Liquidity as an Investment Style

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Previous drafts: June 2007, June 2008, September, 2010.

Current draft: April 21, 2011

We thank Denis Sosyura for his research assistance on a previous version and Michael W. Zhang for his research assistance on the current version.

ABSTRACT

We first show that liquidity, as measured by stock turnover or trading volume, is an economically significant investment style that is just as strong, but distinct from traditional investment styles such as size, value/growth, and momentum. When converted into a less liquid verses more liquid liquidity factor, liquidity is negatively associated with the market and size factors, but positively associated with value and momentum factors. After adjusting for the other four factors, there is still a positive and statistically significant alpha remaining in almost every case. One reason that less liquid stocks outperform is that they are valued at a liquidity discount, thus generating extra returns. Another reason is that stocks tend to migrate toward normal trading volume over time, increasing less liquid valuations while decreasing more liquid valuations.

1. Introduction

Similar to risk, liquidity has a substantial impact on the valuation and returns of all types of securities. In this paper, we focus on the differences in liquidity among publicly traded equity in the U.S. stock market. The less liquid stocks have lower valuations, but higher returns.

We propose that equity liquidity is the missing equity style. In order to be a legitimate style we posit that liquidity should have a positive impact on long-run returns, that the returns be distinct from the well-known existing styles of size, value, and momentum, and further that a portfolio investing in less liquid stocks should be relatively stable over time, so that it can be readily implemented without frequent trading.

We compare liquidity based portfolios with the three conventional investment styles: size, value/growth, and momentum. That is, since small capitalization stocks are known in the long-run to outperform large-cap counterparts (Banz 1981), one can favor small-cap stocks. Since value tends to outperform growth (Fama and French 1993, 1995), an investor can bias against growth. As past winners and losers are likely to repeat their fortunes in the future (Jegadeesh and Titman 1993, 2001), an investor may load up on momentum.

It is well known in the literature that less liquid assets are discounted in price, while more liquid assets have higher prices for the same set of expected cash flows. Correspondingly, less liquid assets have higher expected returns while more liquid assets have lower expected returns.

Much of the liquidity literature is in the fixed income space where yield spreads of more and less liquid securities from the same issuer can be directly compared. For example, Amihud and Mendelson (1991) show that on-the-run treasury yield curves trade at lower yields than comparable off-the-run yield curves. Boudoukh and Whitelaw (1993)

find even larger bond treasury spreads in Japan. Liquidity is also shown to affect corporate bond spreads by Fisher (1959). All of these results were later confirmed by many others. Bonds are an especially good place to measure liquidity premiums since bond yields and their spreads provide a direct window into expected returns.

Numerous studies in the alternative space suggest that private equity has higher returns on average than publicly traded equities. Silber (1991) estimates that restricted stock trades at an average discount of about 30% relative to publicly traded stocks. Chen and Xiong (2001) estimate restricted institutional Chinese shares traded at about an 86% discount relative to exchange traded shares for the same companies. The evidence is that illiquid assets are priced lower, regardless of country or business culture. Thus investors are paid to hold less liquid securities.

There is also an emerging liquidity literature focusing on publicly traded equity markets. Amihud and Mendelson (1986) first demonstrated that less liquid stocks outperform more liquid stocks. Brennan and Subramanyan (1996) use microstructure trading data to further support the connection between stock illiquidity and returns. Datar, Naik and Radcliffe (1998) demonstrate that low turnover stocks on average earn higher future returns than high turnover stocks. Pastor and Stambaugh (2003) and others associate less liquidity with more market impact and develop a factor which confirms the liquidity premium in stocks. Ibbotson, Hu and Chen (2011) apply liquidity to international markets and Idzorek, Xiong, and Ibbotson (2010) apply liquidity to mutual fund holdings and returns. A review of liquidity's impact on asset prices can be found in Amihud, Mendelson, and Pedersen (2005).

Different measures of liquidity have been used in the literature. The three common measures of liquidity --- trading volume, bid-ask spread, and price impact --- are correlated with each other, and yet they are different. It is hard to come up with one function that captures all three, and each is also highly correlated with company size.

In this article, our measure of liquidity is annual turnover. It is very simply defined as the number of shares traded divided by the stock's outstanding shares. Trading volume favors large-size stocks, which is perhaps what any liquidity measure should do as large stocks are generally more tradable. Turnover is relatively market capitalization-neutral, as either small-cap or large-cap stocks can have low or high turnover rates. High turnover stocks tend to have low bid-ask spreads, high trading volume relative to the size of the company, and low price impact per dollar traded. In this paper, we focus on turnover and show that liquidity is different from such traditionally known styles as size, value and momentum.

Trading volume serves as an indicator of demand for a stock. When a stock falls into disfavor, the number of sellers dominates buyers, leading to low prices and low volume. When a stock becomes popular or glamorous, buyers dominate sellers, resulting in higher prices and higher volume. Thus, relatively low turnover is indicative of a stock near the bottom of its expectation cycle, while a relatively high turnover is indicative of a firm close to the top of its expectation cycle. We show the impact of migration on the returns of liquidity quartiles later in this paper.

