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Information Asymmetry and Liquidity Risk

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This study first examines the determinants of information asymmetry by considering both the firm-specific variables and the market-wide factors. We also investigate if the first and second moments of liquidity, at the individual as well as the aggregate level, provide explanatory power for expected returns. The findings are that information asymmetry relates negatively to trading volume and the number of transactions and positively to a firm's liquidity risk. Market liquidity and market liquidity risk, however, have no significant association with information asymmetry. After adjusting for the risk factors of market, size, book-to-market ratio, and momentum, individual firm's liquidity and market liquidity are positively related to excess stock returns, whereas an individual firm's liquidity risk relates negatively to excess returns. Market liquidity risk does not have a significant effect on excess stock returns.

JEL Codes: G30, G10 and M40

1. Introduction

This study has a dual focus. First, the study provides an integrative analysis of the determinants of information asymmetry by considering both the firm-specific variables and the market-wide factors. Second, the study investigates the effects of liquidity and liquidity risk, at the individual as well as the aggregate level, on expected stock returns.

Information asymmetry has been the issue of an important and interesting among academics. Richardson (2000) suggests a systematic relationship between the magnitudes of information asymmetry as measured by bid-ask spread and the level of earnings management. A high level of information asymmetry will induce managers to manipulate earnings. Easley and O'Hara (2004) analyze the role of information asymmetry among investors in the determination of cost of capital.[i] Lambert, Leuz and

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Verrecchia (2009) argue that, in perfect competition, the precision of information is the key determinant of information risk which affects cost of capital. They use information precision as the average quality of information that investors have on the expected cash flows of the firm, and information asymmetry as the difference in precision across investors. Moreover, in case of imperfect competition, information asymmetry will affect the cost of capital by adversely affecting the willingness of liquidity providers to supply liquidity. To measure information asymmetry, Akins, Ng and Verdi (2009) use the information asymmetry component of bid-ask spreads and the probability of informed trading.[ii]

Information asymmetry may influence the stock trading of a firm. Liquidity denotes the speed and ease at which one can stock trade large quantities. Among the numerous measures of liquidity, bid-ask spread is the most popular, and sometimes the only measure used by researchers.[iii] The asymmetric-information models formulated by Glosten and Milgrom (1985) and Kyle (1985) focus on the asymmetric information faced by the market makers.[iv] Market makers trade with both informed and uninformed traders and, on average, lose on trades with the former and profit on trades with the latter.

The aforementioned models focus on trading of individual stocks and provide little guidance about systematic variations in liquidity. The recent studies of Chordia, Roll and Subrahmanyam (2000), Huberman and Halka (2001), and Brockman and Chung (2002) shift emphasis toward analyzing the common determinants of liquidity. The intuitive appeal that the individual firm's liquidity is at least partly determined by market wide factors comes from our knowledge that systematic factors affect other firm-specific attributes (e.g., risk and return). Therefore, in examining the determinants of bid-ask spreads, this study considers firm-specific variables as well as market-wide factors. Specifically, this study analyzes the effects of trading volume, number of trades, individual firm's liquidity risk, market liquidity and market liquidity risk on the magnitude of spreads. Accordingly, the bid-ask spread is positively associated with the degree of information asymmetry, and therefore, this paper uses the bid ask spread as a proxy of the information asymmetry.

The related studies about the relationship between the level of spread and liquidity, Stoll (1978) find both systematic and unsystematic return risks have a significant association with bid-ask spread. Since an increase in liquidity risk, at the individual as well as the aggregate level, would lead to larger uncertainty in a dealer's optimal inventory level, this study conjectures a significant association between bid-ask spread and liquidity risk. Hence, we also analyzes if liquidity and liquidity risk have explanatory power for expected stock returns. The concept that liquidity can influence asset returns was first

proposed by Amihud and Mendelson (1986), who argue that investors require a higher return to compensate for the higher trading cost associated with a less liquid asset. Following Amihud and Mendelson, numerous studies have investigated the effects of liquidity on expected returns and generally find that less liquid stocks have higher expected returns.[v]

In contrast to the numerous studies investigating the association between liquidity and expected returns, relatively few studies have examined the effects of liquidity risk on expected returns. Given that investors are risk averse and dislike variability in liquidity, it is plausible for the second moment of liquidity to be priced. In examining the effects of liquidity and liquidity risk on stock returns, this study follows Pastor and Stambaugh (2003) and Chordia, Subrahmanyam and Anshuman (2001) and adjusts returns for the risk factors of market, book-to market ratio and size proposed by Fama and French (1993) and the momentum risk factor evidenced in Jegadeesh and Titman (1993). This study examines if individual as well as aggregate liquidity and liquidity risk are priced in addition to the four risk factors.

