



**CATÓLICA
LISBON**
BUSINESS & ECONOMICS

Is liquidity the missing piece in asset-pricing models?

Pasquale Marotta | 152217030

Dissertation written under the supervision of José Afonso Faias

*Dissertation submitted in partial fulfilment of requirements for the MSc in Economics, at the
Universidade Católica Portuguesa, 1st June 2019.*

ABSTRACT

Liquidity is usually defined as the easiness of trading an asset. Despite this fairly simple definition, many measures have been proposed throughout the years but none of them have ever received a general consensus, thus leading to different results regarding the effects of liquidity on stock returns. By adopting three commonly used proxies (the relative bid-ask spread, the proportion of daily zero returns and the turnover rate), this study attempts to identify how and if liquidity has any explanatory power of the cross-sectional variability of returns. Moreover, the study also analyzes different investment strategies based on liquidity, with the goal of understanding whether or not liquidity can also outperform market returns. Results confirm the idea that liquidity can, indeed, affect stock returns, but this is not true for all proxies. Additionally, liquidity appears to be a profitable investment style that allows investors to obtain extra-returns by also containing the riskiness of the portfolio and the transaction costs associated with the strategy.

ABSTRACT (PORTUGUESE)

A Liquidez é usualmente definida como a facilidade de comercializar um ativo. Apesar desta simples definição, muitas foram as medidas utilizadas ao longo dos anos, com nenhuma a ter um consenso geral. E, por isso, levando a diferentes resultados relativamente aos reais efeitos da liquidez nos retornos de ações. Ao adotar três proxies usualmente utilizadas (o relativo bid-ask spread, a proporção de retornos iguais a zero e a turnover rate), este estudo tenta identificar como e se a liquidez tem algum poder explicativo sobre a variabilidade dos retornos ao longo de diferentes sectores. Ao mesmo tempo, este estudo também analisa diferentes estratégias de investimento baseadas na liquidez, com o objetivo de perceber se consegue ter uma melhor performance que o mercado. Os resultados confirmam a ideia de que a liquidez afeta os retornos de ações, contudo estes resultados não se verificam para todas as proxies. Adicionalmente, esta estratégia apresenta-se como um estilo de investimento rentável, permitindo aos investidores obter retornos extra ao ter o risco do portfolio e os custos de transação já tidos em conta.

KEYWORDS: Liquidity, Bid-Ask Spread, Turnover Rate, Daily Zero Returns, Investment Strategy

TABLE OF CONTENTS

1. INTRODUCTION	1
2. LITERATURE REVIEW	2
3. DATA	3
3.1. LIQUIDITY OVER TIME	4
4. EXPLANATORY REGRESSIONS	9
5. LIQUIDITY AS AN INVESTMENT STRATEGY	16
5.1. EQUALLY-WEIGHTED ILLIQUID AND IML PORTFOLIOS	16
5.2. EQUALLY-WEIGHTED INDUSTRY BASED ILLIQUID PORTFOLIO	24
6. CONCLUSION	28

LIST OF FIGURES

FIGURE 1: LIQUIDITY PROXIES OVER TIME	5
FIGURE 2: CORRELATION BETWEEN LIQUIDITY PROXIES	7
FIGURE 3: CUMULATIVE RETURNS OF THE ILLIQUID AND IML PORTFOLIOS	17

LIST OF TABLES

TABLE 1: LIQUIDITY - SORTED PORTFOLIOS	8
TABLE 2: IML PORTFOLIO EXPLANATORY REGRESSIONS	10
TABLE 3: BENCHMARK ANALYSIS FOR THE ILLIQUID AND THE IML PORTFOLIO	21
TABLE 4: PERSISTENCY RATES	23
TABLE 5: BENCHMARK ANALYSIS - INDUSTRY	25
TABLE 6: PERSISTENCY RATES - INDUSTRY	27

1. Introduction

Understanding which factors may play a role in explaining the cross-sectional variability of returns has been the question that many researchers, and practitioners, in finance have tried to answer since the Capital Asset Pricing Model was first presented by William Sharpe in 1964. The main idea behind that model, and those that were later developed, is that the higher the systematic and not diversifiable risk, the higher the expected return that such asset will provide. However, while a huge emphasis has been put to firm-related risk factors, like size or value, which are notoriously part of the 3 Factors Fama-French Model (Fama and French, 1993), the relationship between the microstructure of the market and the expected returns of assets has often been overlooked. In fact, as it has been documented also by Subrahmanyam (2009), even in recent literature it is quite unusual for market frictions and, in particular, illiquidity proxies to enter pricing models.

Liquidity, which can be defined as the easiness of trading an asset at low cost and without affecting its price, should be considered a natural candidate to be included in any model. As a matter of fact, it is reasonable to believe that investors would require higher returns for holding illiquid assets, since it may become unexpectedly expensive liquidating those positions in the future. This line of reasoning can be especially extended to market makers who demand to be compensated for both allowing orders to be executed, thus providing liquidity, and by being exposed to price changes while holding those assets. Nevertheless, despite being easy to define, it has been long debated which proxy is the most appropriate to measure liquidity. In fact, due to its multidimensionality, no single proxy has ever achieved a general consensus and, therefore, there has been a wide variety of liquidity measures proposed throughout the years.

Thus, the aim of this study is to provide some empirical evidence about the existing relationship between liquidity and returns. Particularly, the study tests if a liquidity factor has any explanatory power which may justify its use in an asset pricing model. In order to avoid for results to be driven by the specific measure adopted, the analysis is conducted by looking at various liquidity proxies that rely on different aspects of liquidity. Furthermore, this study also attempts to implement an investment strategy based on liquidity, so as to see if illiquid stocks offer higher and more attractive returns compared to those of an equally-weighted portfolio constructed by picking all the stocks on the market.

The study proceeds as follows: Section 2 surveys the existing literature; Section 3 describes the data; Section 4 summarizes results regarding the explanatory regressions

elaborated, Section 5 analyzes liquidity on an investment perspective and Section 6 concludes.

2. Literature Review

A link between stock liquidity and expected returns was first modeled by Amihud and Mendelson (1986). Specifically, they concluded that investors take into consideration the bid-ask spread, which represents the cost of immediate execution, and that there exists a concave and positive relationship between illiquidity and expected returns due to a clientele effect. Indeed, investors who prefer to hold their position for a longer period of time will not be heavily affected by the higher transaction costs of illiquid stocks. Therefore, the premium associated with (il)liquidity will increase but with a slower pace at a higher level of illiquidity. These conclusions were, then, further developed and confirmed also in different settings and by adopting other liquidity measures (Amihud and Mendelson, 1989; Kluger and Stephan, 1997; Datar and al., 1998).

Market-wide liquidity has also been analyzed as a potential risk factor that could correctly predict the cross-sectional variability of stock returns. Pastor and Stambaugh (2003) developed their study by looking at stock sensitivity to fluctuations of aggregate liquidity and found a positive relationship between stock returns and their degree of sensitivity to innovations in market liquidity. Furthermore, evidence about the positive link between stock returns and the covariance of stock illiquidity and market illiquidity has also been found in later academic literature (Acharya and Pedersen, 2005).

Emerging markets, which have usually a lower degree of liquidity compared to their European and US counterparties, have been the subject of many studies related to liquidity too. By using turnover-based liquidity proxies results were inconsistent with the ones documented in previous studies and in more developed markets (Rouwenhorst, 1999; Jun, Marathe and Shawky, 2003). Nevertheless, the use of an alternative measure, that is the proportion of zero daily returns in a month, which was first introduced by Lesmond, Ogden and Trzcinka (1999), was able to produce results in line with the literature. The proportion of zero daily returns and unexpected liquidity shocks were also found to be both positively correlated with expected stock returns, while turnover ratio showed very little predictive power in comparison (Bekaert, Harvey and Lundblad, 2007).

This brings the question regarding whether or not liquidity proxies are similar to one another and, if they differ, what aspects of liquidity is actually measured by each proxy.

Aitken and Comerton-Forde (2003) divide liquidity measures in order-based proxies, like the relative bid-ask spread, and trade-based proxies, like turnover ratio or trading volume, and found that the former better relate to the level of actual liquidity in the market. Further tests have been performed also on the quality of low-latency proxies compared to high-frequency ones. In particular, the CRSP-based bid-ask spread seemed to be still a good approximation of the TAQ-based spread, which relies on intra-day data (Chung and Zhang, 2014). Furthermore, Goyenko, Holden and Trzcinka (2008) compared a dozen of other low-latency proxies and they were able to conclude that many of them performed reasonably well when compared to their counterparty obtained through intra-day observations.

While many studies focused only on the US market, similar results were still found in other markets and with different proxies, thus implying that very little piece of information is lost when performing analysis with low-latency variables (Lesmond, 2005; Ahn, Cai, Yang, 2012).

3. Data

The sample used comprises of all the common stocks (with share codes 10 and 11) of the NYSE, AMEX and NASDAQ included in the CRSP dataset. Three liquidity measures are adopted in this study: relative bid-ask spread, turnover rate and the proportion of daily zero returns.

The relative bid-ask spread of every stock in each month is obtained by taking the monthly average of the daily relative bid-ask spread, that is the ratio between the dollar-spread of the closing bid and ask over its mid-price (Amihud and Mendelson; 1989). In formula:

$$Relative\ Bid\ Ask\ Spread = \frac{Closing\ Ask - Closing\ Bid}{\frac{Closing\ Ask + Closing\ Bid}{2}} \quad (1)$$

The dealer's ask and bid of each stock is the closing ask and bid of the day. The measure is computed only if the number of available daily observations in a month are more or equal than 7. This restriction is implemented so that the monthly average can be considered representative of the liquidity that the stock showed during the month. Moreover, if the bid-ask spread calculated as such resulted to be negative or null, it was discarded. The maximum number of stocks in a month that meet all the aforementioned requirements is 7390, while the minimum is 3606.

