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ESSAYS ON LIQUIDITY

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ABSTRACT:

This dissertation contains two essays of liquidity. In the first essay, I analyze the effects of institutional ownership on liquidity risk in the cross-section of stocks. Using a unique, hand-collected data set of hedge fund ownership, I examine whether stocks held by hedge funds as marginal investors are more sensitive to changes in aggregate liquidity than comparable stocks held by other types of institutions or by individuals. After controlling for institutional preferences for stock characteristics, I find a positive relationship between hedge fund ownership and liquidity risk, and a negative relationship between bank ownership and liquidity risk. In addition, stocks held by hedge funds experience significant negative abnormal returns during liquidity crises, whereas stocks held by banks experience significant positive abnormal returns. These findings support the theory of Brunnermeier and Pedersen (2009) that funding constraints of leveraged speculators lead to a greater liquidity risk, and the theory of Gatev and Strahan (2006) that banks have a unique ability to hedge against market-wide liquidity shocks. In the second essay, I examine the liquidity of global bonds. Global bonds are international securities designed to be traded and settled efficiently in multiple markets. I document significant differences in liquidity and transaction costs between global and domestic bonds issued by the same firms, and find that the greater liquidity of global bonds is priced. These findings are consistent with microstructure models that predict a positive relationship between the number of potential investors and liquidity in over-the-counter markets. The findings also help to explain prior evidence that global bond offerings reduce the cost of debt.

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CHAPTER 1: Institutional Investors and Liquidity Risk

Introduction

"Some hedge fund managers are coming under increased pressure to liquidate their positions as banks ask for more collateral to back funds' borrowing. … Many investors and regulators worry whether a broad hedge-fund deleveraging will create more risk for the overall financial system." "Hedge funds are selling billions of dollars of securities to meet demands for cash from their investors and their lenders, contributing to stock market's nearly 10% drop over the past two days."

-The Wall Street Journal, October 17 and November 7, 2008

The financial markets turmoil in 2008 and 2009 has intensified the debate over the impact of institutional ownership on systematic liquidity risk. Policy makers, practitioners, and academic researchers have expressed concerns that institutional selling could increase the exposure of assets held by institutional investors to systematic liquidity shocks, and create more risk for the overall financial system. Hedge funds, in particular, have come under increased public scrutiny because of the possibility that hedge funds' heavy reliance on leverage may contribute to asset price declines during liquidity crises.

Several recent academic studies provide theoretical grounds for such concerns. These studies predict that institutional ownership can affect the sensitivity of asset returns to fluctuations in aggregate liquidity. For example, Brunnermeier and Pedersen (2009) propose a model that relates liquidity risk to ownership by leveraged speculators such as hedge funds. In their model, adverse funding shocks force hedge funds to liquidate their positions during liquidity crises at depressed prices, thus increasing the covariance between asset returns and market liquidity. The model predicts that assets held by hedge funds as marginal investors should have returns that are more sensitive to changes in aggregate liquidity than assets held by other types of institutions or individual investors. In contrast, Aragon (2007) suggests that restrictions on fund withdrawal allow hedge funds to have long-term investment horizons, and act as suppliers of capital during liquidity crises. According to this view, hedge fund ownership should have no adverse effect on liquidity risk. Ownership by other types of investors, such as mutual funds or commercial banks, could also affect liquidity risk. Chordia, Roll, and Subrahmanyam (2000) hypothesize that correlated trading and herding among mutual funds can increase the liquidity risk of stocks. Gatev and Strahan (2006) argue that banks have a unique ability to trade against market-wide liquidity shocks because they are viewed as safe havens by investors and experience net fund inflows during liquidity crises. Therefore, ownership by banks may decrease the liquidity risk of stocks.

To test these hypotheses, this paper examines empirically the effects of institutional ownership on the liquidity risk of stocks. I measure liquidity risk as the covariance between individual stock returns and innovations in aggregate market liquidity, and investigate whether stocks with higher institutional ownership exhibit greater liquidity risk than comparable stocks held by individual investors. Further, the relative effects of different types of institutional investors on liquidity risk are isolated and compared. Most interestingly, relying on a unique, hand-collected data set of hedge fund holdings, I examine whether stocks held by hedge funds as marginal investors have returns that covary more strongly with changes in aggregate liquidity than otherwise identical stocks held by other types of institutional investors. Such evidence would support the hypothesis that ownership by hedge funds affects liquidity risk more than ownership by other types of institutional investors, such as mutual funds, commercial banks, and insurance companies.

The analysis of the effects of institutional ownership on liquidity risk proceeds as follows: First, several measures of market liquidity are derived from stocks' intraday trade and quote data. Liquidity risk is measured as the liquidity beta, i.e. the sensitivity of daily stock returns to innovations in aggregate liquidity. Second, I investigate the cross-sectional relationship between liquidity betas and institutional ownership (e.g., the fraction of shares held by banks, insurance companies, mutual funds, hedge funds, and other types of institutions). The analysis is performed both at the portfolio and at the individual stock level. To isolate the effect of institutional ownership on liquidity risk from the effect of institutional preferences, I control for stock-specific characteristics such as size, average liquidity, market risk, market valuation, and information asymmetry. In some specifications, I also control for the lagged level of liquidity risk. Finally, in an event-study framework, I examine the relationship between institutional holdings and abnormal stock returns on days with extreme (negative and positive) liquidity shocks.

The empirical results support the hypothesis that institutional ownership has a significant effect on the liquidity risk of stocks and the hypothesis that ownership by different types of institutional investors has a differential effect on the liquidity risk of stocks. Specifically, the liquidity risk (liquidity beta) of stocks in quarter *q* is strongly associated with the percentage and the structure of institutional ownership at the end of quarter *q-1*, and the finding persists even after controlling for stock characteristics and liquidity risk in quarter *q-1*.

In particular, the liquidity risk of stocks is positively and significantly related to the percentage of hedge fund holdings in the cross-section. In other words, daily returns on stocks in which hedge funds are marginal investors are more sensitive to fluctuations in aggregate liquidity than returns on otherwise identical stocks held by individuals or other institutional investors. In contrast, the relationship between the liquidity risk of stocks and bank ownership is negative and significant, suggesting that stocks held by banks as marginal investors are less exposed to liquidity shocks than identical stocks held by individuals or other institutions. Finally, stocks owned by hedge funds as marginal investors experience significant negative abnormal returns on crisis days, whereas stocks held by banks as marginal investors experience significant positive abnormal returns.

These findings lend support to the model of Brunnermeier and Pedersen (2009) in which ownership by leveraged speculators magnifies liquidity risk. In particular, the model's prediction that forced selling by hedge funds exacerbates price declines during liquidity crises is borne out by the finding that stocks held by hedge funds experience negative abnormal returns on days with large adverse shocks to market liquidity. However, there is little support for the hypothesis that correlated trading and herding among mutual fund managers increases the liquidity risk of stocks. Liquidity betas in quarter *q* are not significantly related to mutual fund ownership in quarter *q-1*. Nor are abnormal stock returns during liquidity crises significantly related to mutual fund holdings. Finally, both the tests on liquidity betas and abnormal stock returns on crisis days provide evidence to support the hypothesis of Gatev and Strahan (2006) that commercial banks' ownership of stocks is negatively related to liquidity risk.

The chapter is organized as follows. Section 1.1 reviews related literature on liquidity risk and prior research into the effects of institutional ownership. Section 1.2 develops testable hypotheses about the impact of institutional ownership, especially hedge fund ownership, on the liquidity risk of stocks. Section 1.3 describes data collection procedure for hedge fund holdings and other data used in the paper. The empirical methods and summary statistics are presented in Section 1.4. Section 1.5 provides the sample characteristics and control variables. Section 1.6 presents the major empirical results, and Section 1.7 presents robustness tests. Section 1.8 provides concluding remarks.

1.1 Related research

Researchers have recognized the importance of systematic liquidity risk for asset prices. Pastor and Stambaugh (2003), Acharya and Pedersen (2005), and Korajczyk and Sadka (2008) provide evidence that liquidity risk is priced in the cross-section of stock returns. Acharya and Pedersen (2005) and Korajcyk and Sadka (2008) find that liquidity risk is priced in addition to the level of liquidity. However, an important and yet unanswered question is why some stocks are more exposed to fluctuations in market liquidity than other stocks with similar liquidity and characteristics.

Several lines of research suggest that liquidity risk could be related to institutional ownership. One stream of research attributes liquidity risk to ownership by leveraged speculators such as hedge funds. Brunnermeier and Pedersen (2009) model speculators' trading as a function of the availability of funding. They show that leveraged speculators face binding capital constraints when market liquidity worsens. As markets become illiquid, margin requirements and funding costs increase. Facing increasing margins and higher funding costs, speculators are forced to de-lever their positions. Rather than increasing investment levels when prices decline below fundamental values, speculators may, in the face of capital constraints, sell cheap securities, causing prices to decline further. An implication of their model is that assets held by leveraged speculators such as hedge funds are more likely to be sold off following declines in market liquidity, and should therefore have high liquidity risk.

Recent empirical studies provide supporting evidence for the model of Brunnermeier and Pedersen (2009). Boyson, Stahel, and Stulz (2010), Sadka (2010), and Teo (2010) find evidence supporting Brunnermeier and Pedersen's (2009) model in hedge fund returns. Hameed, Kang, and Viswanathan (2010) show that liquidity dry-ups are often precipitated by large market declines, when leveraged investors hit their margin constraints and are forced to liquidate. Aragon and Strahan (2009) find that stocks held by hedge funds that used Lehman Brothers as the prime broker experienced abnormally large declines in liquidity after Lehman's bankruptcy in September 2008.

On the other hand, hedge funds are typically viewed as rational arbitrageurs who can correct temporary mispricing. Aragon (2007) argues that lockup restrictions allow hedge funds to have long-term investment horizons, and trade patiently even during periods of low market liquidity. Therefore, hedge fund ownership may not increase liquidity risk; it may even reduce the liquidity risk of stocks.

Another stream of research suggests that mutual fund ownership may increase liquidity risk. The tendency of mutual funds to herd, i.e. buy into or out of the same stocks at the same time, is well documented in the literature[1]. Chordia, Roll, and Subrahmanyam (2000) suggest that mutual fund herding may induce correlated changes in liquidity across the market, and exert pressure on stock prices. An implication of this argument is that stocks in mutual funds' portfolios should be more exposed to liquidity risk.

Several studies provide evidence consistent with the hypothesis that correlated trading patterns of mutual funds are a source of systemic risk. Dennis and Strickland (2002) show that stocks with higher mutual fund ownership experience more extreme returns during periods of market volatility. Coval and Stafford (2004) find that mutual fund transactions can create price pressure. Kamara, Lou, and Sadka (2008) document a positive relationship between commonality in liquidity across stocks and mutual fund ownership. This paper adds to the debate on the effects of institutional ownership by examining the cross-sectional relationship between institutional ownership and the liquidity risk of stocks.

Finally, prior research suggests that commercial bank ownership could decrease the liquidity risk of stocks. Gatev and Strahan (2006) argue that regulated commercial banks are viewed as a safe haven by investors and funding tends to become available to them during periods of market stress. They find that, in contrast to other institutions, commercial banks have funding flows and funding costs that co-vary negatively with market liquidity. This gives banks a unique ability to hedge against market-wide liquidity shocks.

1.2 Hypotheses

This paper tests several hypotheses about the effects of institutional ownership on the liquidity risk of stocks. The first hypothesis (H1) states that institutional ownership affects the

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[1] See, e.g., Sias and Starks (1997), Wermers (1999), Nofsinger and Sias (1999), Griffin, Harris, and Topaloglu (2003), Sias (2004).

liquidity risk of stocks in the cross-section. I test the hypothesis by examining whether institutional ownership in quarter *q-1* explains liquidity risk in quarter *q* in the cross-section. H1 is supported if ownership by any type of institution has explanatory power for liquidity risk after controlling for stock characteristics that may be associated with institutional preferences. The null hypothesis that institutional ownership has no effect on liquidity risk is retained if stocks that are largely owned by institutional investors have the same level of liquidity risk as stocks largely held by individual investors.

The literature on institutional investors has identified several trading patterns that may affect liquidity risk, each associated with a different type of institutional investors. Many hedge funds are highly leveraged speculators, and the model of Brunnermeier and Pedersen (2009) predicts that adverse shocks to market liquidity force hedge funds to sell and contribute to the poor performance of stocks in which hedge funds are marginal investors. Hence, I test the second hypothesis (H2) that greater hedge fund ownership leads to a higher liquidity risk of stocks in the cross-section. The hypothesis is supported if stocks held by hedge funds as marginal investors have a larger liquidity risk than stocks held by individuals after controlling for stock characteristics.

Mutual fund ownership could also increase liquidity risk if mutual funds tend to herd out of stocks at the same time, especially during liquidity crises. My third hypothesis (H3) states that greater mutual fund ownership leads to a higher liquidity risk of stocks. The hypothesis is supported if stocks held by mutual funds as marginal investors are subject to more liquidity risk than stocks held by individuals given the stocks' characteristics.

In contrast to other institutional investors, commercial banks have funding flows that co-vary negatively with market liquidity. In addition, banks' holdings reports consolidate shares held in trusts that are not subject to cash withdrawals. Therefore, stocks held by commercial banks are less likely to be subject to liquidity-motivated sales during crises. The fourth hypothesis (H4) states that greater ownership by commercial banks leads to a lower liquidity risk of stocks.

In addition to measuring the effects of institutional ownership against the benchmark of individual ownership, I compare the marginal effects of different types of institutional investors on liquidity risk. Specifically, the fifth hypothesis (H5) is that the effect of ownership by hedge funds on liquidity risk is larger than the effect of ownership by other types of institutional investors, such as mutual funds or independent advisers.

As a further test of the above hypotheses, I examine the relationship between institutional ownership and excess stock returns during liquidity crises. The finding that abnormal stock returns on crisis days are related to institutional ownership would provide additional support for hypothesis H1. Hypothesis H2 (H3) implies that stocks held by hedge funds (mutual funds) as marginal investors have negative abnormal returns on crisis days. According to hypothesis H4, abnormal returns during liquidity crises should be positively related to bank ownership. Hypothesis H5 implies that stocks held by hedge funds should experience greater losses on days with liquidity crises than stock held by other institutional investors.

1.3 Institutional Ownership Data

1.3.1 Hedge fund holdings

This study utilizes a unique, hand-collected data set of hedge fund ownership. The data are based on institutional holdings from 13F reports available through Thomson Financial, but I refine the institutional classifications to distinguish ownership by hedge funds from mutual funds and other types of institutional investors. Hedge funds are private investment vehicles that are exempt from registration with the SEC as an investment company. However, like other institutional investors, hedge fund management companies must report their holdings with the SEC as long as they have more than $100 million of assets under discretionary management. All common stock positions greater than 10,000 shares or $200,000 in market value are subject to reporting. Holdings are reported quarterly, as of the end of each calendar quarter. Although the filings do not contain information on short positions in stocks, they provide the best available proxy for institutional stock holdings.

To identify hedge fund management companies among other institutional money managers, I extend the pioneering approach of Brunnermeier and Nagel (2004) and Griffin and Xu (2009). I obtain lists of hedge fund managers from multiple sources, including TASS, HFR, CISDM, Morningstar, Barclay Hedge, Bloomberg, and Thomson One Banker, and match hedge fund managers up with companies reporting their holdings on Form 13F. In addition, online resources such as the Business Week Private Company Information are used to verify the identity of additional 13F filers. I look up the unmatched advisers and money managers to find out whether they are hedge fund managers. Overall, 1582 hedge fund management firms can be matched with institutional holdings.

After matching, I cross-check all companies that are registered as investment advisers to make sure that their primary business is managing hedge funds. All companies that manage portfolios of $25 million or more for non-hedge fund clients such as mutual funds, pension funds and individual investors must be registered with the SEC as investment advisers. More than a half of the sample companies are registered investment advisers. I manually cross-check the registration documents (Form ADV) for all registered companies, and classify them as hedge fund managers only if they meet both of the following conditions: more than 50% of their clients are hedge funds or high net worth individuals, and they charge performance-based fees. Many large management firms, such as Blackrock Advisers, LLC or First Quadrant, LP, are reclassified as independent advisers because they fail to satisfy these criteria. Based on these criteria, I also classify as investment advisers major U.S. and foreign investment banks and their asset management subsidiaries. These companies (e.g., Goldman Sachs) do not belong to the sample of hedge fund management companies because hedge fund assets constitute only a small part of their reported holdings.

The final hedge fund sample consists of 1,225 management firms whose holdings represent hedge fund ownership. The number of corresponding hedge funds is more than 3,000 because hedge fund management firms frequently manage multiple funds. This sample is several times larger than those used in prior studies. The comprehensive sample allows me to examine the importance of hedge fund ownership for systematic liquidity risk.

1.3.2 Holdings of Other Types of Institutional Investors

Altogether, I distinguish among six types of institutional investors: (1) banks and bank trust departments, (2) insurance companies, (3) investment companies (or mutual funds), (4) investment advisers, (5) hedge funds, and (6) others. The classifications are based on the type codes available on Spectrum before 1998, extended to cover later years, and refined to distinguish among hedge funds, mutual funds, and investment advisers.

Since the type code from Spectrum is not reliable after 1998[2], I carry forward in time prior codes for institutions still in existence after 1998. For new institutions, I use the institutional classification provided by Thomson One Banker to assign institutions in one of the six types. The six institutional types are defined by their legal structure. Banks are regulated

[2] The "typecode" variable from Spectrum has serious classification errors in recent years, and most institutions are improperly classified in the "others" group in 1998 and beyond.

and supervised by federal and state regulatory agencies, including the Federal Deposit Insurance Corporation and the Federal Reserve Board. Insurance companies are governed by state insurance regulations. Investment companies include mutual funds, closed-end funds, and unit trusts registered under the Investment Company Act of 1940. Since majority of investment companies are mutual funds, I use the term “investment companies” and “mutual funds” interchangeably.