The empirical analysis finds that bid-ask spread relates negatively to trading volume and the number of transactions and positively to a firm's liquidity risk, which is consistent with our expectation. Market liquidity and market liquidity risk, however, have no significant association with spread. The evidence implies that in setting the bid-ask spreads, the market makers only consider firm-specific variables and disregard the market-wide factors. As for the association between liquidity risk and excess returns, the evidence indicates that, after adjusting for the well-studied effects of market, size, book-to-market ratio and momentum, individual firm's liquidity and market liquidity relate positively to excess returns, whereas individual firm's liquidity risk relates negatively to excess returns. Market liquidity risk does not have a significant effect on excess returns. Although the direction of the effects of liquidity and liquidity risk on excess returns is contrary to our expectation, the results pinpoint the importance of these factors in asset pricing.

This study makes at least two contributions to the literature. First, while prior studies examining the determinants of liquidity focus on firm-specific variables, this study provides an integrative analysis of the determinants of bid-ask spread by considering both the firm-specific variables and the market-wide factors. Secondly, given that prior research has documented evidence of the first moment of an individual firm's liquidity being a significant factor in asset pricing, this study further investigates if the second moment of liquidity, at the individual as well as the aggregate level, relates to expected returns.

This paper is organized as follows. Section 2 develops hypotheses and Section 3 describes empirical methods, data, and variable measurement. Section 4 shows the empirical results and Section 5 concludes.

2. Literature Review and Hypothesis

A number of researchers using trading cost models have reported an inverse relationship between trading volume and spreads. Tinic and West (1972) argue that when trading volume is high, the disparities and discontinuities in the inflow of buy and sell orders decline, thus reducing the need for the dealer's inventory positioning. Inactive stocks, on the contrary, require rather extensive dealer participation. They investigate the daily spreads of NASDAQ stocks and document smaller spreads in stocks with larger trading volume. Stoll (1978) also uses data from NASDAQ stocks to examine the determinants of the bid-ask spreads. Consistent with his arguments that trading volume determines how long the dealer is exposed to price risk, he find a significant and negative association between trading volume and bid-ask spreads. Mcinish and Wood (1992) argue that greater trading activity can lead to lower spreads due to economies of scale in trading costs. They analyze the intraday patterns in spreads for NYSE stocks to test a negative relationship between spreads and trading activity.. Using both the number of transactions per interval and the number of shares per trade to represent trading activity, they find these two variables relate negatively to spreads.

Researchers examining trading costs find that a dealer's risk of holding a security is a significant determinant of the bid-ask spread. Existent studies typically use measures of total risk and systematic risk. For example, Tinic and West (1972) and Hamilton (1978) find spreads are positively associated with total risk; Stoll (1978) find both systematic and unsystematic risks have a significant association with bid-ask spread. As for the relationship between individual liquidity risk and the level of spread, relatively few studies have examined it. Since an increase in an individual firm's liquidity risk would lead to larger uncertainty in a dealer's optimal inventory level, which in turn would result in higher inventory holding costs, this study expects a positive correlation between individual liquidity risk and bid-ask spread.

The popular press has long mentioned systematic liquidity and some researchers analyze the common underlying determinants of liquidity. Chordia et al. (2000) estimate a "market model" for liquidity by regressing daily percentage changes in liquidity variables for an individual stock on market measures of liquidity. They find that the quoted spread and effective spreads co-move with market-wide liquidity. The common

influences on variations in liquidity remain significant after controlling for the well-known individual liquidity determinants such as volatility, volume and price. Using different statistical techniques, Huberman and Halka (2001) examine the autoregressive structures of the time series of various liquidity proxies. They find a positive correlation between the innovations of the time series for each liquidity proxy, indicating the presence of a common liquidity factor. Brockman and Chung (2002) examine commonality of liquidity using intraday data from the Stock Exchange of Hong Kong, which is an active order-driven market. They claim that order-driven systems are more susceptible to commonality because there is no obligation on the part of any market participant to maintain a fair and orderly market. They show that individual firm liquidity is significantly influenced by a commonality component.

The co-movement in individual security liquidity leads to another question: what is the relationship between aggregate liquidity risk and bid-ask spread? Following the argument of inventory holding cost, this study expects a positive association between aggregate liquidity risk and bid-ask spread since larger aggregate liquidity risk would result into more uncertainty in a dealer's holdings of any individual security. Given these considerations, we formulate the following hypothesis:

Hypothesis 1: Information asymmetry negatively to trading volume, the number of transactions and market liquidity but positively to an individual firm's liquidity risk as well as market liquidity risk.

Models of price formation in securities markets suggest that privately informed investors create significant illiquidity cost for uninformed investors, implying that the required rate of return should be higher for securities that are relatively illiquid. Using a variety of liquidity measures, empirical studies generally find a negative relation between liquidity and required rates of return. Amihud and Mendelson (1986) was the first to empirically test the relation between bid-ask spread and expected return. They use the capital asset pricing model to adjust returns for risk and find evidence that asset returns include a significant premium for the quoted spread. Brennan and Subrahmanyam (1996) investigate the relationship between monthly stock returns and measures of illiquidity obtained from intraday data. They perform generalized least squares regression and find a significant relationship between required rates of return and their measures of illiquidity after incorporating the three-factor model developed by Fama and French (1993), and also after accounting for the effects of the stock price level. Brennan et al. (1998) proxy a firm's liquidity with trading volume and find a significant and negative relationship between returns and trading volume after either adjusting for the Connor and Korajczyk

(1988) risk factors or the Fama and French (1993) risk factors. Following the results of these studies and the recent finding of a positive association between individual stock's liquidity and market liquidity, this study expects a negative association between risk-adjusted excess stock returns and the individual firm's liquidity as well as market liquidity.