The turnover ratio, used by Datar, Naik and Radcliffe (1998), is computed each month as the ratio between the number of shares traded in a month and the number of shares outstanding at the end of that month, as it is shown below:

$$\text{Turnover Rate} = \frac{\text{Trading Volume in the month}}{\text{N}^\circ \text{ of shares outstanding}} \quad (2)$$

The higher the turnover rate, the higher is the liquidity: therefore, there exists an inverse relationship between the turnover rate and the bid-ask spread. Based on the turnover rate, the number of available stocks in each month can vary from a maximum of 7522 to a minimum of 3615.

Finally, the third measure used in this study, which was analyzed by Lesmond, Ogden and Trzcinka (1999) who found it to be highly correlated with other measures of transaction costs, is the proportion of daily zero returns. The measure is computed as a ratio between the number of zero returns in a month and the number of available observations in the month. The following formula describes the measure:

$$\text{Proportion of daily zero returns} = \frac{\text{N}^\circ \text{ of daily zero returns}}{\text{N}^\circ \text{ of trading days in the month}} \quad (3)$$

The same restriction adopted for the relative bid-ask spread is included here too: the total number of available observations in a month must be higher or equal than 7. Finally, the number of stocks for which it was possible to compute the proportion of daily zero returns goes from a maximum of 7485 to a minimum of 3605.

3.1. Liquidity over time

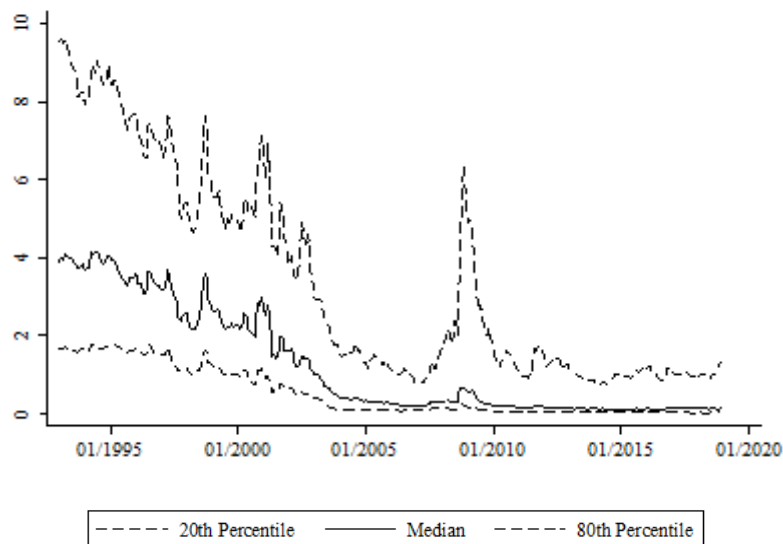
To understand if these proxies are able to capture the evolution of liquidity over time it can be useful to observe how the overall distribution of the proxies here used changed through the time span adopted and how they relate to each other. In particular, it is expected to see that, due to a long process of liberalization and deregulation that characterized the US market, liquidity should increase over time, as Levine and Zervos (1998) showed by comparing the effects of liberalized market policies in a panel of emerging markets.

Figure 1

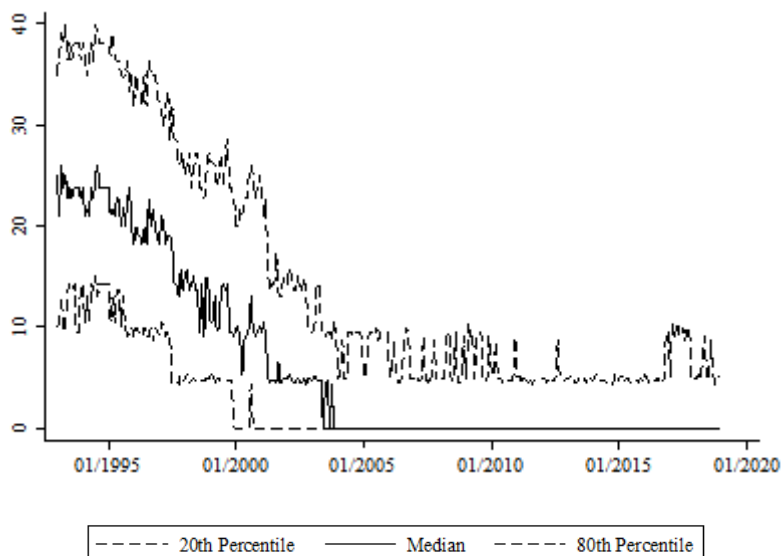
Liquidity Proxies across time

Panel A presents the 20th, the 50th and the 80th percentile of the monthly relative bid-ask spread computed as the average of the daily relative bid-ask spreads for each month and stock. Panel B shows the 20th, the 50th and the 80th percentile of the monthly proportion of the number of daily zero returns on the number of available trading days in the month for every stock. Panel C presents the 20th, the 50th and the 80th percentile of the turnover rate obtained as the ratio of the trading volume in the month and the number of outstanding shares at the end of the month for every stock. The time span goes from January 1993 to December 2018. All the measures on the ordinal axis are in percentage.

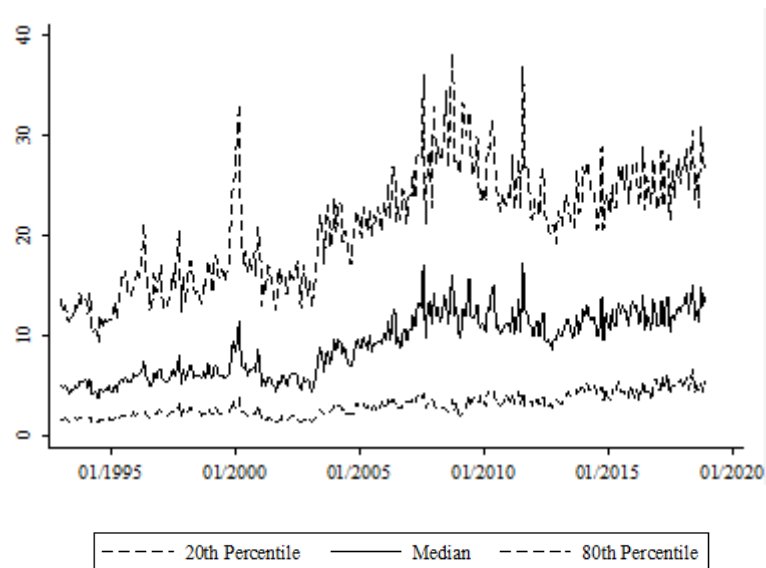
Panel A - Relative Bid-Ask Spread



Panel B - Proportion of Daily Zero Returns



Panel C - Turnover Rate



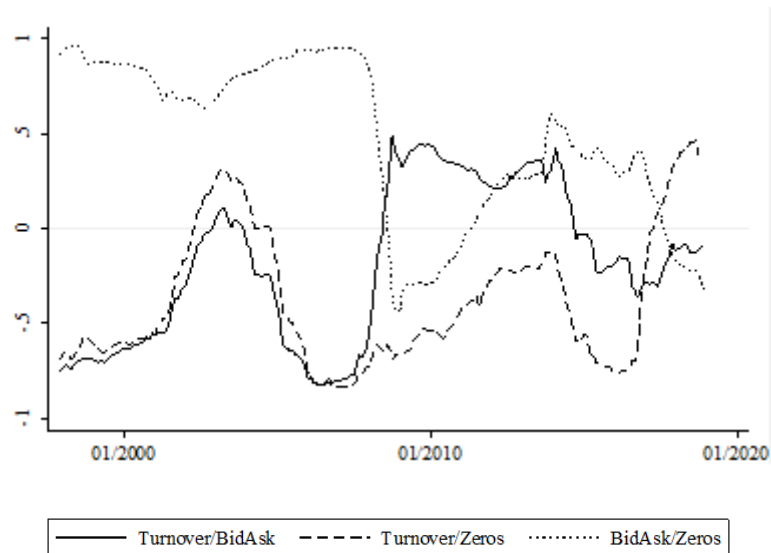
As it can be clearly seen in Figure 1, all the three proxies document the same pattern: over the period between January 1993 to December 2018 liquidity has overall, indeed, increased in the market. Moreover, the distribution of stock liquidity appears to be highly skewed since very little difference can be found between stocks at the 20th and the 50th percentile. However, while the relative bid-ask spread and the proportion of daily zero returns show that this asymmetry has sharpened over time, it doesn't appear to be the case for turnover rate too.

To further analyze the interrelation between the three proxies, Figure 2 plots the correlation between each pair of liquidity measure. Ideally, the relative bid-ask spread and the proportion of daily zero returns are expected to be positively correlated to each other while the turnover rate should appear to be inversely related to both. Although for the majority of the time these relationships hold, during the period between 2008 and 2015, the turnover rate and the relative bid-ask spread showed a persistent positive correlation that violates the initial assumption of an inverse relationship between the two. This time period is also marked by the financial crisis of 2007-2008 and the debt crisis in the eurozone of 2010-2011 which may have had some repercussions on the behavior of investors. In fact, while it can be expected that traders adjusted their positions during crisis and, thus, the overall trading volume surged consequently to this (Hoffmann, Post and Pennings; 2013), the bans imposed by regulators on short-selling activities could have easily widened the spread between the bid and the ask too (Beber and Pagano; 2013). Therefore, the combined effect of the two aforementioned causes may help explain the apparent anomaly displayed by the chart.