The fourth category, investment advisers, includes institutions registered under the Investment Advisers act of 1940 that are not registered as an investment company and are not classified as hedge fund managers. Small independent advisers, broker-dealers, and major investment banks that were not registered as bank holding companies before 2008 are classified as investment advisers. Finally, the category “others” includes university and private endowments, philanthropic foundations, and corporate pension funds.

1.3.3 Summary of Institutional Ownership

Institutional stock holdings data are obtained for each of the 80 quarters from December 1989 through September 2009 for common shares listed on NYSE, AMEX, or NASDAQ. Institutional ownership is measured as the fraction of shares held by each type of institutions. The ownership fractions are calculated by summing up the shares held by each type of institution and dividing by the total number of shares outstanding on the report date.

Table 1.1 summarizes institutional ownership of common shares. The total number of institutions holding sample stocks is 5271. As Panel A shows, most of the institutions are investment advisers (2357) or hedge funds (1225), and the number of hedge funds increases rapidly towards the end of the sample period. Panel B shows that the average fraction of shares held by institutions is 55.7%, with mutual funds (28.5%) and banks (9.9%) being the most important institutional investors. Hedge funds hold on average 4.8% of the outstanding shares, but their ownership fraction increases to 8.7% between 2005 and 2009.

The increasing importance of institutional investors is also apparent in Figures 1.1 and 1.2, which depict, respectively, the number of institutions holding shares and the average fraction of shares held by institutions quarter by quarter[3]. The overall increase in the fraction of shares held by institutions has been well documented in the literature (e.g. Gompers and Metrick (2001), Bennett, Sias, and Starks (2002), Sias, Starks, and Titman (2006)). This paper documents the rapid growth of hedge fund ownership between 1990 and 2009 using the hand-collected comprehensive sample of hedge fund ownership. As Figure 1.3 shows, hedge funds hold 10.5% of the average sample firm's shares in the first quarter of 2008, before their ownership decreases to 7.6% in the last quarter of 2008 as a result of the financial crisis. Bank holdings and mutual fund holdings are relatively stable over time, especially during the past ten years.

1.4 Empirical Methods

The empirical analysis utilizes quarterly holdings data and daily stock returns to assess the effects of institutional ownership on the liquidity risk of stocks. The analysis is carried out in several steps. First, I construct daily liquidity measures such as the effective bid-ask spread, the quoted bid-ask spread, and the Amihud (2002) measure for each stock using both intraday and daily data. The daily changes in firm-level liquidity are then aggregated across common stocks traded on NYSE, AMEX, or NASDAQ to obtain the innovations in the aggregate equity-market liquidity. (Details about the computation of liquidity measures are provided in Appendix A.)

[3] Institutional ownership is significantly higher when calculated as a percentage of the total market capitalization of sample firms. The market-value weighted average institutional ownership fraction is 80% in September 2009.

Figure 1.4 plots the innovations in the market-wide effective bid-ask spread, which is the main measure of market liquidity used throughout the paper. Next, I measure liquidity risk by the liquidity beta, i.e. the sensitivity of daily stock returns to innovations in equity market liquidity. Liquidity betas are estimated for both portfolios and individual stocks, and tests for the effects of institutional trading on liquidity risk are conducted at the portfolio level as well as the individual stock level. The tests at the portfolio level examine the liquidity risk of portfolios sorted on institutional ownership. At the firm level, I estimate cross-sectional regressions of liquidity betas on institutional ownership and firm characteristics, and assess the relative effects of different types of institutional investors on liquidity risk. Finally, I directly examine the relationship between institutional ownership and excess stock returns during days with extreme liquidity shocks.

1.4.1 Measurement of Liquidity Risk

Following Pastor and Stambaugh (2003) and Acharya and Pedersen (2005), I measure the liquidity risk of a stock (portfolio) as the sensitivity of its returns to innovations in aggregate market liquidity. Also known as the liquidity beta, this measure of systematic risk captures the notion that some stocks are more sensitive to market liquidity shocks than other stocks. In each quarter, the liquidity beta is estimated from a regression of daily stock returns on market returns and innovations in market liquidity:

$$R_{i,t} = \beta_i^0 + \beta_i^M R_{M,t} + \beta_i^L \Delta L_t + \varepsilon_{i,t}, \tag{1}$$

where $R_{i,t}$ denotes the return on the i-th stock (portfolio) on day t, $R_{M,t}$ is the return on the CRSP value-weighted portfolio on day t, ΔL_t is the innovation in market liquidity on day t, β_i^M is the market beta for stock i, and β_i^L is the liquidity beta for stock i.

1.4.2 Tests of the Effects of Institutional Ownership on Liquidity Risk

The analysis at the portfolio level is conducted as follows. First, stocks are sorted into deciles according to their total institutional ownership as well as the ownership fractions of banks, insurance companies, mutual funds, investment advisers, hedge funds, and others at the end of each quarter. Then, I compute daily equal-weighted returns on the ten ownership-sorted portfolios during the next calendar quarter. This procedure is repeated each quarter to create a time series of portfolio returns that is used to estimate liquidity betas as in equation (1). Finally, I regress portfolio liquidity betas on the average fraction of shares held by institutions in each portfolio to examine whether liquidity risk is associated with institutional ownership. In addition to the univariate analysis of liquidity betas, I examine the liquidity betas of 25 portfolios independently sorted on institutional ownership and a control characteristic such as the average bid-ask spread or market capitalization.

There are two reasons why institutional ownership could be associated with liquidity betas: (1) institutional ownership affects the liquidity risk of stock returns, and (2) some institutions exhibit preferences for stock characteristics that are correlated with liquidity risk. For example, mutual funds prefer liquid stocks of large firms (Falkenstein (1996)), and hedge funds prefer smaller stocks, value stocks and stocks that have higher volatility (Griffin and Xu(2009)).

To establish causality, I conduct a firm-level analysis and control for stock characteristics that are associated *ex ante* with liquidity risk. Specifically, I estimate cross-sectional regressions of firm-level liquidity betas on past quarter institutional ownership and include a wide range of lagged stock characteristics as control variables:

$$\beta_{i,q}^{L} = \gamma_0 + \gamma_1{}'OWNERSHIP_{i,q-1} + \gamma_2{}'CONTROLS_{i,q-1} + \varepsilon_{i,q}, \qquad (2)$$

where $\beta_{i,q}^{L}$ is the liquidity beta for the i-th stock in quarter q, $OWNERSHIP_{i,q-1}$ is a vector of the fractions of shares held by banks, insurance companies, mutual funds, investment advisers, hedge funds, and others at the end of the quarter *q-1* for stock i. The vector of control variables includes firm-specific measures of average liquidity, market risk, momentum, volatility, leverage, size, book-to-market ratio, and a measure of information asymmetry, all lagged one quarter.

In addition to firm characteristics that may be associated with liquidity risk, the vector of control variables also includes the lagged liquidity beta ($\beta_{i,q-1}^{L}$). Institutional investors may differ in their willingness to assume liquidity risk. Hedge funds, for example, may be attracted to stocks that have a higher liquidity risk, rather than increase liquidity risk through their ownership. I control for a stock's past liquidity risk to address the endogeneity problem. If institutional ownership affects liquidity risk, liquidity risk in quarter *q* should be associated with institutional ownership in quarter *q-1* even after accounting for liquidity risk in quarter *q-1*.

The inference is conducted using the Fama and MacBeth (1973) methodology. This method is designed for cross-sectional analysis and its standard errors are robust to fixed time effects. All variables are standardized to have zero means and unit variances in each quarter. The cross-sectional slope coefficient estimates for each quarter are averaged over time to arrive at the final estimate. The corresponding standard errors are computed from the time series of coefficient estimates, and the reported t-statistics are based on Newey-West (1987) heteroskedasticity and autocorrelation consistent standard errors.

1.4.3 An Event Study of Liquidity Crises

Dennis and Strickland (2002) propose to analyze rare market events such as days with exceptional stock market volatility in an event study framework. I apply this approach to large liquidity shocks, and examine the relationship between institutional ownership and abnormal stock returns on crisis days. Specifically, a negative (positive) liquidity event is defined as the 1% (or 3%) of days with the largest negative (positive) shocks to market liquidity. On each of the 50 (or 150) event days, I estimate the following cross-sectional regression:

$$AR_{i,t} = \gamma_0 + \gamma_1{}'OWNERSHIP_{i,q-1} + \gamma_2{}'CONTROLS_{i,q-1} + \varepsilon_{i,t}, \tag{3}$$

where $AR_{i,t}$ denotes the abnormal return on the i-th stock on event day *t*. The definitions of the ownership variable (OWNERSHIP) and control variables (CONTROLS) are the same as those in Equation (2). Abnormal stock returns are measured as the difference between a stock's return and the contemporaneous market portfolio return and the inferences use the Fama-MacBeth methodology.

1.5 Sample Characteristics and Control Variables

The sample is comprised of common stocks listed on NYSE, AMEX, or NASDAQ over the period January 1990 through December 2009. The data are from CRSP and COMPUSTAT. Several filters are imposed to obtain the final sample. First, only stocks with more than 50 trading days in both the current and previous quarters are included. This requirement ensures that a reliable estimate of liquidity beta and control variables can be obtained. Second, stocks with share price less than $3 at the end of the previous month are excluded. Third, companies incorporated outside the U.S, closed-end funds, real estate investment trusts, and financial firms are excluded. The final sample consists of 197,390 firm/quarter observations over 80 quarters, and the average number of stocks per quarter is 2467.

All control variables are measured over the quarter prior to estimating liquidity betas. Specifically, stock liquidity is the time-series average of the proportional effective bid-ask spread; market risk is the beta coefficient from the market model using daily returns over the previous three months, where the CRSP value-weighted index of all NYSE, AMEX, and NASDAQ stocks is used as a proxy for the market portfolio; volatility is the standard deviation of daily returns over the preceding three months; and momentum is the average stock return over the same period[4]; leverage is the sum of current liabilities and long-term debt over total book assets; book-to-market ratio is the book value of total shareholders' equity divided by the market value of equity; and firm size is the market capitalization of equity in millions of dollars.

In addition to firm characteristics, I also control for the concentration of institutional ownership. Ownership concentration could be an important determinant of liquidity risk if large block owners exhibit different trading behavior than small investors. Ownership concentration is measured by the Hefindahl index, i.e. the sum of the squared ownership fractions of all institutional investors. The last control variable is a measure of asymmetric information, which is from the probability of informed trading (PIN) from the model developed by Easley, Kiefer, O'Hara, and Paperman (1996). I control for informational asymmetry because Ng (2009) finds evidence that firms with a poor quality and timeliness of accounting information have a higher liquidity risk. The PIN measure is estimated for all sample stocks in each quarter. The inputs into the model, including the number of buys and sells on each day for each stock, are inferred from intraday transactions data of ISSM and TAQ. Further details about the estimation are provided in Appendix B.

Table 1.2 reports summary statistics for the dependent and independent variables. All variables except institutional ownership and firm size are winsorized at the 2.5% and 97.5% tails to remove influential outliers. The dependent variables are three alternative measures of

[4] I control for stock return momentum because Grinblatt, Titman, and Wermers (1995) show that mutual funds are momentum investors who tend to purchase stocks based on their past returns.

liquidity risk: the liquidity beta that relies on the effective bid-ask spread as a liquidity measure, the liquidity beta on the quoted bid-ask spread, and the liquidity beta on the Amihud measure. All three measures of liquidity risk have a positive mean, which is statistically different from zero.

The summary statistics for the control variables reflect that the sample is made up of stocks that are relatively liquid. The average effective bid-ask spread is 0.74%, and the average quoted bid-ask spread is 1.16%. The standard deviation of daily returns is 3.89%, and the average daily return 0.09%. Sample firms are quite large, with a mean (median) market capitalization of $3.8 billion ($600 million). The leverage ratio is on average 0.21, the book-to-market ratio is 0.51, and the average probability of informed trading is 0.2.

1.6 Empirical Results

1.6.1 Portfolio-level Analysis

Table 1.3 presents the percentage of shares held by institutional investors for each decile portfolio, where portfolio 1 (10) has the lowest (highest) total institutional ownership. The reported numbers are the time-series averages of the fractions of shares held by institutions. The average number of shares in each portfolio is 247. Total institutional holdings are 9.4% for portfolio 1, and 92.4% for portfolio 10 during the 1989-2009 time period. When stocks are sorted by ownership of banks in each quarter, the fraction of shares held by banks are 1% for portfolio 1, and 44.4% for portfolio 10. Hedge fund ownership is close to zero for decile portfolio 1, 2% for portfolio 5, and 32.4% for portfolio 10 if sample stocks are sorted by hedge fund ownership. These results suggest a large variation in total institutional ownership and in each type of institutional ownership across the decile portfolios.

Table 1.4 reports estimates of liquidity betas with respect to the market-wide effective bid-ask spread (see Equation (1)), and the associated t-statistics for each decile portfolio. Overall, the relationship between total institutional ownership in quarter *q-1* and liquidity risk in quarter *q* exhibits a monotonically decreasing pattern: the smaller the institutional ownership of a decile portfolio, the larger the liquidity risk (portfolio 10 is the only exception). The estimated liquidity beta is 0.15 for portfolio 1, but only 0.03 for portfolio 9 and 0.05 for portfolio 10. Panel A of Figure 1.5 plots portfolio liquidity betas against ownership decile ranks, and reveals a negative relationship between liquidity beta in quarter *q* and total institutional ownership in quarter *q-1*.

When portfolios are formed based on the ownership of each type of institution, the results reported in Table 1.4 reveal a richer pattern. Liquidity risk is negatively related to bank ownership and to a lesser degree also to ownership by insurance companies and institutions classified as "others". In sharp contrast, liquidity risk of stocks is positively related to hedge fund ownership: the larger the hedge fund ownership, the larger the liquidity risk. Mutual fund ownership, on the other hand, is not significantly related to liquidity risk.

I estimate the slope of the regression line of portfolio liquidity betas against the percentage of shares held by institutional investors in each portfolio. The slope for total institutional ownership is negative and significant with a t-statistic of -4.5, confirming a negative relation between liquidity risk and total institutional holdings. Among the six types of institutional investors, the most significant slope coefficient is for hedge fund ownership, followed by bank ownership. The slope coefficient of hedge fund ownership is positive and significant at 1% level (with a t-statistic of 4.7), while the coefficient of bank ownership is negative and significant at 5% level (with a t-statistic of -2.4). Portfolios sorted by ownership of other types of institutional investors do not reveal a significant relationship between institutional ownership and liquidity risk. Panel B of Figure 1.5 provides plots of liquidity betas against decile ranks for portfolios sorted by each type of institutional ownership. This figure clearly shows that the positive relation between hedge fund ownership and liquidity risk is masked when the analysis is based on holdings of all institutions. Therefore, separating hedge funds from other types of institutional investors is crucial to understanding the effects of institutional ownership on the liquidity risk of stocks.

Finally, I examine the liquidity betas of 25 portfolios independently sorted into quintiles based on the average proportional effective bid-ask spread in each quarter and on institutional ownership at the end of that quarter. Table 1.5 and Figure 1.6 show the liquidity betas if stocks are double-sorted by hedge fund ownership and the effective bid-ask spread. Stocks that are illiquid on average, i.e. stocks with wide bid-ask spreads, tend to have higher liquidity risk than liquid stocks. However, liquidity risk is positively associated with hedge fund ownership in each of the bid-ask spread sorted portfolios. Regardless of their average liquidity, stocks with high hedge fund ownership have more liquidity risk than stocks with low hedge funds ownership. Table 1.6 and Figure 1.7 report the liquidity betas if stocks are double-sorted by bank ownership and the effective bid-ask spread. Figure 1.7 clearly reveals the negative relationship between bank ownership and liquidity risk in each of the bid-ask spread sorted portfolios. Stocks with high bank ownership have less liquidity risk than stocks with low bank ownership, regardless of how liquid they are on average.

When portfolio liquidity betas are regressed against the institutional ownership of each portfolio and its average effective bid-ask spread, the coefficient on hedge fund ownership is positive and significant at the 1% level (with a t-statistic of 9.8), while the coefficient on bank ownership is negative and significant at the 1% level (with a t-statistic of -4.0). Thus, liquidity risk remains strongly related to hedge fund and bank ownership even after accounting for the differences in liquidity of stocks held by hedge funds and banks. These results remain unchanged if the control portfolios are formed based on the proportional quoted bid-ask spread, Amihud illiquidity, or market capitalization.

1.6.2 Firm-level Analysis

This sub-section provides additional insights into the effects of institutional ownership on liquidity risk. Specifically, I examine the relationship between institutional ownership and liquidity risk at the firm-level to control for institutional investors' preference for stock characteristics that are correlated with liquidity risk. I also investigate the marginal effect of one institutional type on liquidity risk by holding constant the ownership fractions of the other institutional types.

Table 1.7 reports the time-series averages of the coefficients from quarterly cross-sectional regressions of liquidity betas on institutional ownership, various stock characteristics and other control variables. The liquidity betas are estimated using the market-wide proportional effective bid-ask spread. Specification (1) presents estimation results without control variables, specification (2) with control variables, and specification (3) with the lagged liquidity beta among the control variables. It is noted that the main results about the relationship between institutional ownership and liquidity risk do not change when control variables are included in the analysis.