Given the evidence that the level of liquidity affects asset returns, it is reasonable to conjecture that the second moment of liquidity should be positively associated with asset returns. As long as investors are risk averse and dislike variability in liquidity, stock with greater liquidity risk should command higher expected returns. In investigating the effect of liquidity risk on stock returns, some studies use total liquidity risk and some use systematic liquidity risk. For example, Chordia et al. (2001) use trading volume and share turnover as proxies for liquidity and measure a stock's liquidity risk with the standard deviations of these measures. Contrary to their expectation, they document a negative and strong cross-sectional relationship between stock returns and liquidity risk, after controlling for size, book-to-market ratio, momentum, and the level of liquidity. Eckbo and Norli (2005) construct a "low-minus-high" stock turnover portfolio as a liquidity risk factor and find that liquidity is significantly priced. Marshall (2004) examine the determinants of the level of IPO underpricing and document evidence that firms with greater liquidity concerns at the IPO experience greater underpricing.

On the other hand, Pastor and Stambaugh (2003) examine the relationship between stock returns and systematic liquidity risk and find that a stock's "liquidity beta," measured by its sensitivity to innovations in aggregate liquidity, plays a significant role in asset pricing. Stocks with higher liquidity betas command higher expected returns after adjusting for the three risk factors of Fama and French (1993) and a momentum factor. Martinez, Nieto, Rubio and Tapia (2005) use three systematic liquidity risk measures and find only one measure of systematic liquidity risk is priced in the Spanish market. Gibson and Mougeot (2004) use a bivariate GARCH (1,1)-in-mean specification for the market portfolio excess return and find that aggregate market liquidity risk is priced. Hence, the following hypothesis is formulated:

Hypothesis 2: Risk-adjusted excess return relates negatively to individual firm's liquidity as well as market liquidity, but positively to both individual firm's liquidity risk and market liquidity risk.

3. The Methodology and Model

3.1 Data

This study retrieves data for NYSE stocks from the database of COMPUSTAT for the period of 2001-2005. To be included in the sample, this study requires that a stock be continually listed on the NYSE throughout the research period and have all the data required for estimating the variables involved. We exclude firms in financial distress and newly listed firms during the research period. We also exclude financial and insurance firms due to their characteristics of operations and financial structures, which are different from firms in other industries. Observations with missing information are also excluded. The final sample consists of 73,950 firm-month observations for 1900 firms in ten industries. Table 1 displays the industry classification of the sample based on an SIC code.

Table 1 Industry Classification of Sample Firms

Industry	No. of Firms
Agriculture, Forestry, and Fishing	10
Mining	136
Construction	38
Manufacturing	879
Transportation, Communications, Electric, Gas, and Sanitary Services	393
Wholesale Trade	59
Retail Trade	149
Services	218
Public Administration	18

Note: The first two digits of four-digit SIC code of Agriculture, Forestry, and Fishing are 01, 02, 07, 08 and 09; Mining are 10, 12, 13 and 14; Construction are 5, 16 and 17; Manufacturing are 20~39; Transportation, Communications, Electric, Gas, and Sanitary Services are 40~49; Wholesale Trade are 50 and 51; Retail Trade are 52~59, Services are 70, 72~73, 75~76, 78~84 and 86~89, Public Administration are 91~97 and 99.。

3.2 Methods

In Hypothesis 1, we expect that information asymmetry negatively to trading volume, the number of transactions and market liquidity but positively to an individual firm’s liquidity risk as well as market liquidity risk. This study uses the following model to investigate the determinants of information asymmetry and tries to find whether empirical data supports this hypothesis:

Model 1

$$BAS_{i,t} = b_0 + b_1\, Volume_{i,t} + b_2\, TRADES_{i,t} + b_3\, LiRisk_{i,t} + b_4\, Liqui_t + b_5\, LiRisk_t$$
$$+ b_6\, SIZE_{i,t} + b_7\, PRICE_{i,t} + \sum_{j=1} d_j\, D_j + \varepsilon_{i,t} \qquad (1)$$

where $BAS_{i,t}$: the percentage of bid-ask spread in company *i* in month *t*; $Volume_{i,t}$: trading volume of stock *i* in month *t*; $TRADES_{i,t}$ ：the number of transactions for stock *i* in month *t*; $LiRisk_{i,t}$: firm *i*'s liquidity risk in month *t*; $Liqui_t$ ：market liquidity in month *t*; $LiRisk_t$: market liquidity risk in month *t*; $SIZE_{i,t}$: the size of firm *i* at the end of month *t*; $PRICE_{i,t}$: the stock price of firm *i* at the end of month *t*; D_j : the industry indicator, *j*=1,2,…,8.