The remainder of the article is organized as follows: Section 2 focuses on showing that the liquidity or turnover factor is different from size, value and momentum. Section 3 converts liquidity into a factor, so that it can be compared to the conventional style factors. In section 4, we illustrate the two primary reasons why less liquid stocks have higher returns than the more liquid stocks. The last section offers concluding remarks. An appendix describes the data sets and stock universe used in this research.

2. Liquidity versus size, value, and momentum

In order to be a legitimate equity style, liquidity has to satisfy three criteria. First, it must generate a positive long-term return over and above that received by general equity markets. Second, it must be sufficiently different from the existing generally accepted styles, size, value, and momentum. Third, it must be relatively stable over time, without involving heavy active management to implement it.

In this paper we study the top 3500 U.S. stocks by capitalization, over the period 1972 through 2010. A detailed description of the data along with some of the methodology is in the appendix.

We begin by ranking each of the stocks in our sample by the previous year's share turnover rate. We sort the stocks into liquidity quartiles and contrast them with size or capitalization quartiles. It is often presumed that investing in less liquid stocks is equivalent to investing in small-cap stocks. To see whether liquidity is captured by size, at the end of each December we independently sort the stocks into capitalization and turnover quartiles. The 16 intersection groups are then formed into equally weighted portfolios and held for the next 12 months.

Table 1 reports the annualized geometric average, arithmetic average, and standard deviation of returns along with the average number of stocks in each intersection portfolio. Across the micro-cap quartile, the low-liquidity group earned a geometric average return of 18.17% a year in contrast to the high-liquidity group returning 6.16% a year. Across the large-cap quartile, the low- and high-liquidity groups returned 12.49% and 9.87% respectively, producing a liquidity effect of 2.62%. Within the two mid-size groups, the liquidity return spread is also significant. Therefore, size does not capture

liquidity, i.e. the liquidity premium holds regardless of the size group. Conversely, the size effect does not hold across all liquidity quartiles, especially in the highest turnover quartile. However, it is true that the liquidity effect is the strongest among micro-cap stocks and then declines from micro to small to mid to large-cap stocks. The micro-caps row contains both the highest return and the lowest return cells in the matrix.

Value investing has been popularized since Graham and Dodd (1940). It has been widely supported by rigorous academic research (e.g., Fama and French (1993, 1995), Zhang (2005)). How different is the liquidity style from value? To answer this question, we use the earnings/price (E/P) ratio as a proxy for value, with the understanding that E/P is highly correlated with dividend/price and book/price ratios. Again, we form independently sorted value and liquidity quartiles and take the intersection groups between the two independent sets of quartiles, constructing 16 equally-weighted value/growth verses liquidity portfolios.

The annual return results are reported for the 16 value and liquidity portfolios in Table 2. In this case among the high-growth stocks, the low-liquidity stock portfolio has a compounded annual return of 11.93% while the high-liquidity stock portfolio 3.88%. For high-value stocks, low-liquidity stocks have a 20.82% return, while high-turnover stocks have a return of 12. 53%. Both value and liquidity are distinctly different ways of picking stocks. The best return comes from combining high-value with low-liquidity stocks, while the worst return comes from high-growth stocks with high-turnover stocks.

Finally, we contrast turnover with momentum. Jegadeesh and Titman (1993, 2001), and many other scholars (e.g., Chan, Jegadeesh and Lakonishok (1996), Grundy and Martin (2001), and Rouwenhorst (1998)), found that buying past medium-term winners and selling past medium-term losers and holding the positions for a medium term (6 to 18 months) yields significant profits. These studies have confirmed a common practice among some investors who follow trends using charts or simple return calculations.

After these research results became known, momentum investing has become widely popularized, especially among institutional investors and hedge fund managers.

To examine whether liquidity investing is simply another form of momentum investing, we form in Table 3 two dimensional portfolios based on independent sorting of the stock universe according to past 12-month stock returns (momentum) and turnover rates. The independent sorts are done in the same way as Tables 1 and 2.

The highest compound annual return, 17.41%, is achieved by buying high-momentum low-liquidity stocks, while the lowest return, 5.59%, is for the low-momentum high-liquidity stocks. Again, momentum and liquidity are different stock-picking styles and not substitutes for one another. A better way is to combine the two investment styles and pick stocks that have high-momentum but low-liquidity.

3. Liquidity as a Factor

We can express our liquidity quartile returns as a liquidity factor by creating a dollar neutral long-short portfolio. This is done by subtracting the most liquid quartile from the least liquid quartile.