According to the specification (3) of Table 1.7, the fraction of shares held by hedge funds in quarter *q-1* is positively associated with liquidity risk in quarter *q* in the cross-section, with a coefficient of 0.191, and significant at the 1% level (the Newey-West t-statistic is 5.28).

In contrast, fractional ownership by banks is negatively associated with liquidity risk. The coefficient on bank ownership is -0.139 with a t-statistic of -7.67, significant at the 1% level. Additionally, the ownership fractions of investment advisers and institutions classified as 'others' are related to liquidity risk at the 5% level. Investment advisers enter the regression with a positive sign, and 'others' with a negative sign. However, both marginal effects are small compared with the effects of hedge fund or bank ownership. The effect of mutual fund ownership on liquidity risk is not significant.

Among the control variables, the average bid-ask spread is positively related to liquidity risk, indicating that illiquid stocks on average tend to have a higher degree of liquidity risk. Return momentum, as measured by average stock return over the preceding quarter, is also positively associated with liquidity risk. Further, liquidity betas are smaller for stocks with higher book-to-market ratios, larger market capitalization, and larger market betas. The effect of informational asymmetry on liquidity risk, as measured by the probability of informed trading (PIN), is positive and significant at the 5% level. Nevertheless, none of the control variables subsumes the effect of institutional ownership on liquidity risk. Moreover, the results in Panel C show that controlling for the lagged liquidity beta does not significantly affect the coefficient estimates. Institutional ownership alone accounts for 2.4% of the cross-sectional variation in liquidity betas, whereas the average R^2 is 5.3% after controlling for stock characteristics, and 5.5% when all control variables including the lagged liquidity beta are included.

In summary, the results presented in Table 1.7 support the hypothesis (H1) that institutional ownership affects liquidity risk in stocks' cross-section. Liquidity risk in quarter *q* is positively related to hedge fund ownership and negatively related to bank ownership at the end of quarter *q-1*. These results are robust even after controlling for stock characteristics and after taking into account ownership concentration, informational asymmetry, and liquidity risk in quarter *q-1*. The evidence at both the portfolio and at the individual stock level supports the hypothesis (H2) that hedge fund ownership has an adverse effect on the liquidity risk of stocks. In contrast, there is little support for the hypothesis (H3) that greater mutual fund ownership leads to a higher liquidity risk because of mutual fund herding and correlated trading. Liquidity betas are not significantly related to mutual fund ownership in the cross-section. Next, the hypothesis (H4) that greater ownership by banks leads to a lower liquidity risk of stocks is supported by test results at the portfolio and at the firm level.

Finally, I examine whether the marginal effect of hedge fund ownership is greater than the marginal effects of the other ownership groups to test hypothesis H5. I report the results in Panel B of Table 1.7. Based on the estimates in the third specification of Panel A, the null hypothesis that the effects are equal is rejected at any conventional level of significance. For instance, the F-statistic for testing the difference between the coefficients on hedge fund and mutual fund ownership (0.191 versus 0.018) is 20.9, significant at the 1% level. The difference between the coefficients on hedge funds and investment advisers, 0.191 versus 0.043, is also significant using the F-test. In pairwise comparisons, the null hypothesis that the marginal effect of hedge fund ownership equals the marginal effect of mutual fund (or, banks, etc.) ownership is strongly rejected against the alternative hypothesis that the marginal effect of hedge funds is greater than that of mutual funds. Thus, the evidence supports the hypothesis (H5) that hedge fund ownership has a larger effect on liquidity risk than ownership by other types of institutions.

1.6.3 An Event Study of Liquidity Crises

Next, I turn to an examination of abnormal stock performance during liquidity crises. Table 1.8 provides regression results relating negative event-day abnormal returns to institutional ownership. The negative event days are defined as the 1% of the sample days (50 days in total) with the largest negative changes in market liquidity. Market liquidity is measured the proportional effective bid-ask spread. Using the Fama-MacBeth method, the cross-section model of Equation (3) is estimated for each event day and the estimated coefficients are averaged across the 50 event days. The variables in this regression are not standardized to facilitate the interpretation of the coefficient estimates, and returns are expressed in percent.

The estimates in Table 1.8 show that abnormal stock returns during liquidity crises are strongly related to institutional ownership of the previous quarter, even after controlling for stock characteristics and the lagged liquidity beta. Stocks held by hedge funds as marginal investors experience significantly negative abnormal returns on days with extremely large declines in market liquidity. The coefficient for hedge fund ownership is -2.041 (t-statistic -2.92), while the coefficient for bank ownership is 1.471 (t-statistic 2.79). Both coefficients are significant at the 1% level (see specification (3) of Table 1.8).

To put these numbers in perspective, the estimates indicate that a 10% increase in hedge fund ownership is associated with an average abnormal return of -0.20% on crisis days. In contrast, a 10% increase in bank ownership leads to a positive abnormal return of 0.15%[5]. The effect of mutual fund ownership on abnormal stock performance during liquidity crises is insignificant. The coefficients on stock holdings of other institutions such as insurance companies or investment advisers are also insignificant.

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[5] Put differently, a one standard deviation increase in hedge fund (bank) ownership is associated with an abnormal return of -0.14% (+0.11%) on crisis days, respectively.

Abnormal performance during liquidity crises also depends on past stock return volatility, momentum, book-to-market ratio, and information asymmetry. Highly volatile stocks, stocks with positive return momentum, and stocks with low book-to-market ratios in the quarter preceding a liquidity-shock day experience negative abnormal returns on crisis days. Crisis-day returns are also more negative for stocks with greater informational asymmetry as measured by the probability of informed trading (PIN).

Panel B of Table 1.8 provides an F-test for the null hypothesis that hedge fund ownership has the same effect on abnormal stock performance during liquidity crises as ownership by other types of institutional investors. Based on specification (3), the null hypothesis that the effects are equal is rejected at the 5% level for banks, insurance companies, mutual funds, and institutions classified as "others". The null hypothesis is rejected at the 10% level for ownership by independent investment advisers.

Collectively, these results provide support for the hypothesis (H2) that greater hedge fund ownership increases the liquidity risk of stocks and for the hypothesis (H4) that greater bank ownership decreases the liquidity risk of stocks. The results in Table 1.8 also show that there is no significant relationship between abnormal stock returns on crisis days and mutual fund ownership in the quarter preceding crisis days. Thus the evidence does not support the hypothesis (H3) that mutual fund ownership leads to a higher liquidity risk of stocks. These findings do not change if negative event days are defined as the 3% of sample days (150 days in total) with the largest negative changes in market liquidity.

The results for event days with favorable liquidity shocks are shown in Table 1.9. Positive event days are defined as the 1% of the sample days (50 days in total) with the largest positive changes in market liquidity. Abnormal stock returns on positive event days are associated with both mutual fund and hedge fund ownership in the preceding quarter. For hedge fund ownership, the marginal effect on abnormal returns on days with favorable liquidity shocks is positive and significant at the 5% level (t-statistic 2.10), but much smaller in magnitude than that on liquidity crisis days. A 10% increase in hedge fund ownership is associated with an event-day abnormal return of just 0.09%. A similar result is found for mutual-fund ownership: a 10% increase in mutual fund ownership is associated with an event-day abnormal return of 0.04%. The difference between the effects of mutual funds and hedge funds on abnormal returns on positive event days is not statistically significant (see Panel B of Table 1.9). Except for hedge fund and mutual fund ownership, the coefficients associated with other types of institutional ownership are insignificant. The findings remain the same if positive event days are defined as the 3% of the sample days (150 days in total) with the largest positive changes in market liquidity. Finally, Table 1.10 shows that there is no relationship between abnormal stock returns and institutional ownership on days with no liquidity events, where non-event days are defined as the 3% of the sample days (150 days in total) with the smallest changes in market liquidity.

1.7 Robustness Analysis

1.7.1 Analysis Using Alternative Measures of Market Liquidity

The analysis of the relationship between liquidity risk and institutional holdings so far has relied on the effective bid-ask spread as a measure of aggregate market liquidity. However, there are other liquidity measures that have been proposed to capture the different dimensions of liquidity. To address the concern that the empirical results may be sensitive to the choice of a liquidity measure, I use the quoted bid-ask spread and the Amihud liquidity measure to estimate liquidity betas, and then re-examine the cross-sectional relation between liquidity betas and institutional ownership using Equation (2).

Table 1.11 reports results of firm-level analysis when liquidity is measured by the quoted spread, instead of the effective spread. The results are consistent with those reported in Table 1.7. For example, in the third specification of Table 1.11, the coefficient of hedge fund ownership is positive and significant at the 1% level (t-statistic is 3.04), while the coefficient of bank ownership is negative and significant (t-statistic is -4.90). In contrast to Table 1.7, ownership by independent investment advisers and by "others" is not significantly related to liquidity risk in Table 1.11. The tests for pair-wise comparisons (see Panel B of Table 1.11) reveal that hedge fund ownership has a greater positive effect on liquidity risk than ownership by any other type of institutional investors, including mutual funds and independent investment advisers.

The empirical results relying on the Amihud liquidity measure are presented in Table 1.12. The signs of the coefficients on institutional ownership are the same as those reported in Table 1.7. According to the second specification of Table 1.12, hedge fund ownership continues to have the greatest positive impact on liquidity betas with a coefficient of 0.184 (t-statistic 4.61), and bank ownership the greatest negative impact with a coefficient of -0.078 (t-statistic -3.07). One difference between Table 1.12 and Table 1.7 is that the effect of mutual fund ownership is significant at the 5% level when liquidity betas are estimated with respect to the Amihud illiquidity measure. In pairwise tests presented in Panel B of Table 1.12, I show that the marginal effect of hedge fund ownership (0.184) is more than ten times larger than the marginal effect of mutual fund ownership (0.016), and the difference is significant at the 1% level.

1.7.2 Analysis Using Alternative Estimates of Liquidity Betas

The estimates of liquidity betas are obtained from daily data and could be affected by non-synchronous price movements. Following Dimson (1979), I address this problem by estimating liquidity betas as the sum of the slope coefficients on current and lagged innovations in market liquidity. Specifically, I obtain the quarterly estimate of the liquidity beta of the i-th stock from the following regression:

$$R_{i,t} = \beta_i^0 + \beta_i^{M1} R_{M,t} + \beta_i^{M2} R_{M,t-1} + \beta_i^{L1} \Delta L_t + \beta_i^{L2} \Delta L_{t-1} + \varepsilon_{i,t}, \tag{4}$$

where $R_{i,t}$ denotes the return on the i-th stock on day *t*, $R_{M,t}$ ($R_{M,t-1}$) is the return on the CRSP value-weighted portfolio on day *t* (on day *t-1*), and ΔL_t (ΔL_{t-1}) is the innovation in market liquidity on day *t* (on day *t-1*). The liquidity beta for stock *i* is then calculated as the sum: $\beta_i^L = \beta_i^{L1} + \beta_i^{L2}$.

Table 1.13 provides the results of cross-sectional regressions of the Dimson liquidity betas against institutional ownership and control variables. The liquidity betas are estimated using innovations in the proportional effective bid-ask spread as a measure of market liquidity. The economic and statistical significance of institutional ownership does not change if the Dimson liquidity betas are used as the dependent variable (compare with Table 1.7). Ownership concentration has a significant positive effect on liquidity risk in Table 1.13, but the effect of other variables on liquidity risk remains unchanged.

1.7.3 Analysis Using Univariate Liquidity Betas

The liquidity beta from Equation (1) measures only exposure to the liquidity shocks that are distinct from stock market movements. However, adverse liquidity shocks are often accompanied by large market declines, making it difficult to interpret the liquidity beta after controlling for market returns. An alternative approach to estimating liquidity betas is to regress stock returns on market liquidity innovations without controlling for market returns (see, Achayra and Pedersen (2005)). The resulting measure of liquidity risk (henceforth the univariate liquidity beta) can be interpreted as the covariance between stock returns and market liquidity innovations. The univariate liquidity beta for stock i is estimated using the following equation:

$$R_{i,t} = \beta_i^0 + \beta_i^{LU} \Delta L_t + \varepsilon_{i,t}, \tag{5}$$

where $R_{i,t}$ denotes the return on the i-th stock (portfolio) on day t, ΔL_t denotes the innovation in market liquidity, and β_i^{LU} is the univariate liquidity beta. Using the effective spread to measure liquidity, I estimate Equation (5), and obtain a univariate liquidity beta for each stock in each quarter. The multivariate and univariate liquidity betas are strongly correlated in the cross-section: the time-series average of correlations between them is 0.8 during the sample period.

The portfolio-level results using the univariate liquidity betas are reported in Table 1.14 and plotted in Figure 1.8. The relationship between the univariate liquidity beta and total institutional ownership remains negative. The negative relation between liquidity risk and bank holdings, and the positive relation between liquidity risk and hedge fund holdings, are even more pronounced than if the multivariate liquidity beta is used to measure liquidity risk (compare Table 1.14 with Table 1.4, and Figure 1.8 with Figure 1.5). These results further demonstrate that it is important to distinguish the effect of hedge funds on liquidity risk from the effects of banks and other institutional investors.

Table 1.15 reports the results of firm-level analysis when the univariate liquidity beta is used to measure liquidity risk. It shows that liquidity risk is significantly related to hedge fund ownership, and the coefficient on hedge fund ownership is significant at the 1% level (t-statistic 8.42). Bank ownership continues to have a significant negative effect on liquidity risk. One difference between Table 1.15 and Table 1.7 is that the univariate liquidity betas are positively related to mutual fund ownership. However, the marginal effect of hedge fund ownership (coefficient of 0.277) is about four times larger than that of mutual fund ownership (coefficient of 0.070). The difference between the coefficients for hedge fund and mutual fund ownership is significant at the 1% level using an F-test (see Panel B of Table 1.15). Another difference between Table 1.15 and Table 1.7 is that the average R^2 is higher when using the univariate liquidity beta. For example, the average R^2 is 5.2% when ownership variables are used to explain the cross-sectional variation in liquidity risk, and the average R^2 increases to 15.1% if all control variables are also included in the analysis.

1.7.4 Analysis Using Alternative Estimation Techniques

In addition to estimating cross-sectional regressions for each quarter, I also estimate a pooled time-series and cross-sectional model for liquidity betas. The pooled regression results are reported in Table 1.16. Standard errors are clustered on two dimensions, stock and quarter, as recommended by Petersen (2009). Specification (3) of Table 1.16 shows the estimates when all control variables including the lagged liquidity beta are used. The coefficient on hedge fund ownership is positive and significant with a t-statistic of 6.87, and the coefficient on bank ownership is negative and significant with a t-statistic is -8.01. One difference between the pooled regression estimates and the Fama-MacBeth estimates is that ownership by independent investment advisers is positively and significantly associated with liquidity risk in the pooled regressions. However, the marginal effect of hedge fund ownership on liquidity risk is significantly greater than the marginal effect of ownership by independent investment advisers (0.24 vs. 0.08 in Panel B of Table 1.16). The ownership category of independent investment advisers enters the regression with a positive sign most likely because it includes large financial firms and investment banks that manage some hedge fund related assets. Overall, the results from the pooled regressions are consistent with those from Fama-MacBeth cross-sectional regressions.

Finally, I estimate panel regressions with stock-level fixed effects to examine the relationship between changes in institutional holdings and the time-series variability of liquidity betas. Table 1.17 reports coefficient estimates from the fixed effects model. The coefficient estimate on hedge fund ownership remains positive and significant after the fixed effects transformation (with a t-statistic of 6.98), and the coefficient estimate on bank ownership remains negative and significant (with a t-statistic of -5.73). Although less that 1% of the time-series variability in liquidity betas is explained by the model, the fixed effects estimation provides robust evidence that changes in institutional ownership affect liquidity risk.

1.7.5 Subsample Analysis

To check whether the findings are robust over time, I examine the effects of institutional ownership on liquidity risk over two sub-sample periods: 1990-1999 and 2000-2009. Table 1.18 provides estimation results of firm-level tests for the two sub-periods. The results show that hedge fund and bank ownership are significantly related to liquidity risk during both sub-periods. However, the effect of hedge fund ownership on liquidity risk almost doubles during 2000:2009 as hedge fund ownership becomes widespread (0.255 versus 0.127). The effect of bank ownership is not markedly different across the two sub-periods.

An additional subsample test is performed to check the robustness of results reported in earlier sections. To ensure that the firm-level liquidity betas can be reliably estimated, I repeat the analysis on the subset of the most liquid stocks. Specifically, I estimate the regression model in Equation (2) for the subsample of stocks that trade on every day during the three-month estimation period for liquidity betas. The results reported in Table 1.19 are consistent with those based on the entire sample in Table 1.7. The magnitude of the coefficient estimates and their significance are not significantly affected, but the average R^2 when all control variables are included increases from 5.5% (see specification (3) of Table 1.7) to 8.5% (see specification (3) of Table 1.19), and institutional ownership alone accounts for 4% of the total cross-sectional variation in liquidity betas.

1.8 Conclusion

Although researchers have recognized the importance of liquidity risk for asset prices, it is not clear why some stocks are more exposed to fluctuations in market liquidity than others. This paper examines whether institutional ownership affects the liquidity risk of stocks. In particular, I use unique, hand-collected data of hedge fund ownership to answer the following questions: (1) What is the effect of institutional ownership on the liquidity risk of stocks in the cross-section?; (2) Does the effect of hedge fund ownership on stocks' liquidity risk differ from the effects of ownership by other types of institutional investors such as mutual funds or banks? (3) What is the relationship between hedge fund (or bank) ownership and abnormal stock performance during liquidity crises? These questions are important for academics, policy makers, and institutional investors as well as individual investors.