This study includes the industry indicator to control for industry effect. In addition, this study also controls for size and price effects. As small firms tend to be inherent with larger degrees of information asymmetry, this study expects a negative association between firm size (*SIZE*) and spreads. As for the price effect, several researchers (Demsetz, 1968; Tinic and West, 1972; Mcnish and Wood, 1992) have shown that there is an inverse relationship between a stock's price and its spread.

In Hypothesis 2, we expect that Risk-adjusted excess return relates negatively to individual firm's liquidity as well as market liquidity, but positively to both individual firm's liquidity risk and market liquidity risk. This study uses the following Model 2 to examine the incremental effects of liquidity and liquidity risk, at the individual and the aggregate level, on excess returns after controlling for the risk factors of market, size, book-to-market ratio, and momentum.

Model 2

$$AR_{i,t} = b_0 + b_1\, Liqui_{i,t} + b_2\, LiRisk_{i,t} + b_3\, Liqui_t + b_4\, LiRisk_t + b_5\, MKT_t$$
$$+ b_6\, SMB_t + b_7\, HML_t + b_8\, MOM_t + \sum_{j=1} b_j\, D_j + \varepsilon_{i,t} \qquad (2)$$

where $AR_{i,t}$ ：excess stock return of firm *i* in month *t*; $Liqui_{i,t}$: firm *i*'s liquidity in month *t*; $LiRisk_{i,t}$ ：firm i's liquidity risk in month *t*; $Liqui_t$ ：the market liquidity in month *t*; $LiRisk_t$ ： the market liquidity risk in month *t*; MKT_t ：the excess return of market portfolio in month *t*; SMB_t ：the difference between the returns on the small-stock portfolio and the returns on the big-stock portfolio in month *t*; HML_t ：the difference between the returns on the high-book-to-market-ratio portfolio and the returns on the low-book-to-market-ratio portfolio in month *t*; MOM_t ：the difference between the returns on the winner portfolio and the returns on the loser portfolio in month *t*; D_j ：the industry dummy variable,

j =1,2,…,8.

3.3 Variable measurement

The measurement of the variables used in the models is described as follows:

Percentage bid-ask spread ($BAS_{i,t}$) **:** calculated by **(**ask-bid) / [(ask+bid) / 2]*100%, where ask and bid are the averages of daily ask and bid prices during month *t*.

Trading volume ($Volume_{i,t}$) **:** firm *i*'s total share volume during month *t* divided by firm i's shares outstanding at the end of month *t*. **Number of Transaction** ($TRADES_{i,t}$) **:** measured by the square root of number of transactions in month *t*.

Individual firm's liquidity risk ($LiRisk_{i,t}$) **:** $LiRisk_{i,t}$**=** ($V_{i,t}$ -$m(V_{i,t})$) /$s(V_{i,t})$, where $V_{i,t}$ denotes the average of the daily bid and ask for stock *i* in month *t* and $m(V_{i,t})$ and $s(V_{i,t})$ are the mean and standard deviation of $V_{i,t}$ during the research period, respectively.

Market liquidity ($Liqui_t$) **:** Market liquidity is measured as per Pastor and Stambaugh (2003), who focus on an aspect of liquidity associated with temporary price fluctuations induced by order flow. Their market liquidity measure is a cross-sectional average of individual-stock liquidity measures. Specifically, this study uses the following equation to estimate individual stock's liquidity in month *t*:

$$r^{e}_{i,d,+1,t} = a + b\, r_{i,d,t} + \gamma_{i,t}\, Sign\,(r^{e}_{i,d,t})\; Volume_{i,d,t} + \varepsilon_{i,t} \qquad (5)$$

where $r_{i,d,t}$: stock *i* 's returns on day *d* in month *t*; $r^{e}_{i,d,t}$: abnormal returns of stock *i* on day *d* in month *t,* calculated by subtracting the CRSP value-weighted market returns on day *d* in month t from $r_{i,d,t}$; *Sign* ($r^{e}_{i,d,t}$) : sign($r^{e}_{i,d,t}$)=-1 when $r^{e}_{i,d,t}<0$, sign($r^{e}_{i,d,t}$)=0 when $r^{e}_{i,d,t}=0$, sign($r^{e}_{i,d,t}$)=1 when $r^{e}_{i,d,t}>0$; $Volume_{i,d,t}$: the trading volume of stock i on day *d* in month *t* divided by firm's shares outstanding at the end of month *t*. The estimate $\gamma_{i,t}$ represents stock *i*'s liquidity in month *t* and market liquidity ($Liqui_t$) is estimated by the average of individual-stock liquidity measures; that is $Liqui_t$ = (1/N) $\sum_{i=1}^{N}\gamma_{i,t}$.

Individual stock's liquidity ($Liqui_{i,t}$) **:** measured by the reciprocal of stock *i*'s bid-ask spread. **Market liquidity risk** ($LiRisk_t$) **:** $LiRisk_t$ =($Liqui_t$ -$m(Liqui_t)$)/$s(Liqui_t)$, where $Liqui_t$ is market liquidity and $m(Liqui_t)$ and $s(Liqui_t)$ are the average and standard

deviation of $Liqui_t$ over the research period, respectively.