These returns are then regressed upon the market and the size, value, and momentum dollar neutral factors downloaded from Kenneth R. French's website. In the CAPM framework, the liquidity long-short factor is merely regressed upon the excess returns of market portfolio.

$$(1) \qquad R_{it} = \alpha + \beta_{iM}\left(R_{Mt} - R_{ft}\right) + \varepsilon_{it}$$

In the standard Fama-French three factor model, the long-short liquidity factor is regressed upon the long market portfolio, and the long-short size and value portfolios.

$$(2) \qquad R_{it} = \alpha + \beta_{iM}\left(R_{Mt} - R_{ft}\right) + S_i \times Size + h_i \times Value + \varepsilon_{it}$$

Finally in the full four factor model, the long-short liquidity factor is regressed upon the full four factor model with the long market factor, and the three long-short size, value, and momentum factors.

$$(3)\ R_{it} = \alpha + \beta_{iM}\left(R_{Mt} - R_{ft}\right) + S_i \times Size + h_i \times Value + m_i \times Momentum + \varepsilon_{it}$$

We can perform a similar analysis with the long only portfolios. We create a long only low liquidity portfolio by using only the least liquid quartile of stocks. We measure the portfolio returns less the risk-free rate from U.S. Treasury Bills. In the CAPM version, we similarly subtract the risk-free rate from the market portfolio.

$$(4)\ R_{it} - R_{ft} = \alpha + \beta_{iM}\left(R_{Mt} - R_{ft}\right) + \varepsilon_{it}$$

For the size, value, and momentum factors, we use the same long-short factors that we used in equations (2) and (3). There is no need to subtract the risk-free rate from these factors, since they contain zero net positions.

In Table 4 we present the results. In the CAPM variant, the long-short liquidity factors are negatively associated with the market, with a beta of -0.55. The low liquidity long portfolio has a low beta of 0.80. In both cases the monthly alpha is very positive and significant.

Once we add in size and value factors, we see that the liquidity factor is negatively related to size but positively related to value. The liquidity factor is also positively related to momentum in the four factor model. However, after adjusting for the market, size, and value in the Fama-French model or after also adding in momentum in the four factor model, we see that the less liquid alpha is still positive and significant.

Similarly for the low liquidity long portfolio, there is a positive and statistically significant alpha for the CAPM, Fama-French, and four-factor equations. This positive alpha exists, despite the adjustment for the market size, value, and momentum.

The linkage between the liquidity long-short factor with the market, size, value, and momentum factors is also seen in the cross-correlations shown in Table 5. The liquidity factor has the largest negative correlations with the market and the long-short size factor, and a substantial positive correlation with value. Value and size are negative correlated with each other. None of the other factors are as strongly negative related to the market as is the liquidity factor.

In Table 6 we put together combination portfolios, by selecting the least liquid quartile of stocks along with the smallest capitalization, most value based, and highest momentum based quartiles. These are long portfolios formed from the northwest corner portfolios in Tables 1, 2, and 3. They are then regressed upon the CAPM, Fama-French, and four factor models. The portfolios are related to the market, but with low betas. They are again related to the size and value portfolios, but no longer positively related to the momentum factor, except of course for the high momentum portfolio. In all cases the market alphas are positive, and in all but one case they are statistically significant.

In Figure 1, we compare the small cap based liquidity portfolio to the small and large cap portfolios from Table 1. We compare the value based liquidity portfolio to the value and growth quartiles from Table 2. We compare the momentum based liquidity portfolio to the high and low momentum quartiles from Table 3. In all three cases, it is clear that liquidity mixes well with the higher performing portfolio, and adds incremental return.

4. Why Investing in Liquidity Pays

We have demonstrated that liquidity impacts long-run returns. We have also shown that liquidity, either as a long only return or a long/short factor, is different from size, value/growth, or momentum, offering incremental returns. The results also suggest that the liquidity has a relatively stable impact on returns, since the portfolios were rebalanced only once a year. We now examine directly the migration of stocks in the liquidity portfolios. This examination will help to tell us why investing in less liquid stocks pays extra returns.

There are two major reasons that less liquid stocks outperform. One is based upon equilibrium, and the other is based upon mean reversion of trading volume. First, we consider the equilibrium argument. By investing in less liquid stocks, the investor is a long-term liquidity provider and hence is compensated. For example, Ibbotson, Siegel and Diermeier (1984) demonstrate that a premium has to be paid for any characteristic that investors demand, and a discount must be given for any characteristic investors seek to avoid. Investors like liquidity and dislike illiquidity. The liquidity premium makes liquid securities priced higher than otherwise, which means that liquid securities have lower expected future returns. By the same logic, illiquid or less liquid securities are valued lower, resulting in a higher expected return for these securities. Even if this valuation discount remains stable over time, the investor in less liquid stocks gets higher cash flows, which whether invested or paid out as dividends, result in higher returns.

The second reason involves what happens to the trading volume of individual stocks. Trading volume is often viewed by traders and investors as an indicator of investor demand or the degree of the stock's popularity. If there is too much demand for a stock, the trading volume and turnover will be high, pushing the stock price higher than justified by fundamentals. Conversely, a lower turnover ratio implies an unjustified low

demand for a stock, likely causing the stock price to be too low. Because the demand for stocks is not stable, the level of trading volume migrates over time. Fama and French (2007) show that a similar migration takes place for size and value stocks. This migration causes much of the excess return for all the style categories, but as we will see, it especially benefits the investor in less liquid securities.