Figure 2

Correlation between liquidity proxies

The figure shows the historical 5-year rolling window Pearson correlation coefficients for each pair of liquidity proxies measured monthly. The first available estimates for all the pairs are in January 1998. The time span goes from January 1998 to December 2018.



Finally, in order to understand if liquidity has an impact on the cross-sectional variability of returns, stocks are sorted in 10 equally-weighted portfolios. Each portfolio is formed based on a s -month average of the specified liquidity proxy and then it is held for j subsequent months. For sake of clarity, an example will be now provided. A 6 - 12 strategy based on relative bid-ask spread implies that stocks at time t are sorted in 10 deciles based on an average of the relative bid-ask spread computed from time t to $t - 6$. The stocks are assigned to the 10 portfolios based on their ranking: the most liquid portfolio contains stocks in the first decile while the most illiquid one contains the stocks in the last decile. Then, portfolios are held passively for the next 12 months. Therefore, at any point in time t (after the first j periods) there exist j active portfolios for each decile.

Table 1 reports the time-series average of the 1-month mean return for all the $s - j$ strategies analyzed and for the three proxies used: a consistent pattern emerges from the table.

Table 1**Liquidity - Sorted Portfolios**

This table presents the time-series average of the 1-month mean return of 10 equally-weighted portfolios. Each portfolio is constructed by sorting stocks (with a share code 10 or 11 in CRSP database) at the end of each month t based on their s -month average of their monthly relative bid-ask spread, monthly proportion of daily zero returns or monthly turnover rate. The most liquid stocks belong to the first decile portfolio, while the most illiquid ones belong to the last decile portfolio. Portfolios are then held for j months ahead and the return of the $s - j$ strategy for each decile at the end of the month t is computed as the average of the 1-month return of the j existing portfolios. The difference in mean between the liquid and the illiquid portfolio returns is then tested through an independent t-test. All the results are in percentage. Standard errors are in parenthesis. A statistically significant difference at 10%, 5% or 1% level is respectively labeled by *, **, ***.

	Bid-Ask Spread				Zero Returns				Turnover Rate			
	12-12	12-6	6-12	6-6	12-12	12-6	6-12	6-6	12-12	12-6	6-12	6-6
P1 (Liquid)	0.79	0.75	0.74	0.74	0.77	0.73	0.72	0.71	0.42	0.38	0.37	0.33
P2	0.87	0.84	0.83	0.82	0.81	0.78	0.78	0.85	0.74	0.70	0.66	0.64
P3	0.89	0.88	0.85	0.85	0.80	0.78	0.69	0.66	0.91	0.85	0.83	0.82
P4	0.90	0.87	0.87	0.87	0.86	0.81	0.85	0.81	1.08	1.08	1.01	0.98
P5	0.98	0.97	0.92	0.89	0.96	0.92	0.90	0.86	1.13	1.12	1.06	1.05
P6	0.98	0.94	0.93	0.91	1.01	0.98	0.97	0.92	1.13	1.17	1.12	1.14
P7	0.99	0.97	0.94	0.95	1.10	1.12	1.03	0.99	1.15	1.15	1.13	1.11
P8	0.95	0.95	0.88	0.84	1.16	1.14	1.15	1.16	1.17	1.20	1.15	1.17
P9	1.11	1.06	1.09	1.03	1.31	1.31	1.27	1.29	1.20	1.21	1.19	1.19
P10 (Illiquid)	1.71	1.77	1.71	1.72	1.36	1.43	1.37	1.45	1.11	1.10	1.09	1.06
P10 - P1	0.92* (0.0049)	1.03** (0.0050)	0.97** (0.0049)	0.97* (0.0050)	0.59 (0.0046)	0.70 (0.0046)	0.65 (0.0046)	0.74 (0.0047)	0.69 (0.0060)	0.72 (0.0061)	0.72 (0.0058)	0.73 (0.0059)

Indeed, by looking at the portfolio returns based on the relative bid-ask spread, they show a positive monotonic relation with illiquidity: more illiquid stocks are also expected to provide higher returns, in line with the literature. In particular, this result is not driven by the length of the formation period s or of the holding period j , although the magnitude of returns is going to be clearly affected by it.

The same conclusion cannot be drawn by looking at the results of portfolios formed by sorting stocks by their proportion of daily zero returns or their turnover rate. Despite the fact that they also show the same positive monotonic relation with illiquidity, the difference in mean of the illiquid and liquid decile remains statistically insignificant for all the different $s - j$ strategy implemented.

4. Explanatory Regressions

As shown in Section 3, it appears that illiquid stocks generate higher returns compared to their liquid counterparties at least when they are sorted based on relative bid-ask spread. Therefore, to further understand whether or not liquidity plays a role in explaining how stocks' returns differ cross-sectionally, an illiquid minus liquid portfolio (IML for brevity) is regressed against common risk-factors (Fama and French, 1993).

The IML portfolio is constructed as a self-financing portfolio that goes long on stocks in the last decile, defined by the liquidity proxy adopted, and goes short on stocks in the first decile. The resulting returns of the IML portfolio are then regressed against the excess returns of the market (MKTRF as in the CAPM model), the 3 Fama-French factors (labeled by MKTRF, SMB, HML), the 4 Carhart Factors (which adds to the 3 previous factors the momentum factor MOM), the 4 Carhart Factors plus the Pastor-Stambaugh liquidity factor (LIQ), and finally the 5 Fama-French factors that adds to the usual 3 Fama-French factors also a profitability (RMW) and an investment measure (CMA):

$$IML_t = \alpha + \beta_1 MKTRF_t + \varepsilon_t \quad (4)$$

$$IML_t = \alpha + \beta_1 MKTRF_t + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_t \quad (5)$$

$$IML_t = \alpha + \beta_1 MKTRF_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \varepsilon_t \quad (6)$$

$$IML_t = \alpha + \beta_1 MKTRF_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \beta_5 LIQ_t + \varepsilon_t \quad (7)$$

$$IML_t = \alpha + \beta_1 MKTRF_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + \varepsilon_t \quad (8)$$

Table 2

IML Portfolio Explanatory Regressions

This table shows the estimates obtained by regressing the monthly returns of a self-financing portfolio (IML), that goes long on illiquid stocks and short on liquid ones, against the excess returns of the market (MKTRF), the 3 Fama-French Factors (MKTRF, SMB, HML), the 4 Carhart Factors (MKTRF, SMB, HML, MOM), the 4 Carhart Factors and the Pastor-Stambaugh liquidity factor (LIQ) and the 5 Fama-French Factors (MKTRF, SMB, HML, RMW, CMA). Stocks (with a share code 10 or 11 in CRSP database) are sorted at the end of each month t based on a s -month average of their monthly relative bid-ask spread, monthly proportion of daily zero returns or monthly turnover rate. Portfolios are then held for j months ahead and the return of the $s - j$ strategy for each decile at the end of the month t is computed as the average of the 1-month return of the j existing portfolios. Panel A, B, C and D differ for the different lengths of the formation period (s) and of the holding period (j) adopted. Panel A reports the estimates for the IML portfolio based on a 12 - 12 strategy. Panel B reports the estimates for the IML portfolio based on a 12 - 6 strategy. Panel C reports the estimates for the IML portfolio based on a 6 - 12 strategy. Panel D reports the estimates for the IML portfolio based on a 6 - 6 strategy. All the results are in percentage. Standard errors are in parenthesis and are adjusted for autocorrelation (Newey and West, 1987) with a lag length of 4 months. A statistically significance at 10%, 5% or 1% level is respectively labeled by *, **, ***.

Panel A – IML Portfolio based on a 12-12 strategy

	Bid-Ask spread					Turnover Rate					Zero Returns				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
MKTRF	0.37*** (0.06)	0.33*** (0.06)	0.31*** (0.07)	0.31*** (0.07)	0.30*** (0.06)	-0.05 (0.10)	-0.05 (0.11)	-0.07 (0.15)	-0.08 (0.16)	0.08 (0.14)	0.24*** (0.05)	0.21*** (0.05)	0.19*** (0.07)	0.18*** (0.07)	0.24*** (0.07)
SMB		0.41*** (0.10)	0.41*** (0.10)	0.41*** (0.10)	0.36*** (0.12)		0.26 (0.19)	0.27 (0.19)	0.26 (0.19)	0.48*** (0.15)		0.32*** (0.10)	0.33*** (0.10)	0.32*** (0.09)	0.36*** (0.11)
HML		0.15 (0.11)	0.14 (0.12)	0.14 (0.13)	0.17 (0.11)		0.35* (0.20)	0.33 (0.24)	0.33 (0.24)	0.24 (0.23)		0.17 (0.11)	0.15 (0.12)	0.15 (0.12)	0.13 (0.12)
MOM			-0.03 (0.08)	-0.03 (0.08)				-0.05 (0.20)	-0.06 (0.20)				-0.06 (0.08)	-0.06 (0.08)	
LIQ				0.01 (0.10)					0.07 (0.16)					0.05 (0.10)	
RMW					-0.13 (0.15)					0.63** (0.25)					0.11 (0.14)
CMA					0.04 (0.19)					-0.18 (0.42)					0.01 (0.19)
Alpha	0.72** (0.29)	0.65** (0.27)	0.67** (0.28)	0.67** (0.27)	0.71** (0.27)	0.64 (0.44)	0.53 (0.42)	0.57 (0.46)	0.55 (0.46)	0.24 (0.42)	0.46* (0.27)	0.39 (0.24)	0.43* (0.26)	0.42 (0.26)	0.33 (0.25)
Obs.	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289
R-squared	0.09	0.15	0.15	0.15	0.15	0.00	0.03	0.03	0.03	0.05	0.05	0.10	0.10	0.10	0.10