The empirical results support the hypothesis that institutional ownership affects the liquidity risk of stocks. Stocks in which hedge funds are marginal investors have returns that are more sensitive to changes in aggregate liquidity than stocks held by individuals. In contrast, stocks in which commercial banks are marginal investors tend to be less exposed to market liquidity fluctuations. These results hold even after controlling for stock characteristics such as size, average liquidity, market risk, momentum, volatility and book-to-market ratio, suggesting that the results cannot be explained by institutional investors' preference for stocks with certain characteristics. The results are also robust to including the lagged level of liquidity risk among the control variables.

In particular, I find a significant and positive relationship between hedge fund ownership in quarter *q-1* and liquidity risk of stocks in quarter *q*. Hedge fund ownership has a significantly larger effect on liquidity risk than mutual fund ownership or ownership by other types of institutional investors. Furthermore, the effect of hedge fund ownership on liquidity risk is the most pronounced during liquidity crises. On days with large adverse shocks to market liquidity, there is a negative relationship between abnormal stock returns and the fraction of shares held by hedge funds at the end of the preceding quarter. These findings support the model of Brunnermeier and Pedersen (2009) in which adverse liquidity shocks force speculators to reduce their leverage by selling off assets, leading to declining asset prices and liquidity spirals.

Mutual fund ownership is not consistently related to liquidity risk. Nor are abnormal returns during crises significantly associated with mutual fund ownership. Thus, there is little evidence to support the hypothesis that herding and correlated trading by mutual fund managers lead to an increase in the liquidity risk of stocks.

Stocks held by commercial banks as marginal investors have a significantly lower liquidity risk than comparable stocks held by other types of institutional investors or by individual investors. Also, bank ownership in the quarter preceding liquidity crises is positively associated with abnormal stock returns during liquidity crises. This result provides supporting evidence for the hypothesis of Gatev and Strahan (2006) that banks have a unique ability to hedge against market-wide liquidity shocks. Furthermore, the effects of bank and hedge fund ownership on liquidity risk of stocks are negatively correlated, suggesting that banks provide liquidity when hedge funds are forced to sell their assets.

This study contributes to our understanding of the relationship between liquidity risk and institutional ownership in general and during liquidity crises in particular. Furthermore, it contributes to the growing body of evidence that hedge fund ownership and trading can increase systemic risk (e.g., Brunnermeier and Nagel (2004), Mitchell, Pedersen, and Pulvino (2007), Aragon and Strahan (2009), Boyson, Stahel, and Stulz (2010)). Future research should examine the importance of hedge fund ownership for liquidity risk in other markets including the corporate bond market.

1.9 Appendix A: Measurement of Market Liquidity

Liquidity has multiple dimensions, and many alternative measures of liquidity have been proposed in the literature (see, e.g., Korajczcyk and Sadka (2006), Goyenko, Holden, and Trzcinka (2009)). In this paper, market liquidity innovations are measured as the cross-sectional average of daily changes in the proportional effective bid-ask spread. In addition, I use changes in the proportional quoted bid-ask spread and in the Amihud (2002) measure as alternative liquidity measures. These widely-used measures are designed to capture the different dimensions of liquidity.

The proportional effective spread is two times the absolute value of the difference between the actual transaction price and the midpoint of the bid and ask quote, divided by the quote midpoint:

$$Effective\ Spread_{i,t} = \frac{2\left|P_{i,t} - M_{i,t}\right|}{M_{i,t}}, \tag{6}$$

where $P_{i,t}$ is the trade price for stock i at time t, and $M_{i,t}$ is the corresponding quote midpoint. The effective spread is designed to capture illiquidity as the difference between the fundamental value of a security, as proxied by the quote midpoint, and the market-clearing transaction price.

To compute the spread measures, I use intraday trades and quotes from TAQ and ISSM (prior to 1993). I obtain trades and quotes for ordinary common stocks listed on NYSE, AMEX, or NASDAQ during the sample period January 1990 to December 2009. I exclude shares priced less than \$3 at the end of the previous month, shares of companies incorporated outside the U.S, closed-end funds, and real estate investment trusts. To gauge liquidity near the end of each trading day, I consider only trades and quotes occurring during the last trading hour (i.e. between 3 and 4 p.m.). In addition, I apply the following filters to remove errors and outliers from the intraday data: For the trades file, I retain only regular trades, trades with regular condition of sale, trades with a positive price and size, and trades with an absolute price change of less than 10%. For the quotes file, I retain only regular quotes with a positive bid-ask spread, positive size, and a proportional quoted spread of less than 25%. Trades are matched with quotes that precede each trade by at least 5 seconds, and classified into buys and sells using the method developed by Lee and Ready (1991). Finally, the effective spread is calculated for each transaction, and the daily spread is calculated for each stock as the volume-weighted average across all valid transactions.

The second liquidity measure is the proportional quoted bid-ask spread, which is defined as the difference between the bid and ask prices divided by the quote mid-point. The third liquidity measure is the Amihud (2002) measure of illiquidity. This measure captures the daily price response associated with one million dollars of trading volume. It is computed from daily closing stock prices and volume. Specifically, the Amihud illiquidity ratio is defined as:

$$AMIHUD_{i,t} = \frac{|R_{i,t}|}{\$V_{i,t}}, \tag{7}$$

where $R_{i,t}$ is the returns on stock i for day t, and $\$V_{i,t}$ is the daily volume for stock i measured in millions of dollars.

The daily changes in firm-specific liquidity are aggregated across common stocks traded on NYSE, AMEX, or NASDAQ. Specifically, the daily percentage change in firm-specific liquidity for each liquidity measure L is computed as follows:

$$\Delta L_{i,t} = log\frac{L_{i,t}}{L_{i,t-1}}, \tag{8}$$

where $L_{i,t}$ is a measure of the liquidity level of stock *i* on day *t*. The ratio is defined only if both $L_{i,t}$ and $L_{i,t}$ are non-missing. Then, the equal-weighted average is taken over all common stocks that have a price of at least $3 at the end of the previous month, were not delisted from an exchange in a given calendar month, and have more than 100 valid observations of liquidity changes in a given calendar year. To reduce the effect of outliers, I cap the $\Delta L_{i,t}$ ratio at plus (minus) one. Finally, predictable liquidity reversals are removed with an AR(1) filter, the measures are standardized by the standard deviation over the past 750 days, and multiplied by minus one to represent innovations in liquidity rather than illiquidity. Four days with predictable bid-ask spread changes due to reductions in minimum tick sizes, including 06/02/0997, 06/24/1997, 01/29/2001, and 04/09/2001, are excluded from the analysis.

Figure 1.4 plots the time series of innovations in the aggregate proportional effective bid-ask spread from January 1990 through December 2009. The major spikes correspond to recognizable liquidity events, such as the panic on October 27, 1997, which was caused by the Asian financial crisis, the events surrounding the Russian financial crisis in August 1998, the aftermath of September 11 attacks in 2001, or the turmoil in the financial markets on September 29, 2008, when U.S. lawmakers rejected the bailout plan for the financial industry. The effective spread is significantly correlated with the quoted spread and the Amihud measure. The correlation is 0.53 with the effective spread, and 0.16 with the quoted spread over the sample period. All liquidity measures are positively correlated with returns on the CRSP value-weighted portfolio.

1.10 Appendix B: The Estimation of the Probability of Informed Trading (PIN)

This appendix provides information about the estimation of the probability of informed trading (PIN). The PIN model, developed by Easley et al. (1996, 2002), uses trade data to estimate how likely it is the market maker believes that there is informed trading in a security. The probability depends on the arrival rates of informed and uninformed traders, as well as on the market maker's beliefs regarding the occurrence of information events.

In the model, the market maker estimates the probability that any trade that occurs at time t is information-based as:

$$PIN(t) = \frac{P(t)\mu}{P(t)\mu + 2\varepsilon}, \quad (9)$$

where P(t) is the probability of an information event, μ is the rate of informed trade arrivals, and ε is the rate of unformed trade arrivals. The numerator in equation (9) is the expected number of orders from informed investors, and the denominator is the total number of orders. The market maker knows the arrival rates (μ and ε), and has prior beliefs about the probability of informational events (α), and the probability of bad news (δ). She uses the arrival rates of buy and sell orders to update her beliefs about the probability of good and bad events.

Parameters θ = (α, δ, μ, ε) are known to the market maker who also observes the order arrival process. The researcher observes only the arrival of B buy orders and S sell orders. However, Easley et al. (1996) show that, under certain assumptions,[6] the parameters can be

[6] Buy and sells follow an independent Poisson process on each day. More buys are expected on days with good events, and more sells on days with bad events. Each day is either a no-event day, a good-event day, or a bad-event day, and trades observed on different days are independent.

recovered by maximizing the likelihood of observing a sequence of orders that contains B buys and S sells. The daily likelihood of observing any sequence of B buys and S sells is given by:

$$L(\theta|B,S) = (1-\alpha)e^{-\varepsilon}\frac{\varepsilon^B}{B!}e^{-\varepsilon}\frac{\varepsilon^S}{S!} + \alpha\delta e^{-\varepsilon}\frac{\varepsilon^B}{B!}e^{-(\mu+\varepsilon)}\frac{(\mu+\varepsilon)^S}{S!} + \alpha(1-\delta)e^{-(\mu+\varepsilon)}\frac{(\mu+\varepsilon)^B}{B!}e^{-\varepsilon T}\frac{\varepsilon^S}{S!}, \tag{10}$$

where the first, second, and third terms show, respectively, the likelihood of observing B buys and S sells on a non-event day, a bad-event day, and a good-event day. Over a period of D days, the parameters can be estimated from the daily numbers of buys and sells by maximizing the product of daily likelihoods:

$$L(\theta|(B_1,S_1)\ldots(B_D,S_D)) = \prod_{i=1}^{D} L(\theta|(B_i,S_i). \tag{11}$$

Using intraday data from ISSM (before 1993) and TAQ (after 1993), I estimate the model for each stock with more than 50 trading days in a quarter. Trades are classified as buys or sells using the Lee and Ready (1991) algorithm, which involves a quote test and a tick test. The daily number of buyer-initiated trades and seller-initiated trades is an input into the joint likelihood function (10). The likelihood function is maximized using a dual quasi-Newton algorithm. Convergence of the optimization problem yields parameter estimates along with their standard errors.

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Figure 1.1 Number of Institutions Holding Shares

The figure plots the number of institutional investors holding sample stocks over the 80 quarters from Q4:1989 through Q3:2009. Sample stocks are listed on NYSE, AMEX, or NASDAQ. Institutions are classified as banks, insurance companies, mutual funds, investment advisers, hedge funds, or others. Tick marks correspond to the last quarter of a given year.

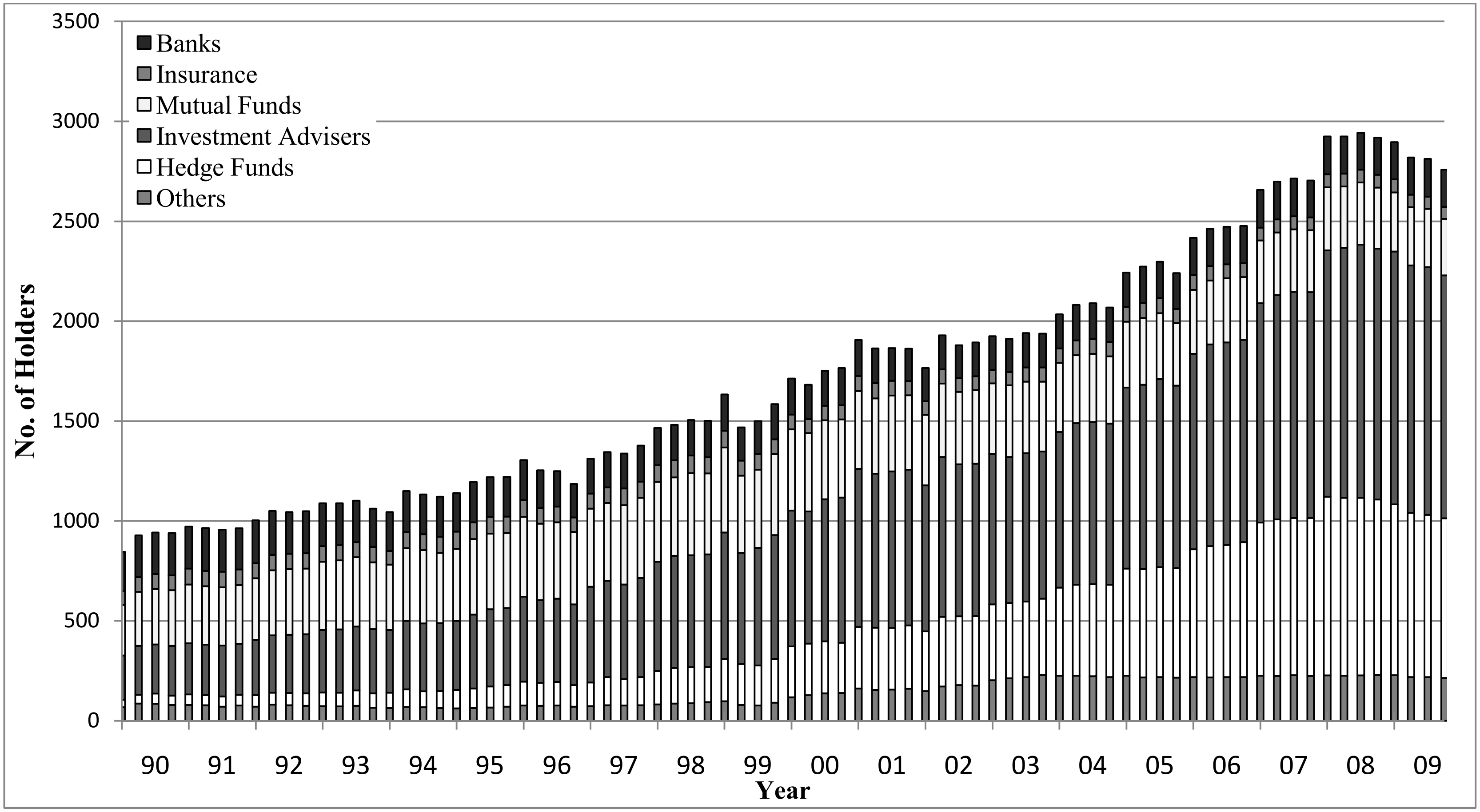


Figure 1.2 Fraction of Shares Held by Institutional Investors

The figure plots the fraction of shares held by institutional investors for the average stock in the sample over the 80 quarters from Q4:1989 through Q3:2009. Sample stocks are listed on NYSE, AMEX, or NASDAQ. Institutions are classified as banks, insurance companies, mutual funds, investment advisers, hedge funds, or others. Tick marks correspond to the last quarter of a given year.

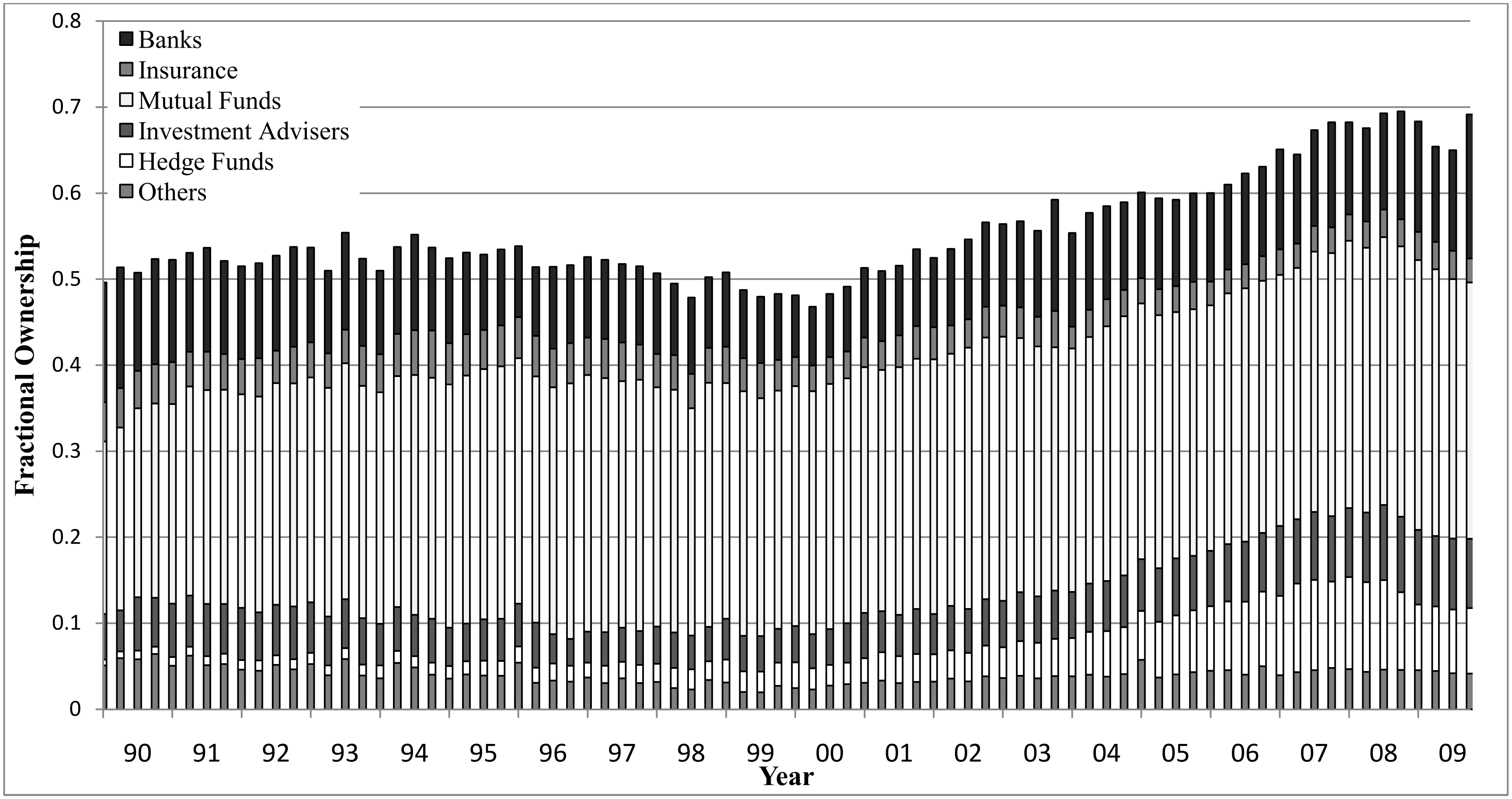


Figure 1.3 Fraction of Shares Held by Different Types of Institutional Investors

The figure plots the average of shares held by six different types of institutional investors for the average stock in the sample over the 80 quarters from Q4:1989 through Q3:2009. Sample stocks are listed on NYSE, AMEX, or NASDAQ. The different institutional investor types are (1) banks, (2) insurance companies, (3) mutual funds, (4) investment advisers, (5) hedge funds, and (6) others. The category "others" includes endowments, foundations, and private pension funds.