Table 7A shows how the stocks in a particular liquidity quartile in one year migrate to other quartiles in the next year. In the lowest liquidity quartile, only 74.89% remain, with 25.11% moving to higher liquidity quartiles. Table 7B shows the returns from the stocks as they are reclassified at year-end accordingly to their changed liquidity. As the liquidity of stocks increase, they earn dramatically higher returns. In contrast, only 70.93% of stocks remain in the most liquid quartile during the next year. As their liquidity drops into lower quartiles, these stocks earned negative returns. Less liquid stocks migrate toward more liquid quartiles while more liquid stocks migrate toward less liquid quartiles. The migration of liquidity is the primary driver of returns.

We compare migration rates of liquidity with size, value, and momentum in Table 8. We split each sample into halves, so that the starting low liquidity portfolio has the half of the stocks with the lowest share turnover rates, the small size portfolio has the stocks with the lowest capitalization, the highest value portfolio has the stocks with the highest E/P ratios, and the momentum portfolio has the highest last year returns.

The migration rate is the highest for momentum, but by definition a drop in returns means a reduction in momentum. Again, by definition, the highest return from migration is when a small cap stock becomes a large cap, but this is accompanied by the lowest migration rate. High value migrates at a 23.80% rate, but this has a mixed impact on returns, since migration occurs as the E/P ratio changes, and this can happen as either a prices rise or an earnings fall.

The portfolio containing the half of the stocks that are least liquid migrates at a rate of 17.24%. When this increase in liquidity takes place, the returns are +50.41%. This migration appears to be the major source of the returns from holding less liquid stocks.

The above two sources of extra return for illiquid stocks are not expected to disappear in the future. Liquidity will continue to be valued high, and illiquid stocks will still come at a discount. Furthermore, there will always be glamour stocks and overlooked value stocks, but they will migrate over time. For these reasons, the liquidity investment style is likely to continue to outperform.

5. Conclusions

We have demonstrated that liquidity is a missing style. Less liquid publicly traded stocks have higher returns than more liquid publicly traded stocks. The quartile matrix comparisons with size, value/growth, and momentum clearly show that the liquidity style is distinct from the other styles, and its impact on returns is just as great if not greater than the other conventional styles. All the styles are relatively stable, since the portfolios are only formed once a year. Thus, we believe that liquidity meets all the criteria to be an investment style.

We create a liquidity factor by subtracting the returns of the most liquid quartile from the least liquid quartile. This long-short liquidity factor is then compared to the market and the other long-short style factors with zero net market exposure. Although the liquidity factor has some correlation with the other style factors, there is almost always an alpha remaining, showing that there is an incremental return from investing in less liquid stocks even after adjusting for the market, size, value/growth, and momentum factors.

We offer two explanations for the excess returns. First, liquidity impacts valuations, so that less liquid stocks can buy cash flows for cheaper. Second, liquidity tends to mean revert, so that valuations rise as liquidity increases for a stock. The migration tables support both explanations. As liquidity increases (decreases), valuations increase (decrease). Thus the investor in less liquid stocks gets lower valuations, effectively buying stocks at a discount. Since liquidity migrates, or mean reverts, the investor in less liquid stocks also gets the gain from the increase in liquidity.

APPENDIX

Data Description:

We measure U.S. stock returns over the period 1972 through 2010. Our sample is collected from the University of Chicago Center for Research in Security Prices (CRSP) and Compustat databases, consisting of firms listed on the New York Stock Exchange (NYSE), American Stock Exchange (AMEX), and NASDAQ stock markets. Portfolios are formed the end of December for each year, with the following filters: First, we include up to the top 3500 stocks based on market capitalization (which is the stock price times the number of shares outstanding). Second, the per-share price must be at least $2 and the market capitalization must be no less than $10 million. Third, Real Estate Investment Trusts (REITs), warrants, American Depository Receipts (ADRs), Exchange Traded Tunds (ETFs), Americus Trust Components, and closed-end funds are all excluded from the study. Lastly, a stock must have available information on dollar trading volume and monthly total returns, earnings, number of shares outstanding, and stock price, for the most recent 12 months.

To ensure a sufficient stock universe for our analyses, we choose to focus on the period from January 1972 through December 2010. This period covers the oil crisis of 1973 and the resulting "bear market" in the mid 1970's. It also covers the "bull" markets of the 1980s and 1990s, as well as the two recessions of the current century.

Table 1A reports summary statistics for the universe, including the number of stocks, along with the largest, average, median and minimum market capitalization for each year (based on the end of December portfolio formation date). We include the constrained CRSP universe up to a maximum of 3500 stocks.

We measure the annual turnover of each stock by computing the dollar volume of shares traded in the previous calendar year, divided by the capitalization at year-end. For NASDAQ stocks, their trading volume is divided by two before 2001 because of the well known duplicated reporting practice by NASDAQ market makers. After this adjustment to NASDAQ stock volume, the volume variable is comparable across exchanges.

For the purposes of style comparisons, we measure the capitalization of each stock at year-end. We calculate earnings to price ratios (E/P ratios) for each company as the earnings per share (EPS) divided by the year-end price. Specifically, we use the four most recent quarters of EPS, with the most recent quarter ending two months prior to the portfolio formation date. This is to avoid any forward-looking bias as it usually takes several weeks for a company to report its recent quarterly earnings after the end of the quarter. The earnings data are from Compustat. We measure momentum from the prior year's return. For each style, we measure the next calendar year's return after we have constructed the portfolios at the end of December.

