity) managers may be more likely to trade; thus, the most liquid stocks may, in fact, suffer the steepest declines because there is a greater propensity for their owners to trade them.

In the Fama-French three-factor regression analysis, consistent with our earlier results our low liquidity composite (L1) had a positive and significant alpha, while our high liquidity composite (L5) had a negative alpha (although the t-statistic was not significant at the 95% confidence level).

Next, in a series of four separate permutations on the construction of our liquidity based composites, we found similar results. More specifically rerunning our analysis with a one quarter implementation delay, moving from monthly rebalancing to annual rebalancing, using an alternative definition of liquidity, and switching from a U.S. equity fund universe to a non-U.S. equity fund universe, all demonstrated the aggregate superiority of investing in funds that hold less liquid stocks. Taken together, the results based on a one quarter implementation delay and the results based on annual rebalancing, the less liquid investment style or signal seems to last relatively long. Constructing composites based on the Amihud definition of liquidity produced positive but less significant results suggesting that the Amihud definition of liquidity measures a different dimension of liquidity than turnover. Finally, the results are less compelling for non-U.S. equity funds than those of the U.S. mutual fund universe, although this result is less conclusive given the lack of available data. Overall, the liquidity investment style is clearly present in mutual funds and leads to dramatic differences in performance.

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