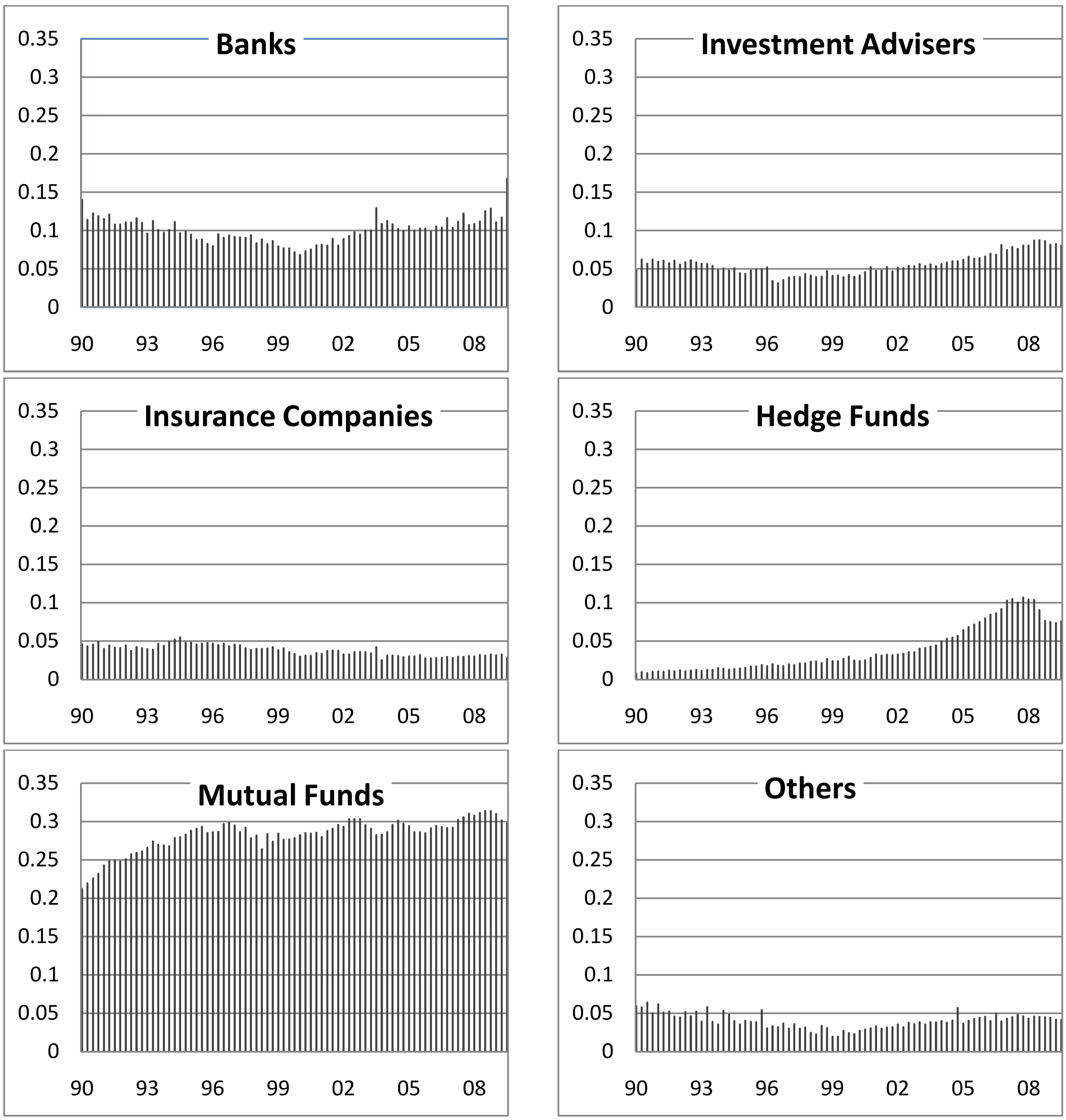


Figure 1.4 Innovations in Aggregate Liquidity

The figure shows the daily changes in the market-wide proportional effective bid-ask spread, multiplied by minus one to measure liquidity. The firm-specific proportional effective spread is derived from intraday data, and daily changes are calculated for each stock. Market-wide liquidity innovations are obtained by aggregating the daily changes in firm-specific bid-ask spread across common stocks listed on NYSE, AMEX, or NASDAQ.

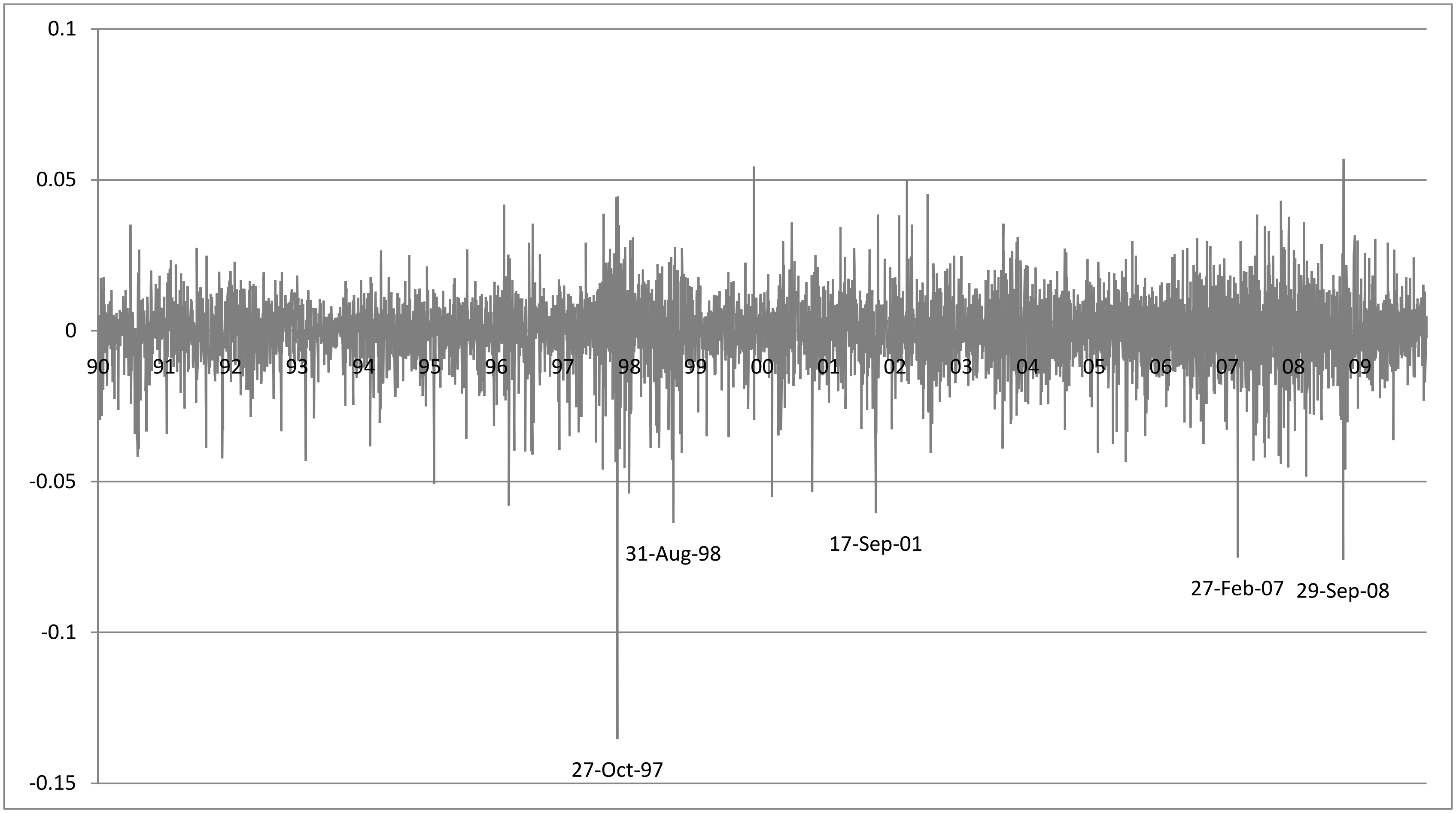
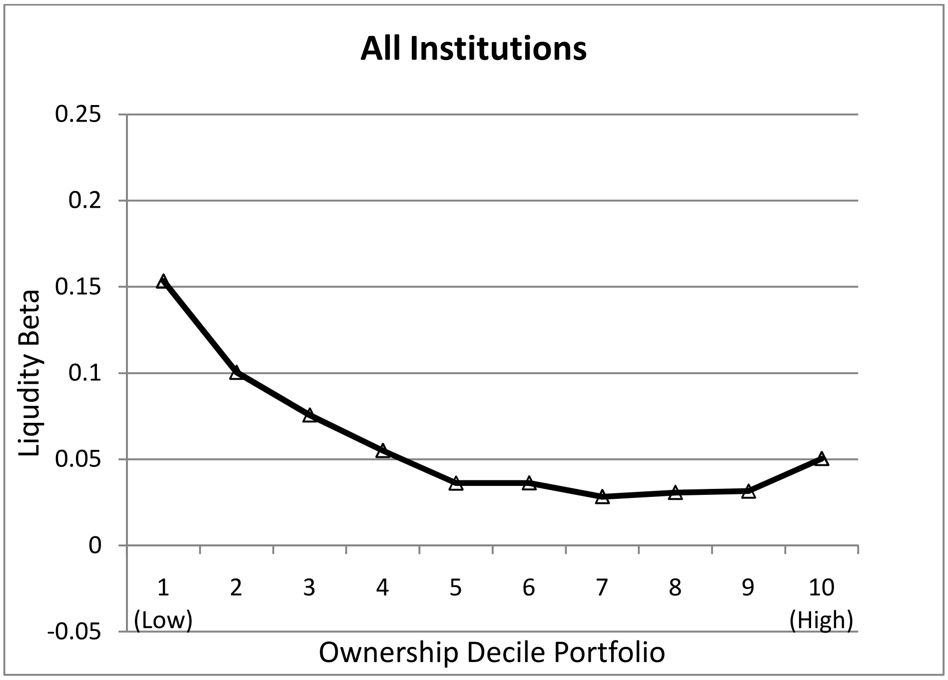


Figure 1.5 Liquidity Betas for 10 Ownership-Sorted Portfolios

The figure plots liquidity betas for 10 ownership-sorted portfolios against portfolio rakings. Stocks are sorted into decile portfolios on the basis of total institutional ownership (Panel A) or ownership of different types of institutional investors (Panel B) at the end of each quarter. The liquidity betas are estimated by regressing the daily equal-weighted portfolio returns over the subsequent quarter against innovations in aggregate market liquidity while controlling for market returns. Market liquidity is measured by the proportional effective bid-ask spread. Portfolio 1 (10) contains stocks in the lowest (highest) institutional ownership decile.

Panel A: Portfolios Sorted by Total Institutional Ownership



Panel B: Portfolios Sorted by Ownership of Different Types of Institutional Investors

The decile portfolio rank is shown on the horizontal axis, and portfolio liquidity betas are plotted on the vertical axis. Portfolio 1 (10) contains stocks in the lowest (highest) ownership decile.

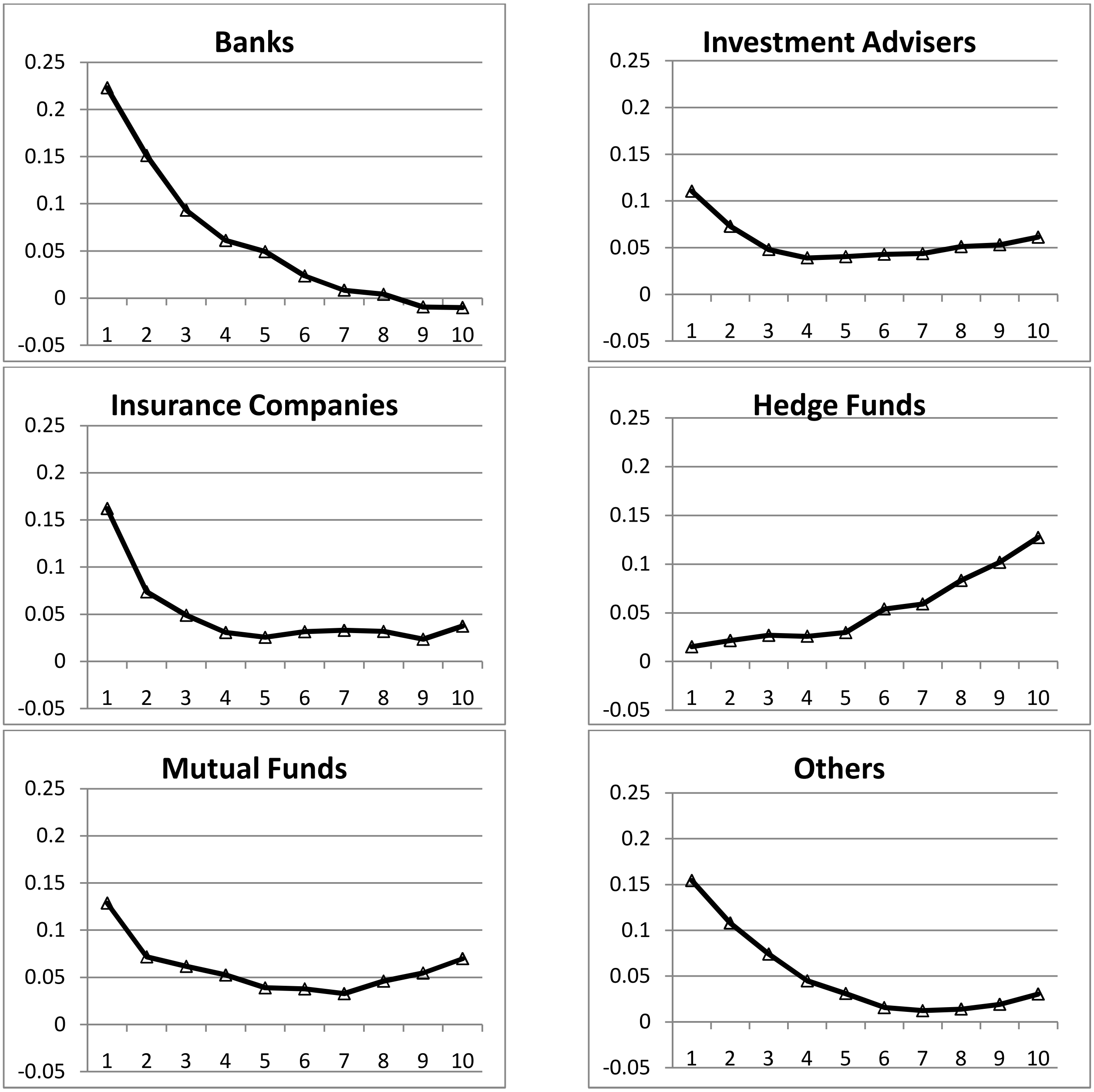


Figure 1.6 Liquidity Betas for 25 Portfolios Sorted on Hedge Fund Ownership and Bid-Ask Spread

The figure plots liquidity betas for 25 portfolios independently sorted into quintiles based on hedge fund ownership and average liquidity. The average liquidity of each stock is measured by its proportional effective bid-ask spread. Stocks are sorted into portfolios in each quarter, and liquidity betas are estimated over the subsequent quarter by regressing daily equal-weighted portfolio returns against innovations in market liquidity (measured by the proportional effective bid-ask spread) while controlling for market returns. Ownership portfolio 1 (5) contains stocks in the lowest (highest) hedge fund ownership quintile. Liquidity portfolio 1 (5) contains stocks in the lowest (highest) effective bid-ask spread quintile.