Panel B - IML Portfolio based on a 12-6 strategy

	Bid-Ask spread					Turnover Rate					Zero Returns				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
MKTRF	0.40*** (0.06)	0.35*** (0.06)	0.34*** (0.07)	0.35*** (0.07)	0.34*** (0.07)	-0.04 (0.10)	-0.04 (0.12)	-0.06 (0.15)	-0.07 (0.16)	0.09 (0.15)	0.25*** (0.05)	0.22*** (0.06)	0.19** (0.08)	0.19** (0.08)	0.26*** (0.07)
SMB		0.40*** (0.10)	0.40*** (0.10)	0.41*** (0.10)	0.37*** (0.12)		0.27 (0.20)	0.28 (0.20)	0.27 (0.20)	0.51*** (0.16)		0.32*** (0.10)	0.33*** (0.10)	0.33*** (0.10)	0.37*** (0.10)
HML		0.16 (0.10)	0.15 (0.11)	0.15 (0.12)	0.18 (0.11)		0.35* (0.21)	0.33 (0.24)	0.33 (0.24)	0.22 (0.24)		0.19 (0.11)	0.15 (0.12)	0.15 (0.12)	0.13 (0.13)
MOM			-0.02 (0.09)	-0.02 (0.09)				-0.04 (0.21)	-0.05 (0.21)				-0.08 (0.09)	-0.08 (0.10)	
LIQ				-0.01 (0.10)					0.07 (0.16)					0.04 (0.10)	
RMW					-0.08 (0.15)					0.67*** (0.25)					0.14 (0.14)
CMA					0.54 (0.19)					-0.18 (0.43)					0.01 (0.20)
Alpha	0.81*** (0.30)	0.74*** (0.27)	0.76*** (0.29)	0.76*** (0.28)	0.78*** (0.28)	0.70 (0.45)	0.59 (0.44)	0.62 (0.47)	0.60 (0.48)	0.28 (0.43)	0.56** (0.28)	0.49* (0.25)	0.55** (0.28)	0.54** (0.27)	0.42 (0.26)
Obs.	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289
R-squared	0.10	0.16	0.16	0.16	0.16	0.00	0.02	0.03	0.03	0.05	0.05	0.10	0.10	0.11	0.10

Panel C - IML Portfolio based on a 6-12 strategy

	Bid-Ask spread					Turnover Rate					Zero Returns				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
MKTRF	0.39*** (0.06)	0.34*** (0.06)	0.33*** (0.07)	0.34*** (0.07)	0.33*** (0.07)	-0.02 (0.09)	-0.02 (0.11)	-0.04 (0.14)	-0.05 (0.15)	0.10 (0.14)	0.24*** (0.05)	0.21*** (0.06)	0.18** (0.08)	0.18** (0.08)	0.25*** (0.07)
SMB		0.41*** (0.10)	0.41*** (0.10)	0.41*** (0.10)	0.39*** (0.11)		0.27 (0.19)	0.28 (0.19)	0.27 (0.19)	0.49*** (0.15)		0.32*** (0.10)	0.33*** (0.09)	0.33*** (0.09)	0.37*** (0.10)
HML		0.16* (0.10)	0.15 (0.11)	0.15 (0.11)	0.18 (0.11)		0.35* (0.19)	0.34 (0.22)	0.34 (0.22)	0.25 (0.22)		0.17* (0.10)	0.14 (0.12)	0.14 (0.12)	0.11 (0.12)
MOM			-0.03 (0.08)	-0.03 (0.08)				-0.04 (0.19)	-0.05 (0.19)				-0.07 (0.09)	-0.07 (0.09)	
LIQ				-0.01 (0.09)					0.06 (0.15)					0.01 (0.09)	
RMW					-0.06 (0.15)					0.62*** (0.24)					0.16 (0.13)
CMA					0.01 (0.19)					-0.18 (0.47)					0.02 (0.20)
Alpha	0.76*** (0.29)	0.68*** (0.26)	0.70** (0.28)	0.71** (0.27)	0.71*** (0.27)	0.68 (0.43)	0.56 (0.41)	0.59 (0.44)	0.57 (0.45)	0.28 (0.41)	0.52** (0.26)	0.45* (0.24)	0.50* (0.26)	0.50* (0.26)	0.36 (0.24)
Obs.	295	295	295	295	295	295	295	295	295	295	295	295	295	295	295
R-squared	0.10	0.16	0.16	0.16	0.16	0.00	0.03	0.03	0.03	0.06	0.05	0.10	0.11	0.11	0.11

Panel D - IML Portfolio based on a 6-6 strategy

	Bid-Ask spread					Turnover Rate					Zero Returns				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
MKT	0.43*** (0.06)	0.39*** (0.06)	0.39*** (0.07)	0.40*** (0.07)	0.35*** (0.07)	-0.00 (0.10)	-0.01 (0.12)	-0.02 (0.14)	-0.03 (0.15)	0.12 (0.14)	0.26*** (0.06)	0.24*** (0.07)	0.21** (0.09)	0.21** (0.09)	0.28*** (0.08)
SMB		0.40*** (0.10)	0.41*** (0.10)	0.41*** (0.10)	0.39*** (0.11)		0.30 (0.20)	0.31 (0.20)	0.30 (0.20)	0.53*** (0.16)		0.34*** (0.10)	0.34*** (0.10)	0.35*** (0.10)	0.40*** (0.09)
HML		0.18* (0.10)	0.18 (0.11)	0.17 (0.11)	0.20* (0.12)		0.35* (0.19)	0.34 (0.21)	0.34 (0.21)	0.24 (0.24)		0.19* (0.11)	0.16 (0.12)	0.16 (0.12)	0.12 (0.14)
MOM			-0.01 (0.09)	-0.01 (0.09)				-0.02 (0.18)	-0.02 (0.18)				-0.07 (0.09)	-0.07 (0.09)	
LIQ				-0.06 (0.09)					0.06 (0.16)					-0.03 (0.09)	
RMW					-0.05 (0.15)					0.63*** (0.24)					0.19 (0.14)
CMA					0.00 (0.19)					-0.17 (0.40)					0.03 (0.21)
Alpha	0.73** (0.30)	0.65** (0.27)	0.66** (0.29)	0.68** (0.29)	0.68** (0.27)	0.70 (0.44)	0.58 (0.42)	0.60 (0.46)	0.57 (0.45)	0.30 (0.42)	0.59** (0.29)	0.51* (0.26)	0.57* (0.29)	0.58** (0.29)	0.41 (0.26)
Obs.	295	295	295	295	295	295	295	295	295	295	295	295	295	295	295
R-squared	0.11	0.17	0.17	0.17	0.17	0.00	0.03	0.03	0.03	0.06	0.05	0.11	0.11	0.11	0.11

To account for autocorrelation, standard errors are adjusted based on the Newey-West approach (Newey and West, 1987) with a lag length of 4 months¹. In order to provide robustness to the results, the same regressions are repeated also for different lengths of the formation s and of the holding period j , on which the IML portfolio is based on. Finally, the results are displayed in Table 2.

The explanatory regressions add evidence to what has already been found in Section 3. By sorting stocks on their relative bid-ask spread and then going long on those that result to be the most illiquid and short on those that, on the contrary, are the most liquid ones provide positive and statistically significant abnormal returns. Indeed, adding controls slightly changes the magnitude of the estimated alpha but it keeps being significant different than zero.

Conversely, the proportion of daily zero returns and the turnover rate don't seem to be able to generate significant abnormal returns. On one hand, the alpha estimated by regressing the IML portfolio formed through the turnover rate never results to be significant. On the other hand, the alpha estimated when the IML portfolio is formed by sorting stocks on the basis of their proportion of daily zero returns is significant but not robust to different asset pricing models: in particular, abnormal returns never appear to be significant when the 5 Fama-French factors are used as control variables.

Remarkable is also the non-significance of the estimates related to the Pastor-Stambaugh liquidity factor which proxies for stocks' sensitiveness to innovations in market liquidity (Pastor and Stambaugh, 2003). Unsurprisingly, the complexity of measuring liquidity, as it has already been documented before, is confirmed also in the framework of this study: the multidimensionality of liquidity cannot be simply approached by adopting one single liquidity proxy, but it helps to disentangle the wide variety of elements that compose liquidity.

It is also worth to notice that the liquidity proxies here adopted, except for the turnover rate, appear also to be strongly correlated with the size factor. The link between the size effect and liquidity has been intensely studied in the academic literature. As a matter of fact, the strong link that exists between transaction costs and size has been documented before (Stoll and Whaley, 1983) as well as the relationship between the liquidity risk and the size effect (Amihud, 2002; Acharya and Pedersen, 2005), but a unanimous agreement on whether the size effect is just a mirror of the liquidity premium has not been reached yet. In line with these previous studies, the results of Table 2 seem to suggest that liquidity and size are undeniably

¹ The lag length is computed based on the formula $T^{1/4}$ suggested by Greene (2012)

correlated to one another, with the smaller firms also being the most illiquid ones on the market.