Excess return（$AR_{i,t}$）**:** $AR_{i,t} = R_{i,t} - R_{f,t}$, where $R_{i,t}$ is stock *i*'s returns in month *t* and $R_{f,t}$ is the risk free rate in month *t*. **Market excess return**（MKT_t）**:** MKT_t **=** $R_{m,t} - R_{f,t}$, where $R_{m,t}$ is the CRSP value-weighted market returns in month *t* and $R_{f,t}$ is the risk free rate.

Size-related risk factor（SMB_t）**:** SMB_t is the difference between the returns on small-stock portfolio and the returns on big-stock portfolio. This study divides the sample firms into three groups, with an equal number of firms in each group, based on each firm's month-end market value. The small-stock portfolio contains stocks in the lowest-market-value group, whereas the big-stock portfolio contains stocks in the largest-market-value group.

Book-to-market-ratio risk factor（HML_t）**:** HML_t denotes the difference between the returns on the high-book-to-market-ratio portfolio and the returns on the low-book-to-market-ratio portfolio. Again, this study divides the sample firms into three groups, with an equal number of firms in each group, based on each firm's month-end book-to-market ratio. The high-book-to-market-ratio portfolio contains stocks in the highest-book-to-market-ratio group, whereas the low-book-to-market-ratio portfolio contains stocks in the lowest-book-to-market-ratio group.

Momentum risk factor（MOM_t）**:** MOM_t represents the difference between the returns on the winner portfolio and the returns on the loser portfolio**.** This study divides the sample stocks into three groups, based on the cumulative returns over the past three months. The winner portfolio is formed with stocks in the highest return group, where as the loser portfolio is formed with stocks in the lowest return group.

Firm size（$SIZE_{i,t}$）**:** $SIZE_{i,t} = \ln(MV_{i,t}) - md(\ln(MV_{m,t}))$, where $MV_{i,t}$ denotes the natural logarithm of the market value of firm *i*'s equity at the end of month *t* and $md(\ln(MV_{m,t}))$ represents the median of the sample firms' market value.

Stock price（$\boldsymbol{PRICE_{i,t}}$）**:** taking natural log of the stock price at the end of month *t*.

Industry dummy variable（D_j）**:** As shown in Table 1, the sample firms come from ten industries, that is, j=1...8.

4. The findings

4.1 The determinants of bid-ask spread

Table 2 presents the descriptive statistics of the variables. As shown, the sample firms

yield on average a monthly excess return (*AR*) of 2.62%. Among the three risk factors proposed by Fama and French (1993), the market risk factor (*MKT*) has the smallest average premium of 0.18% per month, followed by the 0.30% of the size-related risk factor (*SMB*), and the book-to-market factor (*HML*) has the largest average monthly premium of 1.34%. The momentum factor (*MOM*) has an even larger average premium, about 1.49% per month.

Table 3 shows the Pearson correlation coefficients. As shown, the univariate correlation reveals that bid-ask spread (*BAS*) relates significantly and negatively to trading volume (*VOLUME*) and number of transactions (*TRADES*) and positively to an individual firm's liquidity risk ($LiRisk_{i,t}$). The other two research variables, market liquidity ($Liqui$) and market liquidity risk ($LiRisk_{t}$), do not have a significant association with the spread. With regard to the correlation among the independent variables, trading volume has a positive association with the number of transactions (*TRADE*), stock price (*PRICE*) and market liquidity, and a negative association with an individual firm's liquidity risk and market liquidity risk.

Table 4 presents the regression results of Model 1. As shown, the D-W statistics are very close to two, indicating the problems of autocorrelation are not present in the models. The VIF statistics further reveals no multicollinearity among the independent variables. Finally, the adjusted R^2 and the F statistics reveal that the model is well specified.

Table 2 Descriptive Statistics for Variables

	Minimum	Maximum	Mean	Standard Dev.
$BAS_{i,t}$	0.00	0.44	0.16	0.88
$Volume_{i,t}$	0.00	21.97	10.21	4.93
$TRADES_{i,t}$	23.26	184.60	68.51	3.25
$SIZE_{i,t}$	12.20	479.39	139.12	4.73
$PRICE_{i,t}$	2.88	3.62	2.95	2.10
$AR_{i,t}$	0.02	4.05	2.62	1.54
$Liqui_{i,t}$	-5.55	7.92	2.08	3.74
$Liqui_{t}$	-33.45	43.13	0.32	4.52
$LiRisk_{i,t}$	-2.38	1.23	0.56	0.17
$LiRisk_{t}$	0.46	5.19	0.72	0.59
MKT_{t}	-2.38	5.23	0.18	1.33
SMB_{t}	-3.63	4.46	0.30	0.79
HML_{t}	-1.37	8.03	1.34	0.60
MOM_{t}	-1.12	3.37	1.49	0.36

Note: Number of Observations=73,950; *BAS* represents the percentage bid-ask spread; *TRADES* is the number of transaction; *SIZE* denotes firm size; *VOLUME* represents trading volume; *PRICE* denotes stock price; *AR* represents a firms' monthly excess returns; $Liqui_{i,t}$ *and* $Liqui_{t}$ denote individual and aggregate liquidity, respectively; $LiRisk_{i,t}$ and $LiRisk_{t}$ represents individual and aggregate liquidity risk, respectively; *MKT* denotes monthly excess return for the market portfolio; *SMB* represents monthly premium for the size-related risk factor; *HML* represents monthly premium for the book-to-market-ratio- related risk factor; *MOM* is the monthly premium for the momentum risk factor.