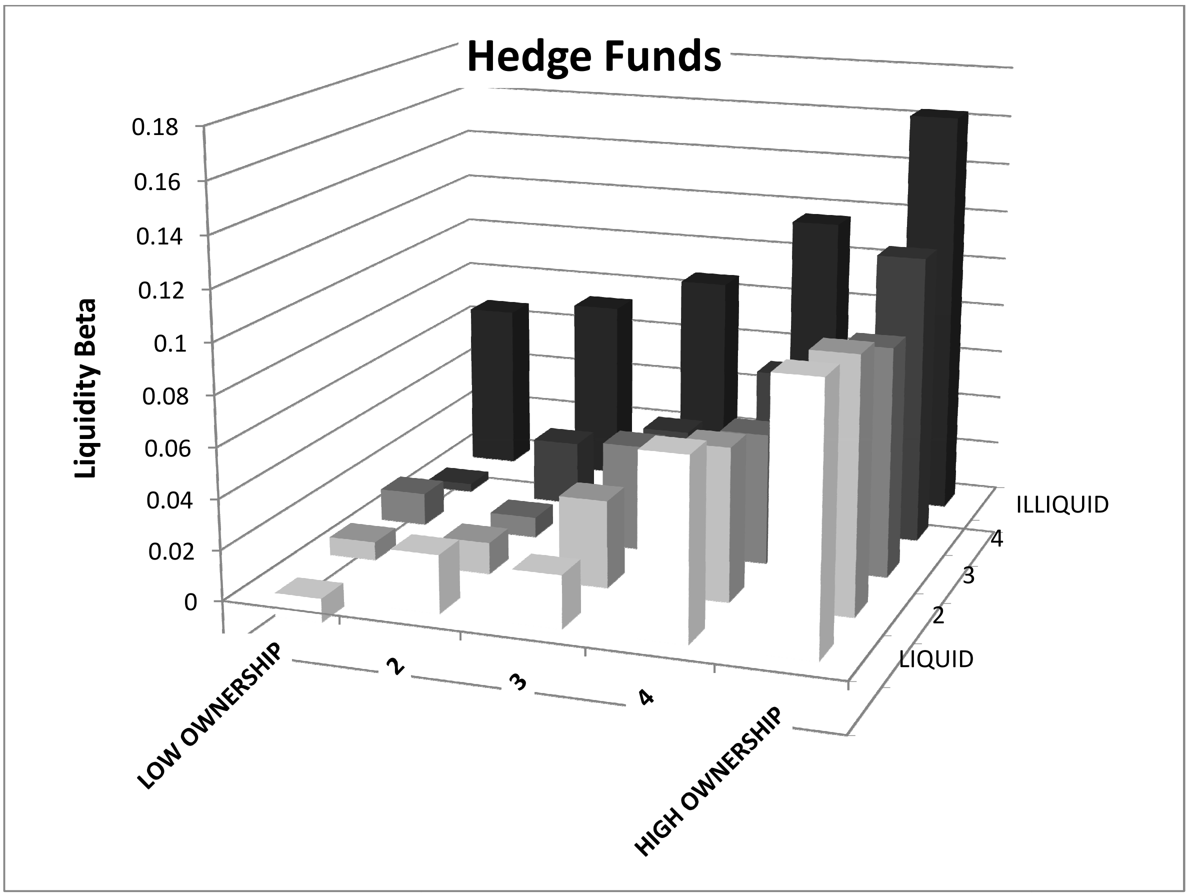


Figure 1.7 Liquidity Betas for 25 Portfolios Sorted on Bank Ownership and Bid-Ask Spread

The figure plots liquidity betas for 25 portfolios independently sorted into quintiles based on bank ownership and average liquidity. The average liquidity of each stock is measured by its proportional effective bid-ask spread. Stocks are sorted into portfolios in each quarter, and liquidity betas are estimated over the subsequent quarter by regressing daily equal-weighted portfolio returns against innovations in market liquidity (measured by the proportional effective bid-ask spread) while controlling for market returns. Ownership portfolio 1 (5) contains stocks in the lowest (highest) bank ownership quintile. Liquidity portfolio 1 (5) contains stocks in the lowest (highest) effective bid-ask spread quintile.

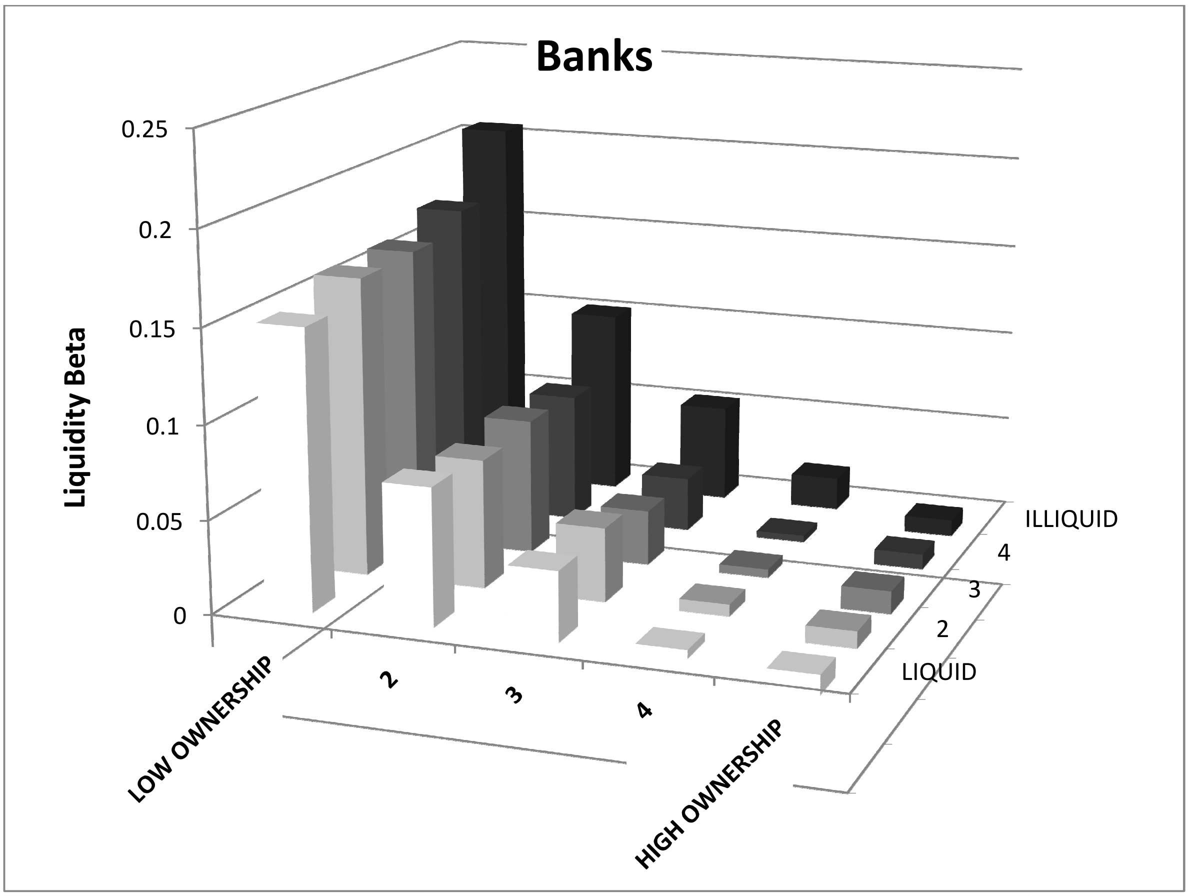
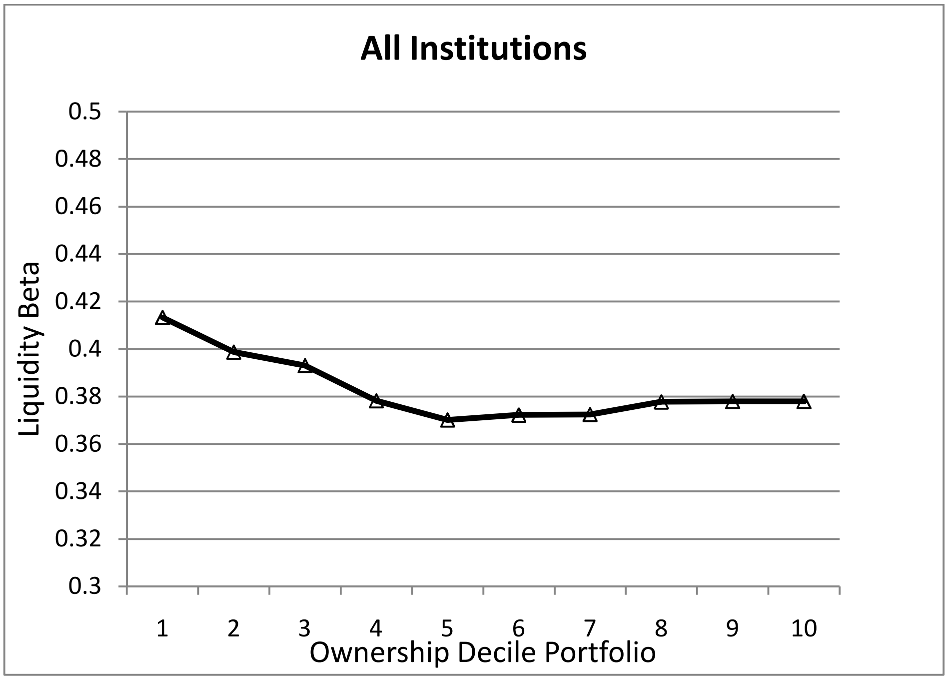


Figure 1.8 Univariate Liquidity Betas for 10 Ownership-Sorted Portfolios

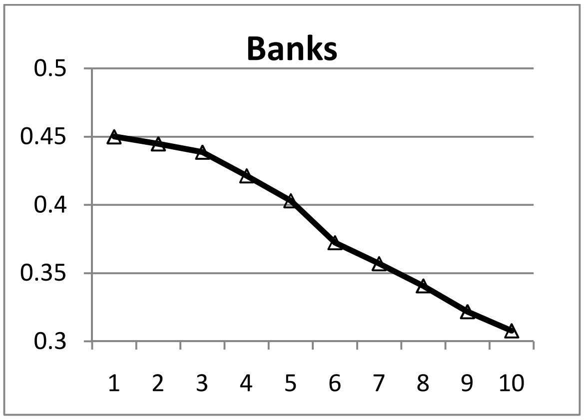
The figure plots the univariate liquidity betas for the 10 ownership-sorted portfolios against portfolio rakings. Stocks are sorted into decile portfolios on the basis of total institutional ownership (Panel A) or ownership of different types of institutional investors (Panel B) at the end of each quarter. The univariate liquidity betas are estimated by regressing the daily equal-weighted portfolio returns over the subsequent quarter against innovations in aggregate market liquidity. Market liquidity is measured by the proportional effective bid-ask spread. Portfolio 1 (10) contains stocks in the lowest (highest) institutional ownership decile.

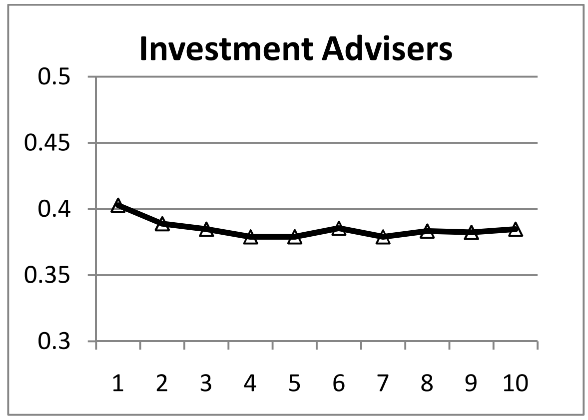
Panel A: Portfolios Sorted by Total Institutional Ownership

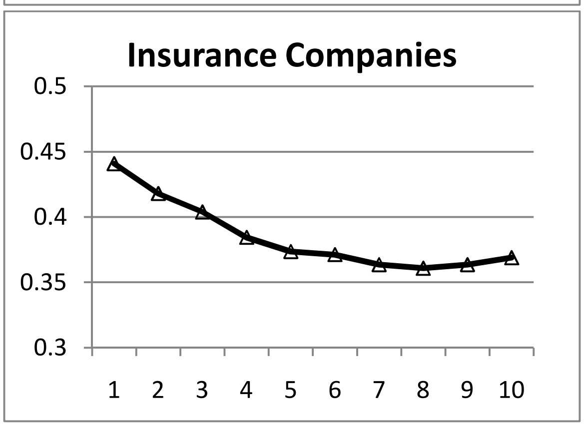


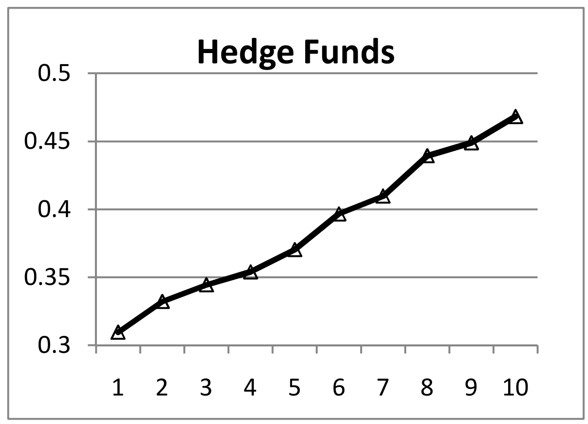
Panel B: Portfolios Sorted by Ownership of Different Types of Institutional Investors (Univariate Liquidity Betas)

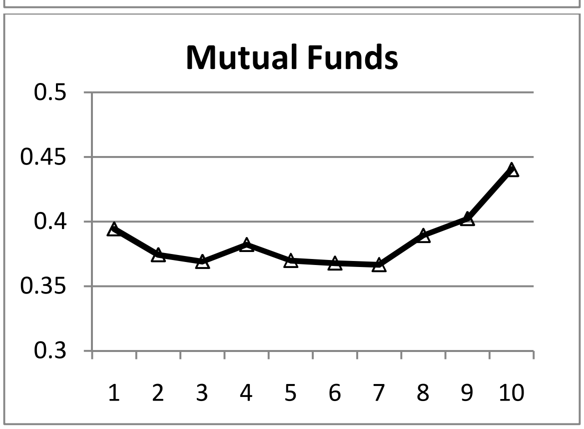
The decile portfolio rank is shown on the horizontal axis, and portfolio liquidity betas are plotted on the vertical axis. Portfolio 1 (10) contains stocks in the lowest (highest) ownership decile.











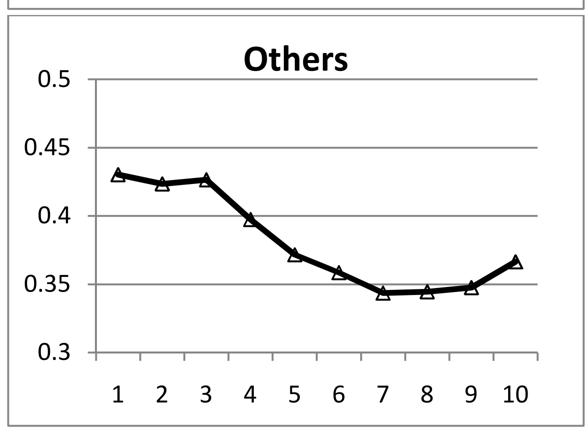


Table 1.1 Summary Statistics of Institutional Ownership

This table provides summary statistics for institutional ownership of sample stocks over the 80 quarters from 1989:Q4 through 2009:Q3. Sample stocks are listed on NYSE, AMEX, or NASDAQ. Panel A shows the total number of institutions holding shares, and Panel B shows the average fraction of outstanding shares held by these institutions. The holdings are broken down by type of institutional investors and sub-period. The six types of institutional investors are (1) banks, (2) insurance companies, (3) mutual funds, (4) investment advisers, (5) hedge funds, and (6) others. The category "others" includes endowments, foundations, and private pension funds.

Panel A: Number of Institutions Holding Shares

Year	Total	Banks	Insurance	Mutual funds	Inv. Advisers	Hedge funds	Others
1989-2009	5271	524	153	576	2357	1225	436
1989-1994	1621	326	103	419	546	123	104
1995-1999	2304	302	109	503	942	300	148
2000-2004	2970	249	93	435	1240	642	311
2005-2009	3744	235	88	364	1705	1062	290

Panel B: Fraction of Shares Held by Institutions

Year	All Institutions	Banks	Insurance	Mutual funds	Inv. Advisers	Hedge funds	Others
1989-2009	0.557	0.099	0.035	0.285	0.057	0.048	0.038
1989-1994	0.526	0.110	0.045	0.257	0.055	0.012	0.049
1995-1999	0.493	0.085	0.041	0.275	0.042	0.022	0.030
2000-2004	0.534	0.092	0.033	0.286	0.052	0.038	0.035
2005-2009	0.636	0.112	0.030	0.299	0.075	0.087	0.044

Table 1.2 Summary Statistics

The table reports summary statics for the sample of 197,390 stock/quarter observations. The sample period is from Januaury 1990 through December 2009. Liquidity betas are measured quarterly by regressing daily stock returns on daily changes in aggregate liquidity while controlling for market returns. Aggregate liquidity is measured by the effective bid-ask spread, the quoted bid-ask spread, or Amihud illiquidity. All other variables are measured over the period of three months preceding the estimation of liquidity betas. Market betas are estimated using daily market model regressions. The standard deviation and average return are based on daily stock returns. Leverage is the sum of current liabilities and long-term debt over total book assets, measured at the end of the previous quarter. Book-to-market ratio is defined as the book value of total shareholders' equity divided by the market value of equity. Institutional ownership is the aggregate ownership by all types of institutional investors. Ownership concentration is measured by the Herfindahl index, and PIN is a measure of asymmetric information.