We create a liquidity factor by selecting our lowest liquidity quartile returns and subtracting out our highest liquidity quartile returns. We compare our liquidity long-short factor to the factors on Kenneth R. French's website. Those factors include a market return which is the CRSP capitalization weighted average return of NYSE, AMEX, and NASDAQ stocks, a risk free rate which is the Ibbotson Associates one-month U.S. Treasury Bill rate, and the three Fama-French long-short zero net exposure size, value/growth, and momentum portfolios.

Table 1A: Summary Statistics of Stock Universe by Year

This table reports summary statistics for stocks listed on NYSE, NASDAQ, or AMEX that meet our criteria for data selection, including $10 million minimum market capitalization, $2 minimum per-share price, no REITs, no ETFs, no warrants, and no ADRs. Market capitalization is based on the end of December information, in millions of dollars.

	# of	Market Capitalization			
Year	Stocks	Mean	Median	Max	Min
1972	1600	502	99	46,701	10.1
1973	1407	432	85	35,832	10.0
1974	1200	351	86	24,396	10.1
1975	1410	418	85	33,289	10.0
1976	1415	484	98	41,999	10.0
1977	1672	437	99	40,333	10.1
1978	1687	450	109	43,524	10.0
1979	1717	522	134	37,569	10.1
1980	1737	676	169	39,626	10.0
1981	1529	602	163	47,888	10.3
1982	1708	730	193	57,982	10.0
1983	2999	546	117	74,508	10.1
1984	2935	547	112	75,437	10.0
1985	2960	696	137	95,607	11.3
1986	2864	795	140	72,711	12.6
1987	2726	833	138	69,815	12.7
1988	2938	855	143	72,165	13.8
1989	2829	1,082	169	62,582	17.1
1990	2491	1,118	174	64,529	15.2
1991	2799	1,318	201	75,653	20.4
1992	3204	1,277	204	75,884	22.5
1993	3500	1,317	228	89,452	30.3
1994	3500	1,315	240	87,193	35.9
1995	3500	1,780	329	120,260	58.8
1996	3500	2,160	421	162,790	78.9
1997	3500	2,849	521	240,136	107.1
1998	3500	3,499	478	342,558	78.9
1999	3277	4,633	554	602,433	88.4
2000	2891	5,060	711	475,003	80.4
2001	3093	4,149	644	398,105	71.5
2002	2839	3,585	585	276,631	57.8
2003	3370	4,024	701	311,066	75.5
2004	3392	4,473	818	385,883	85.5
2005	3331	4,797	887	370,344	90.4
2006	3332	5,348	998	446,944	102.7
2007	3490	5,253	836	511,887	95.8
2008	3017	3,611	607	406,067	56.8
2009	3217	4,354	731	322,668	72.5
2010	3229	5,027	908	368,712	83.8
Whole Sample	105,305	2,420	339	602,433	10.0

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Table 1: Size and Liquidity Quartile Portfolios 1972-2010

For this table, the top 3500 market-cap stock universe is independently and separately sorted into four quartiles according to each stock's market cap and trailing 12-month turnover ratios (liquidity measure), at the end of each December from 1971 to 2009. Each December we equally weight the 16 size and liquidity intersection portfolios. Reported for each intersection portfolio are geometric average annual return, arithmetic average annual return, return standard deviation, and average number of stocks in each cell.

Quartiles		Low Liquidity	Mid-Low	Mid-High	High Liquidity	All
Micro-Cap	Geom. Avg	18.17%	17.46%	13.51%	6.16%	14.73%
	Arithm. Avg	20.59%	20.58%	17.26%	11.85%	18.01%
	Std Dev	23.24%	25.88%	28.56%	36.05%	26.49%
	Avg No. Stocks	240	167	134	126	666
Small-Cap	Geom. Avg	16.87%	15.15%	11.68%	6.52%	12.74%
	Arithm. Avg	18.51%	17.52%	14.58%	10.63%	15.28%
	Std Dev	19.45%	22.98%	25.10%	29.48%	23.40%
	Avg No. Stocks	185	161	154	167	667
Mid-Cap	Geom. Avg	15.15%	14.36%	12.87%	9.56%	13.16%
	Arithm. Avg	16.66%	16.02%	15.42%	13.13%	15.34%
	Std Dev	18.41%	19.10%	23.77%	27.68%	21.75%
	Avg No. Stocks	148	156	171	192	666
Large-Cap	Geom. Avg	12.49%	11.48%	11.55%	9.87%	11.68%
	Arithm. Avg	13.81%	12.87%	13.36%	13.09%	13.34%
	Std Dev	16.68%	17.13%	19.18%	25.30%	18.45%
	Avg No. Stocks	94	185	208	180	667
All	Geom. Avg	16.22%	14.48%	12.60%	8.79%	
	Arithm. Avg	17.94%	16.34%	15.04%	12.60%	
	Std Dev	19.51%	20.02%	22.73%	28.30%	
	Avg No. Stocks	666	668	667	665	

Table 2: Value/Growth and Liquidity Quartile Portfolios 1972-2010

For this table, the top 3500 market-cap stock universe is independently and separately sorted into four quartiles according to each stock's trailing earnings/price ratios (value versus growth measure) and trailing 12-month turnover ratios (liquidity measure), at the end of each December from 1971 to 2009. The lowest earnings/price quartiles are called high growth and mid growth, and the highest earnings to price quartiles are called high value and mid-value. Each December we equally weight the 16 value/growth and liquidity intersection portfolios. Reported for each intersection portfolio are geometric average annual return, arithmetic average annual return, return standard deviation, and average number of stocks in each cell.