Table 3 Pearson Correlation Matrix on the Variables in Model 1

	$BAS_{i,t}$	$TRADES_{i,t}$	$LiRisk_{i,t}$	$Volume_{i,t}$	$SIZE_{i,t}$	$PRICE_{i,t}$	$Liqui_t$	$LiRisk_t$
$BAS_{i,t}$	1.00							
$TRADES_{i,t}$	-0.059 (0.05)	1.00						
$LiRisk_{i,t}$	0.01 (0.000)	-0.08 (0.96)	1.00					
$Volume_{i,t}$	-0.91 (0.00)	0.76 (0.04)	-0.81 (0.04)	1.00				
$SIZE_{i,t}$	-0.01 (0.16)	0.01 (0.85)	0.00 (0.67)	0.45 (0.25)	1.00			
$PRICE_{i,t}$	0.00 (0.07)	0.02 (0.63)	0.75 (0.36)	0.66 (0.05)	0.05 (0.56)	1.00		
$Liqui_t$	-0.00 (0.55)	0.06 (0.69)	-0.42 (0.24)	0.89 (0.01)	0.60 (0.45)	-0.01 (0.36)	1.00	
$LiRisk_t$	0.00 (0.76)	-0.01 (0.25)	0.10 (0.55)	-0.82 (0.01)	-0.05 (0.28)	0.01 (0.21)	-0.00 (0.49)	1.00

Note: Number of Observations=73,950 Figures in parentheses represent p-values; *BAS* represents the percentage bid-ask spread; *TRADES* is the number of transaction; *SIZE* denotes firm size; $LiRisk_{i,t}$ represents individual firm's liquidity risk; *VOLUME* represents trading volume; *PRICE* denotes stock price; $Liqui_t$ and $LiRisk_t$ represent aggregate liquidity and liquidity risk, respectively.,

We conjecture a negative association between trading volume, number of transactions and bid-ask spread since larger trading volumes and more transactions lead to smaller inventory cost for the market makers. Consistent with our conjecture, the estimates on trading volume and number of transactions are significant and negative, implying an increase in a firm's trading activity would improve the firm's liquidity and hence lower the bid-ask spread. This finding is in accordance with existent literature (see, for example, Tinic and West, 1972; Mcinish and Wood, 1992). The significant and positive estimate on an individual firm's liquidity risk is also consistent with our hypothesis. This finding highlights that a stock with more liquidity risk would result into larger uncertainty in a market maker's optimal inventory level, and hence the market maker would charge a higher spread to compensate for the inventory risk he assumes. Built upon the recent studies on the co-movements in bid-ask spreads (see, Chordia et al., 2000; Huberman and Halka, 2001; Brockman and Chung, 2002), this paper also expects a negative association between spreads and market liquidity. The estimated coefficient on market liquidity has the expected sign but is not significant. Furthermore, we hypothesize a positive effect of market liquidity risk on spread because larger aggregate liquidity risk would result into more uncertainty in a market maker's holdings of any individual security. The estimated coefficient on market liquidity risk again has the expected positive sign but is not significant.

With regard to the control variables, we expect firm size to have a negative association with bid-ask spreads because smaller firms are inherent with a larger degree of information asymmetry, implying more risk for the market maker. The estimate has the expected sign, but is not significant. Finally, the positive but insignificant estimate on stock price runs counter to the evidence of Stoll (1978) and Mcinish and Wood (1992), who show that there is an inverse relationship between a stock's price and its spread.

Overall, there is strong evidence that stocks with smaller trading volume, a smaller number of transactions and larger liquidity risk have larger spreads, which is supportive of our hypothesis. On the other hand, we do not find market liquidity and market liquidity risk to be significantly related to spreads. Our findings suggest that market makers consider only firm-specific variables in setting a firm's bid-ask spread and disregard the market-wide factors.