5. Liquidity as an investment strategy

Since it is now clear that liquidity can play an important role in explaining the variability of returns across stocks, it may be also of interest to understand if a liquidity-based investment strategy is both feasible in terms of transaction costs and profitability when compared to a benchmark. In particular, an equally-weighted portfolio of all the stocks available on the market will serve as a benchmark. In this way, small stocks are going to affect the performance of the benchmark portfolio as they do in the portfolios that are going to be presented in the following paragraphs.

To ease the presentation, this Section will be divided into two parts. The first part will reproduce portfolios similar to the ones used in previous sections but now analyzed on an investment perspective. In the second part, a slightly more sophisticated strategy relying on selecting stocks based on their industry will be scrutinized.

5.1. Equally-Weighted Illiquid and IML Portfolios

A simple way to exploit the positive relationship between illiquidity and returns is to create a portfolio that takes a long position on illiquid stocks and a short position on liquid ones: the self-finance IML portfolio attempts to do just this. An alternative formulation may be to take a long position on illiquid stocks only and then finance this long portfolio by borrowing at the risk-free rate.

In Figure 3, the cumulative returns of the equally-weighted portfolios, constructed as mentioned before, are plotted together with the cumulative returns of the benchmark portfolio. From January 1993 to December 2018, the portfolios specified by the relative bid-ask spread were always able to outperform the benchmark and all the other illiquid or IML portfolios. Moreover, when the holding period of the portfolios is reduced from 12 to 6 months, the cumulative returns increased substantially. Finally, as also shown by the regressions in Table 2, the IML and the Illiquid portfolios follow the market and, thus, suffered during crises.

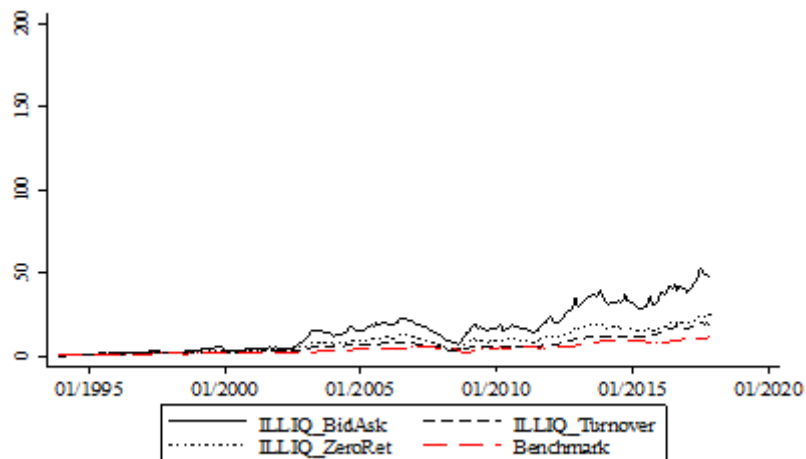
In order to assess if the portfolios can significantly outperform the benchmark created, it is necessary to test whether the performances of the strategies implemented are statistically better. Ideally, a higher average return and Sharpe ratio, a positive skewness (Krauss and Lintzenberg, 1976) combined with low excess kurtosis (Haas, 2007) are the elements that investors look at.

Figure 3

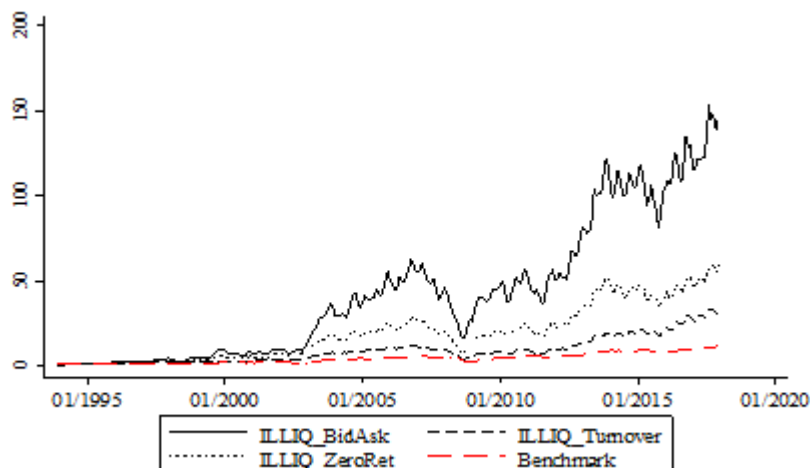
Cumulative Returns of the Illiquid and IML Portfolios

This figure shows the cumulative returns of the Illiquid Portfolios, constructed for each liquidity proxies by taking a long position on the last decile of each month, and of the IML Portfolios, which also takes a short position on the first decile identified by each proxy. The Portfolios so constructed are equally-weighted and they are compared with the cumulative returns of the benchmark portfolio. The benchmark is an equally-weighted portfolio of all the stocks in the sample when compared to the Illiquid Portfolio. When compared to the IML Portfolio, the chart shows the excess returns of the benchmark obtained by subtracting the 1-month T-bill risk-free return from Kenneth French Database. Panel A to H differ for the different formation (s) and holding (j) periods adopted. Panel A to D show the cumulative returns for the Illiquid Portfolios, while Panel E to H show the cumulative returns for the IML Portfolios. The time span goes from January 1993 to December 2018.

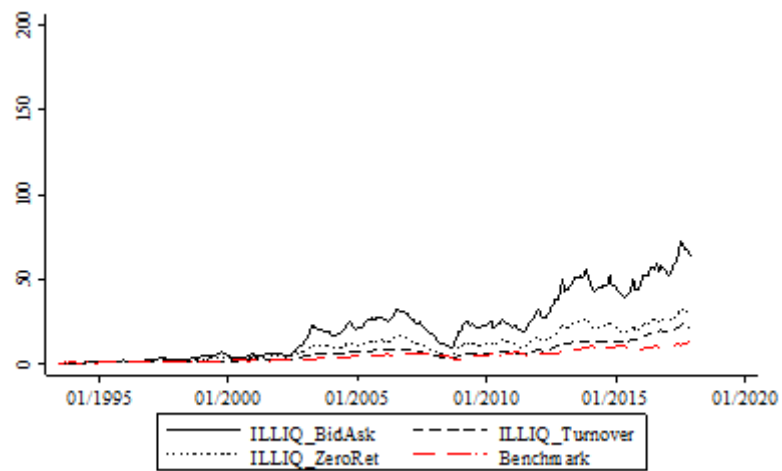
Panel A – Illiquid Portfolios with a 12-12 strategy



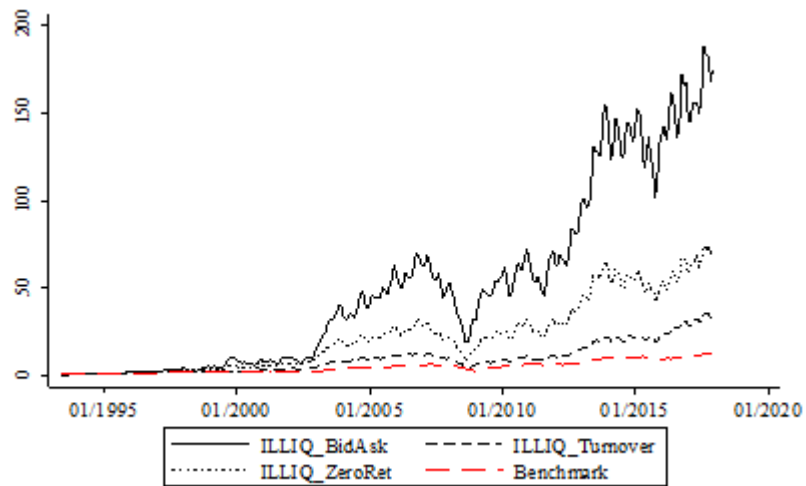
Panel B – Illiquid Portfolios with a 6-6 strategy



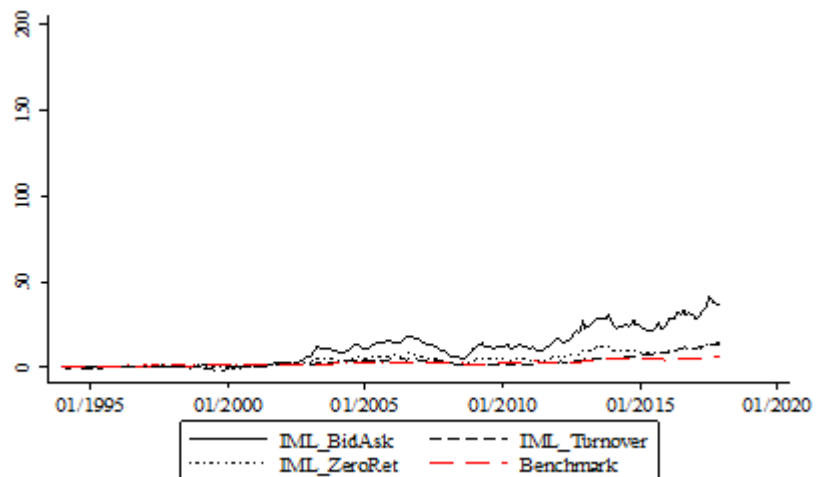
Panel C – Illiquid Portfolios with a 6-12 strategy