Quartiles		Low Liquidity	Mid-Low	Mid-High	High Liquidity	All
High-Value	Geom. Avg	20.82%	17.98%	17.02%	12.53%	17.71%
	Arithm. Avg	22.76%	20.20%	19.54%	16.26%	20.14%
	Std Dev	21.36%	22.07%	23.72%	27.97%	23.26%
	Avg No. Stocks	188	163	154	160	664
Mid-Value	Geom. Avg	15.74%	14.93%	13.54%	12.45%	14.45%
	Arithm. Avg	17.27%	16.55%	15.84%	15.72%	16.35%
	Std Dev	18.91%	19.19%	22.12%	26.06%	20.47%
	Avg No. Stocks	195	182	160	129	666
Mid-Growth	Geom. Avg	13.97%	12.46%	10.69%	8.04%	11.22%
	Arithm. Avg	15.49%	14.13%	12.97%	11.58%	13.24%
	Std Dev	18.32%	18.69%	21.73%	26.73%	20.40%
	Avg No. Stocks	151	174	179	163	667
High-Growth	Geom. Avg	11.93%	11.85%	7.88%	3.88%	8.37%
	Arithm. Avg	14.69%	15.17%	11.91%	9.33%	12.22%
	Std Dev	23.62%	26.60%	29.33%	34.35%	28.57%
	Avg No. Stocks	133	149	174	212	668
All	Geom. Avg	16.22%	14.48%	12.60%	8.79%	
	Arithm. Avg	17.94%	16.34%	15.04%	12.60%	
	Std Dev	19.51%	20.02%	22.73%	28.30%	
	Avg No. Stocks	666	668	667	665	

Table 3: Momentum and Liquidity Quartile Portfolios 1972-2010

For this table, the top 3500 market-cap stock universe is independently and separately sorted into four quartiles according to each stock's trailing 12-month return (momentum measure) and trailing 12-month turnover(liquidity measure), at the end of each December from 1971 to 2009. Each December we equally weight the 16 Momentum and liquidity intersection portfolios. Reported for each intersection portfolio are geometric average annual return, arithmetic average annual return, return standard deviation, and average number of stocks in each cell.

Quartiles		Low Liquidity	Mid-Low	Mid-High	High Liquidity	All
High-Momentum	Geom. Avg	17.41%	15.74%	12.96%	11.02%	14.52%
	Arithm. Avg	19.51%	17.93%	15.97%	15.09%	17.11%
	Std Dev	21.31%	22.09%	25.36%	29.56%	23.64%
	Avg No. Stocks	161	166	170	164	661
Mid-High	Geom. Avg	17.18%	15.77%	12.86%	9.47%	14.73%
	Arithm. Avg	18.84%	17.37%	14.94%	12.76%	16.54%
	Std Dev	19.34%	18.68%	21.17%	25.78%	19.83%
	Avg No. Stocks	204	189	163	112	668
Mid-Low	Geom. Avg	15.29%	14.45%	13.74%	9.38%	13.76%
	Arithm. Avg	17.14%	16.25%	16.00%	12.64%	15.81%
	Std Dev	20.53%	20.05%	22.12%	26.11%	21.14%
	Avg No. Stocks	190	185	169	124	669
Low-Momentum	Geom. Avg	14.31%	10.64%	9.83%	5.59%	8.90%
	Arithm. Avg	16.77%	13.88%	13.13%	10.28%	12.50%
	Std Dev	23.93%	26.39%	26.79%	32.44%	28.14%
	Avg No. Stocks	111	128	165	264	668
All	Geom. Avg	16.22%	14.48%	12.60%	8.79%	
	Arithm. Avg	17.94%	16.34%	15.04%	12.60%	
	Std Dev	19.51%	20.02%	22.73%	28.30%	
	Avg No. Stocks	666	668	667	665	

Table 4: Regression Analyses of Dollar Neutral Liquidity Factor and Low Liquidity Long Portfolio 1972- 2010

Liquidity Factor is the long-short dollar neutral portfolios based on low liquidity quartile minus high liquidity quartile. The Low liquidity Long portfolio is the long only portfolio based on the low liquidity quartile. Market beta is calculated based on market return minus the risk free rate. The size, value, and Momentum are dollar neutral factors. Market returns (Mkt-Rf), size (SMB), Value (HML), and Momentum (MOM) are all downloaded from Kenneth R. French's website. The regressions use CAPM, Fama-French, and Four-Factor models with the returns of Liquidity Factor and the returns net of risk-free rate for the Low Liquidity Long portfolio.