Table 4 The Determinants of Bid-ask Spread

$$BAS_{i,t} = b_0 + b_1\, Volume_{i,t} + b_2\, TRADES_{i,t} + b_3\, LiRisk_{i,t} + b_4\, Liqui_t + b_5\, LiRisk_t + b_6\, SIZE_{i,t} + b_7\, PRICE_{i,t} + \sum_{j=1} d_j\, D_j + \varepsilon_{i,t}$$

Independent Variable	Coefficient	t-statistics	P-Value	VIF
Constant	-6.42	-5.29	0.01	
$Volume_{i,t}$	-43.71	-6.12	0.01	2.39
$TRADES_{i,t}$	-17.58	-6.88	0.00	2.31
$LiRisk_{i,t}$	37.73	3.73	0.02	1.77
$Liqui_t$	-65.74	-0.83	0.38	3.59
$LiRisk_t$	2.65	0.18	0.65	1.54
$SIZE_{i,t}$	-5.97	-0.54	0.49	1.05
$PRICE_{i,t}$	3.06	1.61	0.12	1.79
R^2				0.31
Adjusted R^2				0.29
D-W statistics				2.69
F statistics				171.20

Note: Number of Observations=73,950. *BAS* represents the percentage bid-ask spread; *TRADES* is the number of transaction; $LiRisk_{i,t}$ represents individual firm's liquidity risk; *VOLUME* represents trading volume; *PRICE* denotes stock price; $Liqui_t$ and $LiRisk_t$ represent aggregate liquidity and liquidity risk, respectively., *VOLUME* represents trading volume; *PRICE* denotes stock price; *SIZE* denotes firm size.

4.2 Liquidity, liquidity risk and excess returns

The univariate correlations presented in Table 5 reveal that an excess return relates

significantly and positively to a firm's liquidity and negatively to market liquidity risk and individual firm's liquidity risk. Market liquidity, on the other hand, does not have a significant correlation with excess returns. The three risk factors and the momentum factor demonstrate positive associations with excess returns.

This paper uses Model 2 to examine if the level of liquidity per se and liquidity risk have incremental effects on excess returns in addition to the three risk factors proposed by Fama and French (1993) and the momentum factor evidenced in Jegadeesh and Titman (1993). Table 6 presents the regression results of Model 2. This study conjectures investors would require a higher return for investing in a less liquid security. The estimate on liquidity ($Liqui_{i,t}$), however, is significantly positive, indicating security's excess return is increasing in its liquidity. This finding is in contrast to the hypothesized negative association between excess returns and liquidity, but is consistent with the results in Brennan and Subrahmanyam (1996) and Eleswarapu and Reinganum (1993). As individual firm's liquidity co-moves with market-wide factors, this study also expects a negative relationship between excess returns and market liquidity. Again, contrary to the expectation, the estimate on market liquidity ($Liqui_t$) is significantly positive.

Table 5 Pearson Correlation Matrix on the Variables in Model 2

	$AR_{i,t}$	$Liqui_t$	$Liqui_{i,t}$	MKT_t	SMB_t	HML_t	MOM_t	$LiRisk_t$	$LiRisk_{i,t}$
$AR_{i,t}$	1.00								
$Liqui_t$	0.00 (0.26)	1.00							
$Liqui_{i,t}$	1.90 (0.05)	0.84 (0.00)	1.00						
MKT_t	0.02 (0.00)	0.00 (0.49)	0.63 (0.47)	1.00					
SMB_t	0.00 (0.02)	0.91 (0.84)	0.75 (0.62)	0.00 (0.52)	1.00				
HML_t	0.89 (0.00)	0.00 (0.66)	0.90 (0.03)	0.00 (0.57)	0.00 (0.49)	1.00			
MOM_t	0.81 (0.02)	0.03 (0.24)	0.44 (0.39)	0.92 (0.69)	0.48 (0.53)	0.65 (0.86)	1.00		
$LiRisk_t$	-0.01 (0.01)	-0.00 (0.49)	-0.71 (0.10)	-0.23 (0.55)	-0.54 (0.06)	-0.22 (0.98)	-0.67 (-0.71)	1.00	
$LiRisk_{i,t}$	-0.74 (0.05)	-0.42 (0.24)	-0.63 (0.03)	-0.82 (0.02)	-0.38 (0.74)	-0.48 (0.52)	-0.76 (0.45)	0.10 (0.55)	1.00

Note: Number of Observations=73,950. AR represents a firms' monthly excess returns; $Liqui_{i,t}$ *and* $Liqui_t$ denote individual and aggregate liquidity, respectively; $LiRisk_{i,t}$ and $LiRisk_t$ represents individual and aggregate liquidity risk, respectively; MKT denotes monthly excess return for the market portfolio; SMB represents monthly premium for the size-related risk factor; HML represents monthly premium for the book-to-market-ratio-related risk factor; MOM is the monthly premium for the momentum risk factor.

Given that investors are risk averse and dislike fluctuations in liquidity, this study conjectures that asset returns include a significant premium for liquidity risk. The significant and negative estimate on individual firm's liquidity risk ($LiRisk_{i,t}$) reveals, however, that a stock's excess return is decreasing in its liquidity risk. Although inconsistent with the expectation, the finding accords with the results in Chordia et al (2001). In addition, as market liquidity risk affects every individual stock's liquidity risk, this study also expects a positive relationship between market liquidity risk and excess returns. The evidence, however, is not in support of the hypothesis; the estimate on market liquidity risk ($LiRisk_t$) is negative but insignificant.