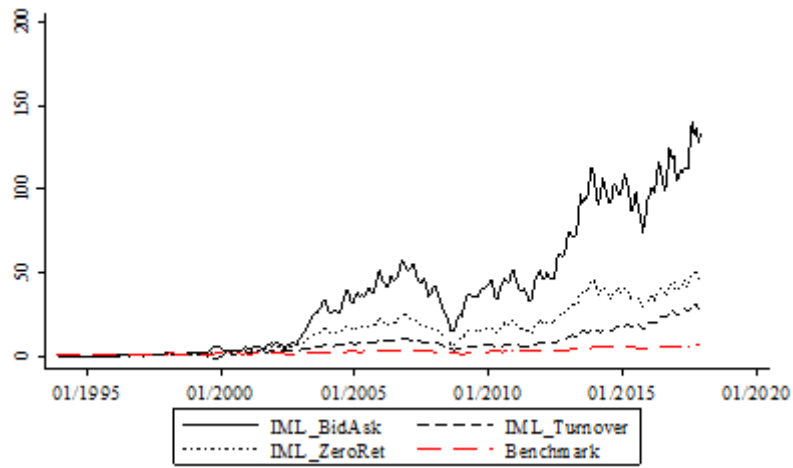
Panel D – Illiquid Portfolios with a 6-6 strategy



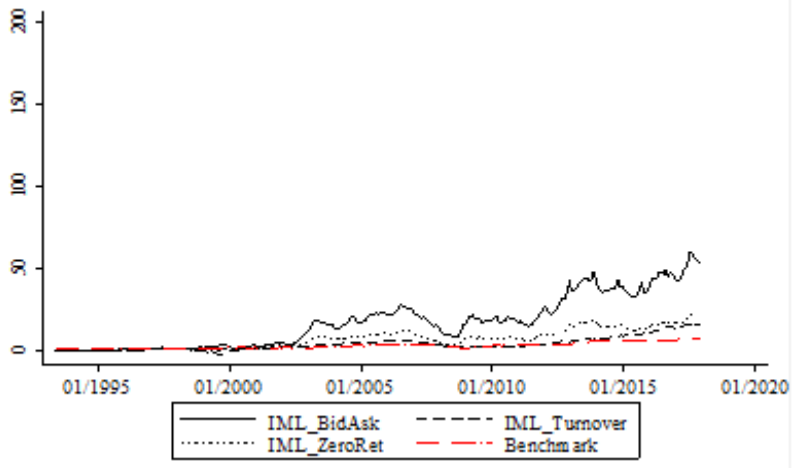
Panel E – IML Portfolios with a 12-12 strategy



Panel F – IML Portfolios with a 12-6 strategy



Panel G – IML Portfolios with a 6-12 strategy



Panel H – IML Portfolios with a 6-6 strategy

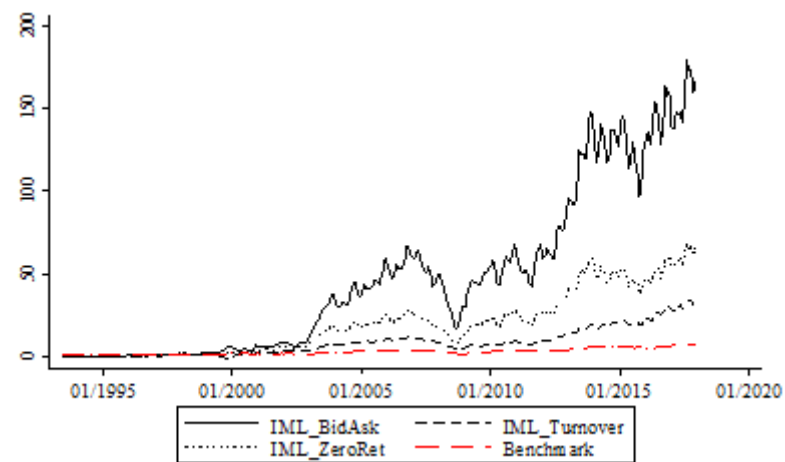


Table 3 compares the moments of the return distributions of the defined strategies and compare them with the benchmark portfolio. In particular, while the average return and the Sharpe ratio are tested by comparing them with the respective measures of the benchmark, skewness and excess kurtosis are tested against the hypothesis of normality.

Results for the IML portfolios and the Illiquid Portfolios significantly differ from each other. The first moment of the distributions analyzed for the Illiquid portfolios is statistically different and higher than the benchmark average return with the exception of the portfolios based on the Turnover Rate. The IML portfolios, instead, were never able to reach the level of statistically significant when compared to the benchmark. Similarly, the Sharpe Ratio of the Illiquid portfolios were always statistically significant when tested against the Sharpe Ratio of the benchmark, while the opposite is true for the IML portfolios. The combination of these two statistics implies that Illiquid portfolios produce higher returns and that they are not offset by a proportionally higher volatility, which results in a significantly higher Sharpe Ratio.

Furthermore, an interesting result which enhances the attractiveness of the strategy here explained is the non-normal distribution of the returns. Namely, both strategies based on the relative bid-ask spread present a positive skewness of the returns, which connotes a distribution that occasionally exhibits positive abnormal returns. However, returns for these strategies, as well as for all the others, are also characterized by leptokurtic distributions which entail the so-called kurtosis risk – a higher likelihood for extreme values to appear.

For investment purposes, however, it is necessary to take into account the transaction costs that investors need to bear to implement these strategies. An indirect tool that allows this kind of analysis is the computation of the persistency rate. This ratio, computed each month, returns the proportion of stocks that remained in the same decile after j periods of time. Therefore, the higher the persistency rate, the lower will be the transaction costs.

Table 4 presents the average persistency rates for the liquid, the illiquid and the IML portfolios. Additionally, the table also reports the maximum and the minimum rate recorded for each portfolio in the time span considered.

Overall, the results suggest that the relative bid-ask spread is the most persistent measure, that is stocks sorted based on this proxy usually remain in the same decile over time. Conversely, the proportion of daily zero returns seem to be too volatile which may erode the returns of the portfolio. As it can be expected, when the strategy implemented combine a longer formation period with a shorter holding period, the persistency rates are usually higher than in the other strategies.

The explanation of this phenomenon is quite intuitive: a longer formation period smooths the liquidity measurement by considering more information, while at the same time a shorter holding period implies that portfolios are balanced more frequently based on slower measurements.

Table 3

Benchmark Analysis for the Illiquid and the IML Portfolio

This table presents the results of the comparison between the performances of the Illiquid Portfolios, and the IML Portfolios against the equally-weighted Portfolio benchmark. The Illiquid Portfolio is an equally-weighted portfolio constructed by taking a long position on the stocks in the illiquid decile defined by the s – month liquidity proxy and by borrowing at the risk free rate. The IML Portfolio is an equally weighted portfolio constructed by taking a long position on the stocks in the illiquid decile and a short position on the stocks in the liquid decile. Mean returns and the Sharpe Ratio are tested against the benchmark Mean and Sharpe Ratio, while Skewness and Excess Kurtosis are tested against the normality assumption. Mean and Sharpe Ratio are annualized. Panel A to D differ for the different formation (s) and holding (j) periods used. The t-stat are in brackets and in bold if significant at 10% level.

Panel A – Portfolios based on a 12-12 strategy

	Bid-Ask Spread		Zero Returns		Turnover Rate		Benchmark
	ILL-Rf	IML	ILL-Rf	IML	ILL-Rf	IML	EWP
Mean	19.56	11.04	15.12	7.08	11.88	8.28	10.20
	[3.92]	[0.28]	[2.55]	[-0.43]	[0.78]	[-0.30]	
Sharpe Ratio	0.90	0.62	0.89	0.45	1.04	0.30	0.52
	[1.94]	[0.43]	[1.78]	[-0.42]	[2.14]	[-1.02]	
Skewness	0.63	0.41	0.07	0.29	-0.44	-0.90	-0.19
	[4.41]	[2.84]	[0.48]	[2.00]	[-3.06]	[-6.35]	
Excess Kurtosis	2.77	1.67	1.67	1.66	2.70	5.93	2.12
	[9.94]	[6.04]	[6.04]	[5.99]	[9.70]	[21.20]	

Panel B – Portfolios based on a 12-6 strategy

	Bid-Ask Spread		Zero Returns		Turnover Rate		Benchmark
	ILL-Rf	IML	ILL-Rf	IML	ILL-Rf	IML	EWP
Mean	20.28 [4.09]	12.36 [0.53]	15.96 [2.91]	8.40 [-0.21]	11.88 [0.75]	8.76 [-0.21]	10.20
Sharpe Ratio	0.90 [2.03]	0.66 [0.76]	0.93 [2.00]	0.51 [-0.08]	1.00 [2.12]	0.31 [-0.97]	0.52
Skewness	0.68 [4.74]	0.47 [3.32]	0.16 [1.16]	0.39 [2.73]	-0.45 [-3.16]	-0.72 [-5.05]	-0.19
Excess Kurtosis	2.63 [9.43]	1.55 [5.59]	1.55 [5.60]	1.94 [6.96]	2.89 [10.38]	4.57 [16.37]	2.12

Panel C – Portfolios based on a 6-12 strategy

	Bid-Ask Spread		Zero Returns		Turnover Rate		Benchmark
	ILL-Rf	IML	ILL-Rf	IML	ILL-Rf	IML	EWP
Mean	19.54 [3.85]	11.64 [0.37]	15.36 [2.67]	7.80 [-0.35]	11.64 [0.64]	8.64 [-0.26]	10.20
Sharpe Ratio	0.89 [1.93]	0.65 [0.64]	0.90 [1.85]	0.49 [-0.14]	0.97 [2.01]	0.31 [-0.92]	0.52
Skewness	0.68 [4.80]	0.43 [3.08]	0.17 [1.22]	0.42 [3.00]	-0.47 [-3.34]	-0.65 [-4.61]	-0.19
Excess Kurtosis	2.71 [9.81]	1.50 [5.48]	1.61 [5.85]	1.91 [6.96]	2.97 [10.76]	4.15 [14.98]	2.12

Panel D – Portfolios based on a 6-6 strategy

	Bid-Ask Spread		Zero Returns		Turnover Rate		Benchmark
	ILL-Rf	IML	ILL-Rf	IML	ILL-Rf	IML	EWP
Mean	19.68 [3.71]	11.64 [0.38]	16.20 [3.05]	8.76 [-0.17]	11.52 [0.56]	8.88 [-0.21]	10.20
Sharpe Ratio	0.87 [1.82]	0.62 [0.53]	0.93 [2.02]	0.52 [0.06]	0.93 [1.91]	0.34 [-0.90]	0.52
Skewness	0.78 [5.50]	0.43 [3.05]	0.37 [2.60]	0.40 [2.85]	-0.47 [-3.31]	-0.40 [-2.85]	-0.19
Excess Kurtosis	2.84 [10.31]	1.45 [5.28]	1.79 [6.52]	1.64 [5.99]	3.22 [11.65]	2.48 [8.99]	2.12

Table 4**Persistence Rates**

This table shows the persistence of stocks in the same decile as sorted by each liquidity proxy at the end of every month. The persistence is computed by observing the ranking of each stock j periods before and by dividing the number of stocks that remained in the same decile by the number of stocks existing in that month. If a stock has no correspondence, it is not considered in the number of stocks in the month. Panel A and B differ for the formation (s) and holding (j) periods used. Results are in percentage.