Variable	Mean	Standard Deviation	Lower Quartile	Median	Upper Quartile
Liquidity Beta (Eff. Spread)	0.05	0.46	-0.18	0.02	0.26
Liquidity Beta (Quoted Spread)	0.06	0.55	-0.21	0.03	0.29
Liquidity Beta (Amihud)	0.05	0.48	-0.19	0.02	0.26
Effective Spread	0.74%	0.74%	0.22%	0.48%	1.00%
Quoted Spread	1.16%	1.08%	0.41%	0.83%	1.54%
Market Beta	1.07	1.63	-0.08	1.05	2.19
Standard Dev. of Return	3.89%	2.80%	1.63%	3.38%	5.63%
Average Daily Return	0.09%	0.45%	-0.14%	0.08%	0.31%
Leverage	0.21	0.19	0.02	0.17	0.33
Book-to-Market	0.51	0.37	0.25	0.43	0.67
Market Capitalization ($ M)	3753	15713	214	610	2004
Price ($)	26.58	30.57	10.95	21.00	34.92
Total Institutional Ownership	0.56	0.27	0.35	0.58	0.77
Bank Ownership	0.10	0.07	0.04	0.09	0.14
Insurance Company Ownership	0.04	0.04	0.01	0.03	0.05
Mutual Fund Ownership	0.28	0.17	0.15	0.28	0.41
Investment Advisor Ownership	0.06	0.06	0.02	0.04	0.08
Hedge Fund Ownership	0.05	0.07	0.01	0.02	0.06
Other Ownership	0.04	0.04	0.01	0.03	0.05
Ownership Concentration	0.03	0.04	0.01	0.02	0.03
PIN	0.20	0.10	0.13	0.19	0.26
Stocks per Quarter	2467	1144	1142	3046	3420

Table 1.3 Institutional Ownership for 10 Ownership-Sorted Portfolios

At the end of each quarter, stocks are sorted into decile portfolios on the basis of total institutional ownership, and independently on the basis of ownership by banks, insurance companies, mutual funds, investment advisers, hedge funds, and others. Portfolio 1 (10) contains stocks in the lowest (highest) institutional ownership decile. The table reports the time-series averages of the fractions of shares held by institutional investors for the ownership-sorted portfolios. The average number of stocks in each portfolio is 247.

	Ownership Decile Portfolio									
Sorted on Ownership of:	P-1 (Low)	2	3	4	5	6	7	8	9	P-10 (High)
All Institutions	0.094	0.250	0.362	0.458	0.541	0.615	0.682	0.747	0.815	0.924
Banks	0.010	0.029	0.048	0.067	0.085	0.103	0.121	0.143	0.170	0.444
Insurance	0.003	0.009	0.015	0.021	0.027	0.034	0.042	0.052	0.069	0.399
Mutual Funds	0.034	0.097	0.151	0.201	0.249	0.295	0.342	0.395	0.460	0.699
Investment Advisers	0.006	0.017	0.026	0.034	0.041	0.050	0.061	0.076	0.099	0.340
Hedge Funds	0.002	0.006	0.010	0.015	0.021	0.028	0.039	0.054	0.081	0.324
Others	0.003	0.008	0.015	0.023	0.032	0.040	0.047	0.056	0.072	0.483

Table 1.4 Liquidity Betas for 10 Ownership-Sorted Portfolios

The table shows liquidity beta estimates for the 10 ownership-sorted portfolios. Portfolio 1 (10) contains stocks in the lowest (highest) institutional ownership decile. Stocks are sorted into portfolios in each quarter, and liquidity betas are estimated over the subsequent quarter by regressing daily equal-weighted portfolio returns against innovations in market liquidity (measured by the proportional effective bid-ask spread) while controlling for market returns. The t-statistics in parentheses below liquidity betas are computed using Newey-West standard errors with 8 lags. The last column shows the slope coefficient and the associated t-statistic from regressions of portfolio liquidity betas against the average institutional ownership in each portfolio. Slope coefficients significant at the 5% (1%) level are marked with one (two) asterisks.

Sorted on Ownership of:	P-1 (Low)	2	3	4	5	6	7	8	9	P-10 (High)	Slope
All Institutions	0.15	0.10	0.08	0.06	0.04	0.04	0.03	0.03	0.03	0.05	-0.13**
	(9.2)	(7.2)	(5.8)	(4.8)	(3.9)	(4.1)	(3.2)	(3.3)	(3.2)	(4.7)	(-4.5)
Banks	0.22	0.15	0.09	0.06	0.05	0.02	0.01	0.00	-0.01	-0.01	-0.40*
	(11.8)	(9.3)	(6.3)	(4.6)	(4.3)	(2.4)	(1.0)	(0.5)	(-1.2)	(-1.2)	(-2.4)
Insurance Comp.	0.16	0.07	0.05	0.03	0.03	0.03	0.03	0.03	0.02	0.04	-0.07
	(9.9)	(4.6)	(3.5)	(2.5)	(2.5)	(3.7)	(4.4)	(4.3)	(3.0)	(4.4)	(-0.6)
Mutual Funds	0.13	0.07	0.06	0.05	0.04	0.04	0.03	0.05	0.05	0.07	-0.05
	(8.3)	(5.3)	(5.4)	(4.7)	(4.3)	(4.1)	(3.7)	(4.7)	(5.3)	(5.6)	(-1.1)
Investment Advisers	0.11	0.07	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.06	-0.01
	(7.4)	(6.1)	(4.8)	(4.6)	(4.9)	(4.7)	(4.7)	(5.1)	(4.8)	(5.2)	(-0.2)
Hedge Funds	0.02	0.02	0.03	0.03	0.03	0.05	0.06	0.08	0.10	0.13	0.33**
	(1.4)	(2.5)	(3.1)	(3.2)	(3.1)	(5.4)	(5.2)	(6.8)	(8.0)	(9.0)	(4.7)
Others	0.15	0.11	0.07	0.04	0.03	0.02	0.01	0.01	0.02	0.03	-0.09
	(10.4)	(7.9)	(5.3)	(3.7)	(2.9)	(1.9)	(1.8)	(2.3)	(2.5)	(3.0)	(-0.8)

Table 1.5 Liquidity Betas for 25 Portfolios Sorted on Hedge Fund Ownership and Bid-Ask Spread

The table shows liquidity betas for 25 portfolios independently sorted into quintiles based on hedge fund ownership and average liquidity. The average liquidity of each stock is measured by its proportional effective bid-ask spread. Stocks are sorted into portfolios in each quarter, and liquidity betas are estimated over the subsequent quarter by regressing daily equal-weighted portfolio returns against innovations in market liquidity (measured by the proportional effective bid-ask spread) while controlling for market returns. The t-statistics in parentheses below liquidity betas are computed using Newey-West standard errors with 8 lags. Ownership portfolio 1 (5) contains stocks in the lowest (highest) hedge fund ownership quintile. Liquidity portfolio 1 (5) contains stocks in the lowest (highest) effective bid-ask spread quintile.

Sorted on:	Own-1 (Low)	Own-2	Own-3	Own-4	Own-5 (High)
Liq-1 (Liquid)	-0.01	0.02	0.02	0.07	0.10
	(-0.86)	(2.48)	(1.95)	(5.67)	(7.06)
Liq-2	0.01	0.01	0.03	0.06	0.10
	(0.72)	(1.40)	(3.29)	(4.75)	(6.95)
Liq-3	0.01	0.01	0.04	0.05	0.09
	(1.23)	(0.91)	(4.27)	(4.26)	(7.02)
Liq-4	0.01	0.03	0.04	0.06	0.12
	(0.31)	(2.93)	(3.37)	(5.10)	(8.09)
Liq-5 (Illiquid)	0.07	0.07	0.09	0.12	0.16
	(5.71)	(6.39)	(7.12)	(8.68)	(10.75)

Table 1.6 Liquidity Betas for 25 Portfolios Sorted on Bank Ownership and Bid-Ask Spread

The table shows liquidity betas for 25 portfolios independently sorted into quintiles based on bank ownership and average liquidity. The average liquidity of each stock is measured by its proportional effective bid-ask spread. Stocks are sorted into portfolios in each quarter, and liquidity betas are estimated over the subsequent quarter by regressing daily equal-weighted portfolio returns against innovations in market liquidity (measured by the proportional effective bid-ask spread) while controlling for market returns. The t-statistics in parentheses below liquidity betas are computed using Newey-West standard errors with 8 lags. Ownership portfolio 1 (5) contains stocks in the lowest (highest) bank ownership quintile. Liquidity portfolio 1 (5) contains stocks in the lowest (highest) effective bid-ask spread quintile.

Sorted on:	Own-1 (Low)	Own-2	Own-3	Own-4	Own-5 (High)
Liq-1 (Liquid)	0.15	0.07	0.04	0.01	-0.01
	(8.48)	(4.70)	(3.52)	(0.47)	(-1.17)
Liq-2	0.16	0.07	0.04	0.01	-0.01
	(9.23)	(4.64)	(3.48)	(0.76)	(-1.07)
Liq-3	0.16	0.07	0.03	0.01	-0.01
	(9.88)	(5.10)	(2.61)	(0.55)	(-1.44)
Liq-4	0.17	0.07	0.03	0.01	-0.01
	(9.70)	(4.73)	(2.65)	(0.40)	(-0.98)
Liq-5 (Illiquid)	0.21	0.10	0.05	0.02	-0.01
	(10.98)	(7.04)	(4.39)	(1.71)	(-0.92)

Table 1.7 Cross-Sectional Regressions of Liquidity Betas on Institutional Ownership

The table reports the results from Fama-MacBeth regressions of liquidity betas on the fraction of shares held by different types of institutional investors and control variables. The liquidity betas are estimated with respect to changes in the market-wide effective bid-ask spread. All variables are standardized to have zero means and unit variances in each quarter. Shown is the time-series average of the quarterly cross-sectional slope coefficients and the Fama-MacBeth t-statistic corrected for serial correlation using the method of Newey-West with 4 lags. Using the estimates from the third column, Panel B provides an F-test of the hypothesis that hedge fund ownership has the same effect on liquidity risk as ownership by other types of institutional investors. Coefficients significant at the 5% (1%) level are marked with one (two) asterisks.

Panel A: Parameter Estimates

	(1)		(2)		(3)	
	Coefficient	T-Stat.	Coefficient	T-Stat.	Coefficient	T-Stat.
Banks	-0.272**	-9.93	-0.146**	-7.73	-0.139**	-7.67
Insurance	-0.043	-1.90	-0.004	-0.20	-0.004	-0.21
Mutual Funds	0.008	0.61	0.018	1.62	0.018	1.70
Investment Advisers	0.052*	2.15	0.045*	2.30	0.043*	2.26
Hedge Funds	0.239**	7.63	0.197**	5.26	0.191**	5.28
Others	-0.128**	-3.22	-0.077*	-2.08	-0.072*	-2.01
Own. Concentration			0.011	1.95	0.010	1.91
Avg. Effective Spread			0.065**	4.88	0.063**	4.82
Market Beta			-0.010**	-2.90	-0.009**	-2.69
Standard Deviation			0.005	1.44	0.004	1.27
Average Return			0.022**	2.86	0.021**	2.76
Leverage			-0.001	-0.21	-0.001	-0.16
Book-to-Market			-0.018*	-2.17	-0.017*	-2.12
Market Cap.			-0.031**	-2.98	-0.029**	-2.95
NASDAQ			0.024	1.29	0.024	1.29
PIN			0.012*	2.40	0.012*	2.53
Lagged Liquidity Beta					0.038**	5.41
Observations	197390		197390		197390	
Quarters	80		80		80	
Avg. R^2	0.024		0.053		0.055	

Panel B: Tests for Difference between Hedge Funds and Other Institutional Investors

	Difference	F-Statistic
Hedge Funds - Banks	0.330**	66.57
Hedge Funds - Insurance Companies	0.195**	23.08
Hedge Funds - Mutual Funds	0.172**	20.9
Hedge Funds - Investment Advisers	0.148**	13.17
Hedge Funds - Others	0.263**	26.63

Table 1.8 Regressions of Crisis-Day Abnormal Returns on Institutional Ownership

The table contains the results from Fama-MacBeth regressions of crisis-day market-adjusted abnormal returns on the fraction of shares held by different types of institutional investors and control variables. Crisis days are defined as the 50 days with the largest declines in market liquidity. Market liquidity is measured by the proportional effective bid-ask spread. Returns are expressed in percent per day. Shown is the time-series average of the quarterly cross-sectional slope coefficients and the Fama-MacBeth t-statistic. Using the estimates from the third column, Panel B provides an F-test of the hypothesis that hedge fund ownership has the same effect on crisis-day returns as ownership by other types of institutional investors. Coefficients significant at the 5% (1%) level are marked with one (two) asterisks.

Panel A: Parameter Estimates

	(1)		(2)		(3)	
	Coefficient	T-Stat.	Coefficient	T-Stat.	Coefficient	T-Stat.
Banks	2.866**	3.15	1.529**	2.81	1.471**	2.79
Insurance	0.825	1.62	0.105	0.23	0.090	0.20
Mutual Funds	-0.266	-1.50	-0.276	-1.61	-0.220	-1.37
Investment Advisers	-0.309	-0.82	-0.722	-1.83	-0.749	-1.89
Hedge Funds	-3.204**	-3.46	-2.114**	-2.92	-2.041**	-2.92
Others	0.888	1.71	0.011	0.03	-0.001	0.01
Own. Concentration			0.085	0.19	0.087	0.19
Avg. Effective Spread			-0.115	-1.77	-0.103	-1.64
Market Beta			-0.028	-1.79	-0.020	-1.63
Standard Deviation			-0.039**	-3.79	-0.038**	-4.17
Average Return			-0.416**	-2.29	-0.402*	-2.18
Leverage			-0.084	-0.78	-0.096	-0.89
Book-to-Market			0.270*	2.20	0.250*	2.10
Market Cap.			0.001	-0.26	0.001	-0.38
NASDAQ			-0.158	-1.40	-0.133	-1.25
PIN			-0.904**	-2.77	-0.944**	-2.88
Lagged Liquidity Beta					-0.207*	-2.10
Observations	125236		125236		125236	
Event Days	50		50		50	
Avg. R^2	0.023		0.060		0.063	
Event Day Avg. Return	-1.67%					

Panel B: Tests for Differences between Hedge Funds and Other Institutional Investors

	Difference	F-Statistic
Hedge Funds - Banks	-3.512**	12.45
Hedge Funds - Insurance Companies	-2.130**	8.96
Hedge Funds - Mutual Funds	-1.820**	8.25
Hedge Funds - Investment Advisers	-1.291	3.47
Hedge Funds - Others	-2.040*	6.39

Table 1.9 Regressions of Positive Event-Day Abnormal Returns on Institutional Ownership

The table contains the results from Fama-MacBeth regressions of event-day market-adjusted abnormal returns on the fraction of shares held by different types of institutional investors and control variables. Positive event days are defined as the 50 days with the largest improvements in market liquidity. Market liquidity is measured by the proportional effective bid-ask spread. Returns are expressed in percent per day. Shown is the time-series average of the quarterly cross-sectional slope coefficients and the Fama-MacBeth t-statistic. Using the estimates from the third column, Panel B provides an F-test of the hypothesis that hedge fund ownership has the same effect on crisis-day returns as ownership by other types of institutional investors. Coefficients significant at the 5% (1%) level are marked with one (two) asterisks.

Panel A: Parameter Estimates

	(1)		(2)		(3)	
	Coefficient	T-Stat.	Coefficient	T-Stat.	Coefficient	T-Stat.
Banks	-0.691	-1.23	-0.103	-0.28	-0.083	-0.23
Insurance	-0.164	-0.43	0.308	0.86	0.304	0.86
Mutual Funds	0.427**	2.67	0.360*	2.29	0.363*	2.35
Investment Advisers	0.186	0.52	0.153	0.44	0.158	0.46
Hedge Funds	1.170*	2.54	0.908*	2.17	0.873*	2.10
Others	-0.356	-1.14	0.035	0.09	0.059	0.15
Own. Concentration			-0.380	-0.73	-0.354	-0.68
Avg. Effective Spread			-0.132*	-2.47	-0.125*	-2.38
Market Beta			0.048**	3.06	0.038**	2.92
Standard Deviation			0.015	1.78	0.011	1.37
Average Return			0.108	0.96	0.125	1.15
Leverage			-0.144	-1.54	-0.131	-1.43
Book-to-Market			-0.067	-0.57	-0.060	-0.51
Market Cap.			-0.001	-1.75	-0.001	-1.67
NASDAQ			0.121	1.70	0.098	1.47
PIN			1.035**	3.89	1.080**	4.21
Lagged Liquidity Beta					0.102	1.31
Observations	146437		146437		146437	
Event Days	50		50		50	
Avg. R^2	0.0082		0.032		0.0349	
Event Day Avg. Return	1.08%					

Panel B: Tests for Difference between Hedge Funds and Other Institutional Investors

	Difference	F-Statistic
Hedge Funds - Banks	0.957	2.5
Hedge Funds - Insurance Companies	0.569	1.09
Hedge Funds - Mutual Funds	0.511	1.45
Hedge Funds - Investment Advisers	0.716	2.34
Hedge Funds - Others	0.814	2.37

Table 1.10 Regressions of Non-Event-Day Abnormal Returns on Institutional Ownership

The table contains the results from Fama-MacBeth regressions of non-event-day market-adjusted abnormal returns on the fraction of shares held by different types of institutional investors. The non-event days are defined as the 150 days with the smallest changes in market liquidity. Market liquidity is measured by the proportional effective bid-ask spread. Shown is the time-series average of the quarterly cross-sectional slope coefficients and the Fama-MacBeth t-statistic. None of the coefficients is significant at the 5% level.