Consistent with prior studies, the estimates on the market risk factor and book-to-market risk factor are significantly positive, demonstrating that these two risk factors have reliable power in explaining the cross-section of excess returns. The size-related risk factor, on the other hand, does not have a significant estimate. While inconsistent with Fama and French (1993), this evidence goes in the same direction as that reported by Brennan, et al. (1998), who find an attenuated size effect when they include trading volume, a proxy for liquidity, in the model. Finally, the results presented in Table 6 further show that the momentum risk factor, when considered jointly with other risk factors, does not have explanatory power for excess returns.

Although the direction of the association between liquidity, liquidity risk and excess returns is unexpected, the results demonstrate strong effects of liquidity and liquidity risk on excess returns. To sum up, the evidence reveals that variables related to liquidity per se and liquidity risk, at the individual as well as the aggregate level, play an important role in the cross-section of excess returns in addition to the well-studied effects of market, size, book-to-market ratio, and momentum.

Table 6 The Relation between Liquidity, Liquidity Risk and Excess Returns

$$AR_{i,t} = b_0 + b_1\ Liqui_{i,t} + b_2\ LiRisk_{i,t} + b_3\ Liqui_t + b_4\ LiRisk_t + b_5\ MKT_t + b_6\ SMB_t + b_7\ HML_t + b_8\ MOM_t + \sum_{j=1} b_j\ D_j + \varepsilon_{i,t} \quad (2)$$

Independent Variable	Coefficient	t-statistics	P-Value	VIF
Constant	2.45	6.49	0.00	
$Liqui_{i,t}$	16.64	2.20	0.00	2.29
$LiRisk_{i,t}$	-178.02	-5.44	0.00	2.48
$Liqui_t$	8.56	2.05	0.00	2.44
$LiRisk_t$	-25.38	-0.48	0.48	1.28
MKT_t	6.17	3.99	0.00	2.59
SMB_t	32.09	0.79	0.78	4.69
HML_t	44.48	1.99	0.06	3.78
MOM_t	2.18	0.29	0.80	3.01
R^2				0.32
Adjusted R^2				0.30
D-W statistics				2.86
F statistics				569.47

Note: Number of Observations=73,950; *AR* represents a firms' monthly excess returns; $Liqui_{i,t}$ *and* $Liqui_t$ denote individual and aggregate liquidity, respectively; $LiRisk_{i,t}$ and $LiRisk_t$ represents individual and aggregate liquidity risk, respectively; *MKT* denotes monthly excess return for the market portfolio; *SMB* represents monthly premium for the size-related risk factor; *HML* represents monthly premium for the book-to-market-ratio-related risk factor ; *MOM* is the monthly premium for the momentum risk factor.

5. Summary and Conclusions

Using the bid-ask spread as the main measure of information asymmetry, this study provides an integrative analysis of the determinants of bid-ask spread by considering both the firm-specific variables and the market-wide factors. In addition, given that an individual firm's liquidity has been shown to be priced, this study also investigates if market liquidity, an individual firm's liquidity risk and aggregate liquidity risk relate to expected returns.

The empirical analysis with data for the NYSE stocks reveals that bid-ask spread relates negatively to trading volume and number of transactions and positively to a firm's

liquidity risk, which is consistent with our expectation. Market liquidity and market liquidity risk, however, do not have a significant association with spread. As for the association between liquidity, liquidity risk and excess returns, the evidence indicates that, after adjusting for the risk factors of market, size, book-to-market ratio and momentum, an individual firm's liquidity and market liquidity relate significantly and positively to excess returns, whereas individual firm's liquidity risk relates negatively to excess returns. Market liquidity risk does not have a significant effect on excess returns. Although the direction of the association between liquidity, liquidity risk and excess returns is unexpected, the results highlight the role of these factors in the cross-section of excess returns.

The unexpected association between liquidity, liquidity risk and excess returns do not lend themselves to an obvious explanation. Future research can further investigate these results. In addition, extending the analysis to other financial markets, such as foreign exchange markets or international equity markets, would also be useful. Moreover, information asymmetry variable can further be divided into order-processing component and adverse-selection component based on the decomposition of the bid-ask spread.

Endnotes

[i] Their model indicates that they demand a return premium for firms with a higher degree of information asymmetry (i.e., a higher level of information risk).

[ii] Akins, Ng and Verdi (2009) measure the information asymmetry component of the bid-ask spread for NYSE, AMEX, and NASDAQ firms for the period from 1983 to 2004 using the model of price formation.

[iii] Existing explanations of the presence and the magnitude of a spread are based on market makers' considerations of inventory costs and information asymmetry. The inventory-based models proposed by Amihud and Mendelson (1980) and Ho and Stoll (1981) focus on market makers' exposure to risk through the inventories of securities. The market makers' inventories fluctuate over time to accommodate transitory excess demand or supply disturbances. The spread is a source of profit to compensate market makers for exposure to risk and administrative costs. Accordingly, the magnitude of spread is an increasing function of the inventory holding cost.

[iv] Kyle (1985) indicates that liquidity providers increase bid-ask spread to guard against adverse selection risk.

[v] For example, Brennan and Subrahmanyam, 1996; Brennan, Chordia and Subrahmanyam,1998; Datar, Naik and Radcliffe,1998.

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