Panel A – Persistence rates for the 12-12 and 6-6 strategies

		Bid-Ask spread		Zero Returns		Turnover Rate	
		12-12	6-6	12-12	6-6	12-12	6-6
P1	Average	75.41	79.16	40.85	44.46	60.57	65.33
	Max	91.26	92.90	69.27	65.22	70.12	75.14
	Min	55.47	47.47	23.88	26.70	50.43	51.65
P10	Average	73.20	76.65	58.59	56.81	71.85	71.60
	Max	84.38	86.11	73.89	71.59	80.40	78.29
	Min	57.07	63.43	33.54	33.54	62.06	61.84
P10-P1	Average	74.34	78.26	48.54	49.18	66.24	68.49
	Max	85.65	87.68	70.95	67.25	72.42	73.73
	Min	58.84	62.61	33.70	36.17	57.30	59.55

Panel B - Persistence rates for the 12-6 and 6-12 strategies

		Bid-Ask spread		Zero Returns		Turnover Rate	
		12-6	6-12	12-6	6-12	12-6	6-12
P1	Average	85.14	72.14	59.53	41.43	76.64	54.72
	Max	94.67	89.05	81.74	60.85	82.18	64.88
	Min	62.09	42.16	37.53	24.42	64.84	40.91
P10	Average	77.54	69.49	73.87	50.53	82.10	66.68
	Max	93.23	88.76	85.03	65.75	87.90	75.76
	Min	54.81	36.76	51.95	27.21	75.25	54.64
P10-P1	Average	84.80	70.32	65.94	44.87	78.39	63.58
	Max	92.11	82.98	82.49	62.89	84.20	74.40
	Min	72.66	55.37	50.86	30.72	70.77	54.76

5.2. Equally-Weighted Industry based Illiquid Portfolio

It has been previously highlighted that Illiquid Portfolios were able to outperform, both statistically and economically, the Benchmark Portfolio. Moreover, those portfolios also presented a fairly high persistency rate of stocks, which make them quite appealing for investors due to the lower transaction costs that they would bear. Nevertheless, it's plausible to assume that not all industries are affected in the same way by liquidity and that it may be possible to identify, at each point in time, the single industry that has produced the highest returns compared to the others.

This is how the Industry-based Illiquid Portfolio is formed. Stocks are divided in 10 Industries based on the classification defined by the Kenneth French Data Library. Within the same Industry, stocks are sorted in deciles by the liquidity proxy adopted. In each month t the cumulative returns computed from period $t - s$ of the illiquid decile of each industry is used to identify the stocks that are going to belong to the Portfolio. The Portfolio is then passively held for j months and it is financed by borrowing at the risk-free rate. Ideally, the performance of this strategy should be able to bring better results than the ones of the simpler strategies presented in the previous paragraph. For this reason, the benchmark adopted here is the Illiquid Portfolio constructed before instead of the Equally-Weighted Portfolio of all the stocks in the market.

In Table 5 the results are showed. As before, the Mean and the Sharpe Ratio are tested against the Mean and the Sharpe Ratio of the Benchmark adopted. Skewness and Excess Kurtosis are tested against the normality hypothesis.

Noticeable improvements can be observed only for the strategies based on the Turnover Rate, which were able to provide either a higher Mean, or positive Skewness and lower Excess Kurtosis. Unsurprisingly, the Sharpe Ratio dropped almost in all strategies with the only exception being the Turnover Rate in the 6 – 12 framework which, however, didn't result to be statistically significant. The reason for this phenomenon may be attributed to the lower degree of diversification that an Industry-based strategy determines, since stocks are now more likely to be highly correlated to each other.

Table 5**Benchmark Analysis – Industry**

This table presents the results of the comparison between the performances of the Industry-based Illiquid Portfolio strategy and the equally-weighted Portfolio benchmark. The Industry-based Illiquid Portfolio is an equally-weighted portfolio constructed by taking a long position, in each month t , on the stocks in the illiquid decile, as defined by the s – month liquidity proxy adopted, of the industry which obtained the highest cumulative returns in the s months before. The Portfolio is financed by borrowing at the risk free rate. Mean returns and the Sharpe Ratio are tested against the benchmark Mean and Sharpe Ratio, while Skewness and Excess Kurtosis are tested against the normality assumption. Mean and Sharpe Ratio are annualized. Panel A to D differ for the different formation (s) and holding (j) periods used. The t-stat are in brackets and in bold if significant at 10% level.

Panel A – Portfolios based on a 12-12 strategy

	Bid-Ask Spread		Zero Returns		Turnover Rate	
	Industry	ILL-Rf	Industry	ILL-Rf	Industry	ILL-Rf
Mean	14.76	19.56	11.40	15.12	15.12	11.88
	[-0.86]		[-1.14]		[1.09]	
Sharpe Ratio	0.42	0.90	0.45	0.89	0.80	1.04
	[-2.45]		[-2.18]		[-1.00]	
Skewness	1.05	0.63	0.63	0.07	0.29	-0.44
	[7.48]		[4.46]		[2.05]	
Excess Kurtosis	2.69	2.77	3.02	1.67	2.41	2.70
	[9.64]		[10.18]		[8.66]	

Panel B - Portfolios based on a 12-6 strategy

	Bid-Ask Spread		Zero Returns		Turnover Rate	
	Industry	ILL-Rf	Industry	ILL-Rf	Industry	ILL-Rf
Mean	17.64	20.28	14.64	15.96	15.96	11.88
	[-0.47]		[-0.30]		[1.31]	
Sharpe Ratio	0.52	0.90	0.52	0.93	0.80	1.00
	[-2.05]		[-2.11]		[-0.92]	
Skewness	0.71	0.68	0.55	0.16	0.35	-0.45
	[4.98]		[3.84]		[2.45]	
Excess Kurtosis	1.69	2.63	3.36	1.55	0.83	2.89
	[6.11]		[12.05]		[3.02]	

Panel C – Portfolios based on a 6-12 strategy

	Bid-Ask Spread		Zero Returns		Turnover Rate	
	Industry	ILL-Rf	Industry	ILL-Rf	Industry	ILL-Rf
Mean	23.40	19.54	16.44	15.36	16.56	11.64
	[0.82]		[0.38]		[2.23]	
Sharpe Ratio	0.69	0.89	0.66	0.90	1.00	0.97
	[-1.00]		[-1.15]		[0.22]	
Skewness	1.03	0.68	0.70	0.17	0.07	-0.47
	[7.32]		[4.97]		[0.49]	
Excess Kurtosis	3.65	2.71	3.14	1.61	1.46	2.97
	[13.19]		[11.36]		[5.33]	

Panel D – Portfolios based on a 6-6 strategy

	Bid-Ask Spread		Zero Returns		Turnover Rate	
	Industry	ILL-Rf	Industry	ILL-Rf	Industry	ILL-Rf
Mean	22.68	19.68	14.16	16.20	15.96	11.52
	[0.61]		[-0.52]		[1.69]	
Sharpe Ratio	0.69	0.87	0.48	0.93	0.87	0.93
	[-0.89]		[-2.31]		[-0.32]	
Skewness	0.26	0.78	1.46	0.37	-0.14	-0.47
	[1.84]		[10.39]		[-1.01]	
Excess Kurtosis	1.67	2.84	8.78	1.79	3.33	3.22
	[6.03]		[31.66]		[12.04]	

Nevertheless, by observing the transaction costs implied by this strategy, the better performances may easily be offset if frictions on the market are too high. In order to assess the weight of these costs, it is possible to observe the persistency of stocks after j periods. Intuitively, if the strategy often switches from one industry to another, this will necessarily imply that also stocks will present a much lower degree of persistency in the Portfolio. However, the drawback of this approach is that the rate computed by observing only the change in the industry chosen will always be higher than the real persistency rate. Indeed, it is implicitly assumed that the same set of illiquid stocks always remain in the same decile for every industry. Thus, even if the same industry is picked after j periods, the assumption used presupposes that the most illiquid stocks in that industry kept being illiquid. Obviously, this is not necessarily true.