	Monthly Alpha	Market Beta	Size	Value	Momentum	Adj.R^2	N
Liquidity Long Short Factor							
CAPM	0.66%	-0.55				38.5%	468
t-stat	(4.36)	(-17.12)					
Fama-French	0.50%	-0.43	-0.22	0.36		48.8%	468
t-stat	(3.55)	(-13.61)	(-4.88)	(7.53)			
Four-factor	0.34%	-0.40	-0.22	0.41	0.16	51.6%	468
t-stat	(2.45)	(-12.64)	(-5.00)	(8.73)	(5.31)		
Low Liquidity Long							
CAPM	0.47%	0.80				76.0%	468
t-stat	(4.73)	(38.43)					
Fama-French	0.20%	0.78	0.55	0.36		94.2%	468
t-stat	(4.13)	(70.38)	(34.84)	(21.91)			
Four-factor	0.16%	0.79	0.55	0.38	0.04	94.4%	468
t-stat	(3.29)	(70.66)	(35.34)	(22.51)	(3.76)		

Table 5: Pearson Correlations of Monthly Liquidity Factor Returns with Other Factors 1972 - 2010

The Liquidity Factor is the long-short dollar neutral portfolio based on the low liquidity quartile minus the high liquidity quartile equally weighted. The market is the monthly market return minus the risk free rate. The size, value, and momentum are dollar neutral factors. Market returns (Mkt-Rf), size (SMB), value (HML), and momentum (MOM) are all downloaded from Kenneth R. French's website.

Variable	Liquidity Factor All	Market	Size	Value	Momentum
Liquidity Factor	1	-0.621	-0.367	0.467	0.192
Market	-0.621	1	0.272	-0.325	-0.141
Size	-0.367	0.272	1	-0.24	-0.007
Value	0.467	-0.325	-0.24	1	-0.161
Momentum	0.192	-0.141	-0.007	-0.161	1

Table 6: Regression Analyses of Enhanced Liquidity Portfolios 1972 – 2010

Small Cap Based Liquidity is the intersection of the smallest size quartile and the lowest liquidity quartile. Value Based Liquidity is the intersection of the value quartile and the lowest liquidity quartile. Momentum Based Liquidity is the intersection of the smallest size quartile and the lowest liquidity quartile. Market beta is calculated based on market return minus the risk free rate. The size, value, and Momentum are dollar neutral factors. Market returns (Mkt-Rf), size (SMB), Value (HML), and Momentum (MOM) are all downloaded from Kenneth R. French's website. The regressions use CAPM, Fama-French, and Four-Factor models with Small Cap Based Liquidity, Value Based Liquidity, and Momentum Based Liquidity returns net of risk-free rate.

	Monthly Alpha	Market Beta	Size	Value	Momentum	Adj.R^2	N
Small Cap Based Liquidity							
CAPM	0.62%	0.82				61.2%	468
t-stat	(4.36)	(27.16)					
Fama-French	0.28%	0.77	0.81	0.44		89.6%	468
t-stat	(3.78)	(45.09)	(33.61)	(17.31)			
Four-factor	0.25%	0.77	0.81	0.45	0.03	89.6%	468
t-stat	(3.30)	(44.69)	(33.71)	(17.36)	(1.94)		
Value Based Liquidity							
CAPM	0.81%	0.74				63.2%	468
t-stat	(6.61)	(28.34)					
Fama-French	0.45%	0.77	0.50	0.57		85.7%	468
t-stat	(5.76)	(43.60)	(19.97)	(21.39)			
Four-factor	0.48%	0.76	0.50	0.55	-0.03	85.8%	468
t-stat	(6.07)	(42.44)	(20.02)	(20.49)	(-2.00)		
Momentum Based Liquidity							
CAPM	0.48%	0.93				66.2%	468
t-stat	(3.31)	(30.25)					
Fama-French	0.32%	0.81	0.76	0.12		85.0%	468
t-stat	(3.25)	(36.72)	(24.27)	(3.50)			
Four-factor	0.04%	0.87	0.76	0.21	0.28	90.7%	468
t-stat	(0.49)	(48.88)	(30.78)	(7.99)	(16.73)		

Table 7: Stock Migrations Across Liquidity Groups One Year after the Liquidity Portfolio Formation 1972-2010

The stocks are sorted into four quartiles according to each stock's trailing 12-month turnover (liquidity measure), at the end of each December from 1971 to 2009. Stocks are allocated to one of four groups in year t can remain in that group, or move to other three groups at the end of year t+1.

A. Average number of stocks that migrate as a percentage of firms after the portfolio formation year

Weights		Year t+1 Liquidity			
		1 Low	2	3	4 High
Year t Liquidity	1 Low	**74.89%**	19.35%	4.25%	1.50%
	2	20.74%	**50.60%**	22.49%	6.18%
	3	3.01%	25.30%	**49.39%**	22.30%
	4 High	0.49%	4.35%	24.23%	**70.93%**

B. Average annual returns in excess of the market return for migrations after the portfolio formation year

Returns		Year t+1 Liquidity			
		1 Low	2	3	4 High
Year t Liquidity	1 Low	**9.95%**	33.53%	71.80%	138.49%
	2	-1.31%	**11.00%**	30.53%	83.35%
	3	-9.18%	0.31%	**11.56%**	36.69%
	4 High	-24.11%	-13.53%	-0.29%	**13.47%**

Some of the Year t data is incomplete for liquidity classification in Year t+1. However, even for this data, the less liquid quartiles have progressively higher returns. The missing returns for liquidity quartile rows 1, 2, 3, and 4 are 19.09%, 17.53%, 15.58%, 9.18% respectively.

Table 8: Stock Migration Speed Comparison 1972-2010

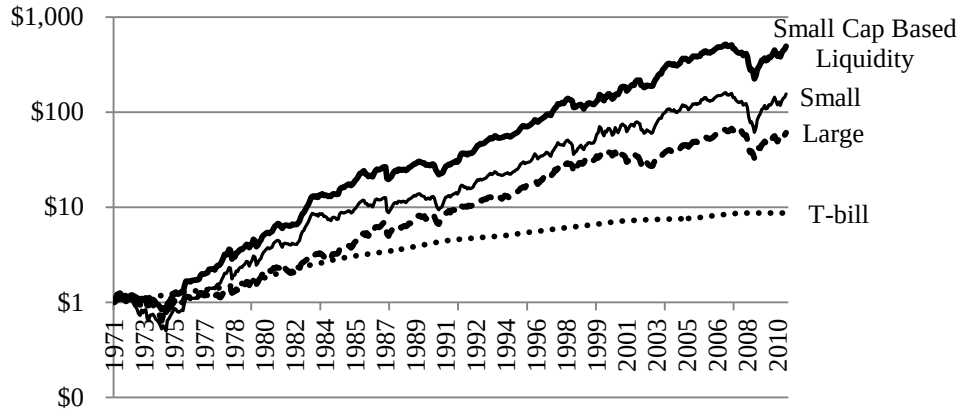
This table reports the percentage numbers of stocks that migrate out of each half group one year after the portfolio formation according to their liquidity, size, value, and momentum we compare the returns for stocks that remained in the group verses those that migrated out of the group. The stocks are sorted into two groups according to each measure at the end of each December from 1971 to 2009. The percentage of the stocks migrate out of the original half group is reported in the "Percent of Names Migrating" column. The next two columns report the returns of the stocks remained in the starting half group after one year, and the returns of the stocks that moved to other half group after one year. The weighted average return of both halves assumes a constant migration rate each year.

Starting Half	Percent of Names Migrating	Return of Stocks Remaining in Starting Half	Return of Stocks Migrating to Other Half	Weighted Average Return of Both Halves
Low Liquidity	17.24%	11.53%	50.41%	18.23%
Small Size	7.72%	10.36%	106.58%	17.79%
High Value	23.38%	15.84%	15.40%	15.74%
High Momentum	46.65%	48.19%	-22.39%	15.26%

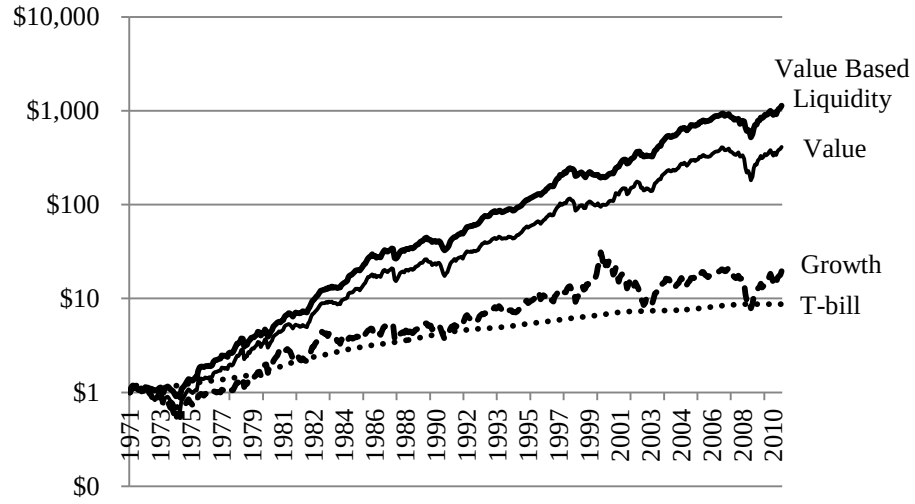
Starting Half	Percent of Names Migrating	Return of Stocks Remaining in Starting Half	Return of Stocks Migrating to Other Half	Weighted Average Return of Both Halves
High Liquidity	16.64%	14.07%	-2.41%	11.33%
Large Size	7.40%	15.85%	-38.27%	11.85%
High Growth	24.22%	12.65%	13.23%	12.79%
Low Momentum	48.15%	-26.45%	55.70%	13.11%

Figure 1: Cumulative Investment Returns across Portfolios 1972 – 2010

A. Comparison for liquidity and market cap related portfolios



B. Comparison for liquidity and value/growth related portfolios



C. Comparison for liquidity and momentum related portfolios