Table 6**Persistence Rates - Industry**

This table shows the relative frequency of each industry in the Industry-based Illiquid portfolio. The persistency rate is computed by observing at each month t the industry picked j periods before and by dividing the number of matches with the number of periods in which the strategy was implemented decreased by j . Panel A and B differ for the different formation (s) and holding (j) periods adopted. Results are in percentage.

Panel A – Persistence rates for the 12-12 and 6-6 strategies

	Bid-Ask spread		Zero Returns		Turnover Rate	
	12-12	6-6	12-12	6-6	12-12	6-6
I1	7.29	7.14	9.38	5.44	5.56	6.80
I2	7.99	8.16	10.76	13.61	5.21	9.86
I3	6.60	5.10	8.33	6.12	4.17	2.72
I4	22.92	23.47	19.44	20.41	26.39	17.35
I5	4.51	5.78	5.90	4.76	3.82	4.76
I6	16.67	15.99	11.81	15.31	24.65	21.77
I7	10.42	7.82	3.82	3.74	2.08	3.06
I8	7.64	8.50	2.78	1.70	4.17	4.42
I9	11.46	11.22	10.42	15.65	11.46	16.67
I10	4.51	6.80	17.36	13.27	12.50	12.59
Persistence Rate	14.39	17.93	12.23	11.72	17.98	17.93

Panel B – Persistence rates for the 12-6 and 6-12 strategies

	Bid-Ask spread		Zero Returns		Turnover Rate	
	12-6	6-12	12-6	6-12	12-6	6-12
I1	6.25	7.14	8.68	6.12	5.56	6.80
I2	7.99	8.16	10.76	13.95	5.21	9.86
I3	6.60	5.78	7.29	6.80	4.17	2.72
I4	22.57	23.47	19.10	22.11	26.39	17.35
I5	4.17	5.78	15.56	5.10	3.82	4.76
I6	16.32	16.33	10.07	13.95	24.65	21.77
I7	9.72	8.50	3.13	4.76	2.08	3.06
I8	7.64	8.50	2.78	2.72	4.17	4.42
I9	14.24	9.18	16.67	8.16	11.46	16.33
I10	4.51	7.14	15.97	16.33	12.50	12.93
Persistence Rate	24.65	14.44	26.76	13.38	35.21	15.84

Conscious of this limitation, the reading of Table 6 still allows to infer the peculiarity of this strategy. Table 6 shows both the frequency that characterized each industry in the Portfolio (i.e. the number of times that an Industry was picked in relative terms) and their persistency rate after j periods. In fact, while some better results can be achieved in a few cases, as shown by Table 5, it is fundamentally clear that, with a persistency rate that varies from as low as 11% to at most 35%, the higher returns that this strategy may provide are almost completely erased by transaction costs.

6. Conclusion

This study questions the effects of liquidity on the cross-sectional variability of returns by analyzing if different liquidity proxies, namely the relative bid-ask spread, the proportion of daily zero returns and the turnover rate, are able to produce abnormal returns or if their effects are already priced by other common risk factors. Moreover, by applying an investment approach, different strategies, which try to exploit the differences of the aforementioned proxies, are compared to a benchmark portfolio so as to see if long-term investments may provide appealing returns by simply observing the level of illiquidity of stocks.

With respect to the first question, an Illiquid Minus Liquid Portfolio was constructed in order to proxy for the liquidity measure that had to be tested. The results of the explanatory regressions clearly show that relative bid-ask spread is not absorbed by the size factor, or by any other common factor usually adopted in the asset-pricing literature, but that it can identify a positive and significant alpha even when controlling for other risk factors. The same is not true for the turnover rate, while for the proportion of daily zero returns the alpha becomes insignificant only when controlling for the 5 Fama-French factors.

By adopting an investment approach, different investment strategies relying on the three liquidity proxies and on different time horizons, both for the formation and the holding periods, were implemented and compared to the Equally-Weighted Portfolio of all the stocks in the market. This was chosen to be the Benchmark for the comparison of the results, since it didn't under-weight small stocks that are still included in the implemented strategies.

All the Illiquid Minus Liquid Portfolios weren't able to significant outperform the benchmark other than in the third moment by showing a positive skewness. These results hold true with the exception of the strategies based on the Turnover Rate. Instead, the Illiquid Portfolio which takes only a long a position on the most illiquid decile of stocks and it is financed by borrowing at the risk-free rate, consistently beat the benchmark with very few exceptions. The strategies based on the relative bid-ask spread and the turnover rate also carry

low transaction costs as described by the high persistency rates that characterize stocks sorted by those proxies, which increases the attractiveness of these portfolios.

However, when conditioning on industries and constructing a portfolio that picks the illiquid decile of the industry that generated the highest cumulative returns in the formation period adopted, results didn't ameliorate the overall performance of the respective Illiquid Portfolios. The only exception to this is represented by the Industry-based strategies constructed on the Turnover Rate.

Nonetheless, when analyzing the persistency rates for these strategies, their effectiveness is then highly reduced by the much higher implied transaction costs that investors would bear when implementing them and that is indicated by the low persistency rates.

Finally, albeit results didn't clearly show a consistent pattern for all the liquidity proxies considered, it cannot be understated the effect that the microstructure of the market has on the cross-sectional variability of returns. The intrinsic difficulty in measuring liquidity may explain *per se* the difference in results that were obtained with the different proxies used, and it also calls for further studies on the topic. The need for more sophisticated and complete measures of liquidity, so as to fully capture its multidimensionality is important not just for investment purposes but also for regulators, who often pursue the goal of increasing liquidity in order to achieve higher efficiency in the market.

References

- Acharya, V. V., Pedersen, L. H., 2005. Asset Pricing with Liquidity Risk. *Journal of Financial Economics* 77, 375-410.
- Ahn, H. J., Cai, J., Yang, C. W., 2012. Which Liquidity Proxy Measures Liquidity Best in Emerging Markets?. *한국재무학회 학술대회*, 1120-1165.
- Aitken, M., Comerton-Forde, C., 2003. How Should Liquidity Be Measured?. *Pacific-Basin Financial Journal* 11. 45-49.
- Amihud, Y., Mendelson, H., 1986. Asset Pricing and the Bid-Ask Spread. *Journal of Financial Economics* 17, 223-249.
- Amihud, Y., Mendelson, H., 1989. The Effect of Beta, Bid-Ask Spread, Residual Risk, and Size on Stock Returns. *The Journal of Finance* 44, 479-486.
- Amihud, Y., 2002. Illiquidity and Stock Returns: Cross-Section and Time Series Effects. *Journal of Financial Markets* 5, 31-56.
- Beber, A., Pagano, M., 2013. Short-Selling Bans Around The World: Evidence From The 2007-09 Crisis. *The Journal of Finance* 98, 343-381.
- Bekaert, G., Harvey C. R., Lundblad, C., 2007. Liquidity and Expected Returns: Lessons from Emerging Markets. *The Review of Financial Studies* 20, 1783-1831.
- Chung, K. H., Zhang, H., 2014. A Simple Approximation of Intraday Spreads Using Daily Data. *Journal of Financial Markets* 17, 94-120.
- Datar, V. T., Naik, N. Y., Radcliffe, R., 1998. Liquidity and Stock Returns: An Alternative Test. *Journal of Financial Markets* 1, 203-219.
- Fama, E. F., Fama K. R., 1993. Common Risk Factors in the Returns on Stocks and Bonds. *Journal of Financial Economics* 33, 3-56.
- Goyenko, R. Y., Holden, C. W., Trzcinka, C. A., Do Liquidity Measures Measure Liquidity?. *Journal of Financial Economics* 92, 153-181
- Haas, M., 2007. Do Investors Dislike Kurtosis?. *Economics Bulletin* 7, 1-9.
- Hoffman, A. O. I., Post, T., Pennings, J. M. E., 2013. Individual Investor Perceptions and Behavior During the Financial Crisis. *Journal of Banking & Finance* 37, 60-74.

Jun, S. G., Marathe, A., Shawky H. A., 2003. Liquidity and Stock Returns in Emerging Equity Markets. *Emerging Markets Review* 4, 1-24.

Kluger, B. D., Stephan, J., 1997. Alternative Liquidity Measures and Stock Returns. *Review of Quantitative Finance and Accounting* 8, 19-36.

Kraus, A., Litzenberger, R. H., 1976. Skewness Preference and the Valuation of Risk Assets. *The Journal of Finance* 31, 1085-1100.

Lesmond, D. A., Ogden J. P., Trzcinka, C. A., 1999. A New Estimate of Transaction Costs. *The Review of Financial Studies* 12, 1113-1141.

Lesmond, D., 2002. The Liquidity of Emerging Markets. *Journal of Financial Economics* 77, 411-452.

Levine, R., Zervos, S., 1998. Stock Markets, Banks, and Economic Growth. *American Economic Review*: 537-558.

Newey, W. K., West, K. D., 1987. A Simple, Positive, Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix. *Econometrica* 55, 703-708.

Pastor, L., Stambaugh, R. F., 2003. Liquidity Risk and Expected Stock Returns. *Journal of Political Economy* 111, 642-685.

Rouwenhorst, K. G., 1999. Local Return Factors and Turnover in Emerging Stock Markets. *The Journal of Finance* 54, 1439-1464.

Sharpe, W. F., 1964. Capital Asset Prices: A Theory of Market Equilibrium Under Condition of Risk. *Journal of Finance* 19, 425-442.

Stoll, H. R., Whaley, R. E., 1983. Transaction Costs and the Small Firm Effect. *Journal of Financial Economics* 12, 57-79.

Subrahmanyam, A., 2009. The Implications of Liquidity and Order Flows for Neoclassical Finance. *Pacific-Basin Finance Journal* 17, 527-532.