	(1)		(2)		(3)	
	Coefficient	T-Stat.	Coefficient	T-Stat.	Coefficient	T-Stat.
Banks	-0.270	-1.07	-0.091	-0.56	-0.074	-0.46
Insurance	0.089	0.47	0.149	0.83	0.145	0.81
Mutual Funds	-0.080	-0.89	-0.007	-0.08	-0.005	-0.07
Investment Advisers	0.136	0.77	0.074	0.43	0.091	0.52
Hedge Funds	-0.102	-0.29	-0.016	-0.05	-0.009	-0.03
Others	-0.280	-1.86	-0.265	-1.47	-0.263	-1.47
Own. Concentration			-0.120	-0.53	-0.106	-0.47
Avg. Effective Spread			0.020	0.99	0.020	1.00
Market Beta			-0.008	-1.22	-0.009	-1.56
Standard Deviation			0.004	0.90	0.003	0.73
Average Return			-0.031	-0.71	-0.031	-0.70
Leverage			-0.065	-1.23	-0.066	-1.27
Book-to-Market			0.063	1.55	0.065	1.64
Market Cap.			0.000	-0.66	0.000	-0.63
NASDAQ			0.013	0.37	0.010	0.27
PIN			0.053	0.53	0.059	0.60
Lagged Liquidity Beta					0.032	1.06
Observations	322632		322632		322632	
Event Days	150		150		150	
Avg. R^2	0.001		0.022		0.0234	
Event Day Avg. Return	-0.09%					

Table 1.11 Cross-Sectional Regressions Using the Quoted Bid-Ask Spread to Measure Market Liquidity

The table contains results from cross-sectional regressions of liquidity betas on institutional ownership and control variables. Liquidity betas are measured with respect to changes in the proportional quoted bid-ask spread. All variables are standardized to have zero means and unit variances in each quarter. Shown is the time-series average of the quarterly cross-sectional slope coefficients and the Fama-MacBeth t-statistic corrected for serial correlation using the method of Newey-West with 4 lags. Using the estimates from the third column, Panel B provides an F-test of the hypothesis that hedge fund ownership has the same effect on crisis-day returns as ownership by other types of institutional investors. Coefficients significant at the 5% (1%) level are marked with one (two) asterisks.

Panel A: Parameter Estimates

	(1)		(2)		(3)	
	Coefficient	T-Stat.	Coefficient	T-Stat.	Coefficient	T-Stat.
Banks	-0.202**	-6.38	-0.114**	-5.01	-0.110**	-4.90
Insurance Companies	-0.064**	-2.81	-0.033	-1.59	-0.032	-1.59
Mutual Funds	-0.010	-1.12	-0.005	-0.57	-0.005	-0.58
Investment Advisers	0.003	0.10	0.003	0.08	0.002	0.08
Hedge Funds	0.156**	4.67	0.121**	3.05	0.120**	3.04
Others	-0.056*	-2.50	-0.024	-0.94	-0.022	-0.91
Own. Concentration			0.004	0.78	0.004	0.74
Avg. Effective Spread			0.032*	2.58	0.031*	2.55
Market Beta			-0.006	-1.54	-0.006	-1.50
Standard Deviation			0.011**	2.68	0.011**	2.66
Average Return			0.033**	4.03	0.033**	4.10
Leverage			-0.006	-1.36	-0.005	-1.31
Book-to-Market			-0.010	-1.51	-0.009	-1.44
Market Cap.			-0.018**	-3.23	-0.017**	-3.21
NASDAQ			0.014	0.71	0.014	0.69
PIN			-0.002	-0.35	-0.002	-0.33
Lagged Liquidity Beta					0.023**	2.77
Observations	197390		197390		197390	
Quarters	80		80		80	
Avg. R^2	0.016		0.040		0.042	

Panel B: Tests for Differences between Hedge Funds and Other Institutional Investors

	Difference	F-Statistic
Hedge Funds - Banks	0.230**	25.64
Hedge Funds - Insurance Companies	0.152**	11.76
Hedge Funds - Mutual Funds	0.125**	9.57
Hedge Funds - Investment Advisers	0.118*	5.75
Hedge Funds - Others	0.142**	9.37

Table 1.12 Cross-Sectional Regressions Using the Amihud Measure of Market Liquidity

The table contains results from cross-sectional regressions of liquidity betas on institutional ownership and control variables. Liquidity betas are measured with respect to changes in Amihud illiquidity. All variables are standardized to have zero means and unit variances in each quarter. Shown is the time-series average of the quarterly cross-sectional slope coefficients and the Fama-MacBeth t-statistic corrected for serial correlation using the method of Newey-West with 4 lags. Using the estimates from the third column, Panel B provides an F-test of the hypothesis that hedge fund ownership has the same effect on crisis-day returns as ownership by other types of institutional investors. Coefficients significant at the 5% (1%) level are marked with one (two) asterisks.

Panel A: Parameter Estimates

	(1)		(2)		(3)	
	Coefficient	T-Stat.	Coefficient	T-Stat.	Coefficient	T-Stat.
Banks	-0.166**	-3.78	-0.082**	-3.02	-0.078**	-3.07
Insurance Companies	-0.081**	-4.25	-0.049**	-3.06	-0.046**	-2.96
Mutual Funds	0.011	1.33	0.016*	2.20	0.016*	2.18
Investment Advisers	0.059*	2.58	0.059**	2.84	0.058**	2.81
Hedge Funds	0.219**	5.01	0.189**	4.64	0.184**	4.61
Others	-0.091**	-5.28	-0.059**	-3.37	-0.057**	-3.26
Own. Concentration			0.005	1.45	0.005	1.42
Avg. Effective Spread			0.028**	4.24	0.027**	4.24
Market Beta			0.002	0.43	0.002	0.40
Standard Deviation			0.009*	1.99	0.008	1.91
Average Return			0.014	1.63	0.014	1.57
Leverage			-0.006	-1.91	-0.005	-1.80
Book-to-Market			-0.014**	-2.75	-0.013**	-2.71
Market Cap.			-0.016**	-4.34	-0.016**	-4.29
NASDAQ			0.055*	2.22	0.052*	2.19
PIN			-0.010	-1.88	-0.010	-1.90
Lagged Liquidity Beta					0.032**	4.83
Observations	197390		197390		197390	
Quarters	80		80		80	
Avg. R^2	0.012		0.023		0.032	

Panel B: Tests for Differences between Hedge Funds and Other Institutional Investors

	Difference	F-Statistic
Hedge Funds - Banks	0.262**	30.6
Hedge Funds - Insurance Companies	0.230**	28.81
Hedge Funds - Mutual Funds	0.168**	17.11
Hedge Funds - Investment Advisers	0.126**	7.92
Hedge Funds - Others	0.241**	30.57

Table 1.13 Cross-Sectional Regressions of Dimson Liquidity Betas on Institutional Ownership

The table reports the results from Fama-MacBeth regressions of Dimson liquidity betas on the fraction of shares held by different types of institutional investors and control variables. Dimson betas are obtained as the sum of the slope coefficients on current and lagged innovations in market liquidity. The effective bid-ask spread is used to measure market liquidity. All variables are standardized to have zero means and unit variances in each quarter. Shown is the time-series average of the quarterly cross-sectional slope coefficients and the Fama-MacBeth t-statistic corrected for serial correlation using the method of Newey-West with 4 lags. Using the estimates from the third column, Panel B provides an F-test of the hypothesis that hedge fund ownership has the same effect on crisis-day returns as ownership by other types of institutional investors. Coefficients significant at the 5% (1%) level are marked with one (two) asterisks.

Panel A: Parameter Estimates

	(1)		(2)		(3)	
	Coefficient	T-Stat.	Coefficient	T-Stat.	Coefficient	T-Stat.
Banks	-0.289**	-12.17	-0.163**	-8.37	-0.153**	-8.41
Insurance Companies	-0.054	-2.48	-0.027	-1.47	-0.026	-1.42
Mutual Funds	0.012	0.92	0.027*	2.15	0.026*	2.19
Investment Advisers	0.074*	2.57	0.054*	2.55	0.051*	2.49
Hedge Funds	0.249**	7.33	0.210**	4.77	0.202**	4.83
Others	-0.150**	-4.12	-0.109**	-2.96	-0.101**	-2.92
Own. Concentration			0.016**	2.79	0.014**	2.78
Avg. Effective Spread			0.073**	6.19	0.069**	6.16
Market Beta			-0.011*	-2.74	-0.010*	-2.56
Standard Deviation			0.008*	2.06	0.007	1.99
Average Return			0.010	1.52	0.009	1.47
Leverage			0.001	-0.08	0.001	0.02
Book-to-Market			-0.021*	-2.42	-0.019*	-2.32
Market Cap.			-0.035**	-2.98	-0.032**	-2.99
NASDAQ			-0.010	-0.71	-0.010	-0.67
PIN			0.012*	2.56	0.013**	2.71
Lagged Liquidity Beta					0.045**	5.82
Observations	197390		197390		197390	
Quarters	80		80		80	
Avg. R^2	0.024		0.053		0.057	

Panel B: Tests for Differences between Hedge Funds and Other Institutional Investors

	Difference	F-Statistic
Hedge Funds - Banks	0.355**	60.61
Hedge Funds - Insurance Companies	0.227**	24.96
Hedge Funds - Mutual Funds	0.176**	16.28
Hedge Funds - Investment Advisers	0.151**	10.57
Hedge Funds - Others	0.303**	31.11

Table 1.14 Univariate Liquidity Betas for 10 Ownership-Sorted Portfolios

The table shows the univariate liquidity beta estimates for the 10 ownership-sorted portfolios. Portfolio 1 (10) contains stocks in the lowest (highest) institutional ownership decile. The univariate liquidity betas are estimated by regressing daily equal-weighted portfolio returns against innovations in market liquidity (measured by the proportional effective bid-ask spread). The t-statistics in parentheses below liquidity betas are computed using Newey-West standard errors with 8 lags. The last column shows the slope coefficient and the associated t-statistic from regressions of portfolio liquidity betas against the average institutional ownership in each portfolio. Slope coefficients significant at the 5% (1%) level are marked with one (two) asterisks.

Sorted on Ownership of:	P-1 (Low)	2	3	4	5	6	7	8	9	P-10 (High)	Slope
All Institutions	0.41	0.40	0.39	0.38	0.37	0.37	0.37	0.38	0.38	0.38	-0.04
	(14.7)	(15.8)	(16.2)	(16.6)	(16.9)	(17.1)	(17.5)	(17.4)	(17.2)	(17.9)	(-3.4)**
Banks	0.45	0.44	0.44	0.42	0.40	0.37	0.36	0.34	0.32	0.31	-0.34**
	(15.6)	(16.3)	(16.3)	(16.4)	(16.8)	(16.8)	(16.7)	(16.8)	(16.2)	(16.1)	(-3.9)
Insurance Comp.	0.44	0.42	0.40	0.38	0.37	0.37	0.36	0.36	0.36	0.37	-0.07
	(15.7)	(15.8)	(15.9)	(16.1)	(16.6)	(17.1)	(17.7)	(17.6)	(17.2)	(17.4)	(-0.9)
Mutual Funds	0.39	0.37	0.37	0.38	0.37	0.37	0.37	0.39	0.40	0.44	0.09**
	(14.7)	(15.3)	(16.3)	(16.6)	(16.8)	(17.2)	(17.4)	(17.6)	(18.0)	(17.8)	(3.3)
Investment Advisers	0.40	0.39	0.38	0.38	0.38	0.39	0.38	0.38	0.38	0.38	-0.03
	(15.8)	(16.7)	(16.9)	(17.5)	(17.0)	(17.4)	(17.3)	(17.4)	(17.2)	(17.1)	(-1.1)
Hedge Funds	0.31	0.33	0.34	0.35	0.37	0.40	0.41	0.44	0.45	0.47	0.41*
	(15.8)	(16.7)	(16.8)	(17.0)	(16.9)	(17.4)	(16.9)	(17.3)	(17.7)	(17.5)	(2.9)
Others	0.43	0.42	0.43	0.40	0.37	0.36	0.34	0.34	0.35	0.37	-0.06
	(17.0)	(17.0)	(17.0)	(17.0)	(17.0)	(17.0)	(17.0)	(17.0)	(17.0)	(17.0)	(-0.7)

Table 1.15 Cross-Sectional Regressions Using Univariate Liquidity Betas

The table reports the results from Fama-MacBeth regressions of the univariate liquidity betas on the fraction of shares held by different types of institutional investors and control variables. The liquidity betas are estimated with respect to changes in the market-wide effective bid-ask spread, without controlling for market returns. All variables are standardized to have zero means and unit variances in each quarter. Shown is the time-series average of the quarterly cross-sectional slope coefficients and the Fama-MacBeth t-statistic corrected for serial correlation using the method of Newey-West with 4 lags. Using the estimates from the third column, Panel B provides an F-test of the hypothesis that hedge fund ownership has the same effect on crisis-day returns as ownership by other types of institutional investors. Coefficients significant at the 5% (1%) level are marked with one (two) asterisks.

Panel A: Parameter Estimates

	(1)		(2)		(3)	
	Coefficient	T-Stat.	Coefficient	T-Stat.	Coefficient	T-Stat.
Banks	-0.326**	-4.81	-0.143**	-4.34	-0.120**	-4.11
Insurance Companies	-0.094*	-2.48	0.035	1.67	0.036	1.84
Mutual Funds	0.090**	4.85	0.080**	5.03	0.070**	5.17
Investment Advisers	-0.046	-1.52	-0.010	-0.47	-0.009	-0.46
Hedge Funds	0.453**	9.23	0.314**	8.49	0.277**	8.42
Others	-0.123**	-2.51	0.001	0.05	0.011	0.41
Own. Concentration			-0.004	-0.90	-0.005	-1.12
Avg. Effective Spread			0.005	0.21	-0.001	-0.04
Market Beta			0.054**	6.57	0.033**	6.69
Standard Deviation			0.050**	7.02	0.042**	7.61
Average Return			0.033*	2.19	0.034*	2.55
Leverage			-0.013*	-2.06	-0.011	-1.80
Book-to-Market			-0.041**	-3.76	-0.035**	-3.52
Market Cap.			0.001	0.13	0.002	0.45
NASDAQ			0.209**	3.94	0.178**	3.88
PIN			0.049**	2.81	0.052**	3.15
Lagged Liquidity Beta					0.118**	5.23
Observations	197390		197390		197390	
Quarters	80		80		80	
Avg. R^2	0.052		0.138		0.151	

Panel B: Tests for Differences between Hedge Funds and Other Institutional Investors

	Difference	F-Statistic
Hedge Funds - Banks	0.397**	85.17
Hedge Funds - Insurance Companies	0.241**	42.75
Hedge Funds - Mutual Funds	0.207**	33.86
Hedge Funds - Investment Advisers	0.285**	57.85
Hedge Funds - Others	0.265**	43.73

Table 1.16 Pooled Time Series and Cross-Section Regressions

The table reports the results from pooled time series and cross-section regressions of liquidity betas on the fraction of shares held by different types of institutional investors and control variables. The liquidity betas are estimated with respect to changes in the market-wide effective bid-ask spread. All variables are standardized to have zero means and unit variances in each quarter. Standard errors are clustered by stock and by quarter. Using the estimates from the third column, Panel B provides an F-test of the hypothesis that hedge fund ownership has the same effect on crisis-day returns as ownership by other types of institutional investors. Coefficients significant at the 5% (1%) level are marked with one (two) asterisks.

Panel A: Parameter Estimates

	(1)		(2)		(3)	
	Coefficient	T-Stat.	Coefficient	T-Stat.	Coefficient	T-Stat.
Banks	-0.240**	-9.26	-0.153**	-8.08	-0.147**	-8.01
Insurance	-0.017	-1.05	0.019	1.20	0.018	1.22
Mutual Funds	-0.006	-0.50	0.018	1.60	0.017	1.57
Investment Advisers	0.125**	4.82	0.079**	3.65	0.076**	3.61
Hedge Funds	0.275**	7.45	0.254**	7.02	0.245**	6.87
Others	-0.104**	-4.10	-0.057*	-2.24	-0.054*	-2.18
Own. Concentration			-0.001	-0.40	-0.001	-0.41
Avg. Effective Spread			0.057**	6.66	0.055**	6.55
Market Beta			-0.008	-1.57	-0.008	-1.52
Standard Deviation			0.011*	2.24	0.011*	2.11
Average Return			0.016	1.52	0.016	1.55
Leverage			-0.004	-0.98	-0.004	-0.95
Book-to-Market			-0.021*	-2.49	-0.020*	-2.42
Market Cap.			-0.016**	-3.03	-0.016**	-2.99
NASDAQ			0.007	0.47	0.006	0.45
PIN			0.008	1.62	0.008	1.68
Lagged Liq. Beta					0.037**	5.94
Observations	197390		197390		197390	
Stock Clusters	8783		8783		8783	
Quarter Clusters	80		80		80	
R^2	0.0069		0.0108		0.0121	

Panel B: Tests for Differences between Hedge Funds and Other Institutional Investors

	Difference	F-Statistic
Hedge Funds - Banks	0.392**	75.62
Hedge Funds - Insurance Companies	0.226**	37.47
Hedge Funds - Mutual Funds	0.228**	42.79
Hedge Funds - Investment Advisers	0.169**	15.12
Hedge Funds - Others	0.299**	47.18

Table 1.17 Panel Regressions with Stock-Level Fixed Effects

The table reports the results from panel regressions with stock-level fixed effects of liquidity betas on the fraction of shares held by different types of institutional investors and control variables. The liquidity betas are estimated with respect to changes in the market-wide effective bid-ask spread. All variables are standardized to have zero means and unit variances in each quarter. Standard errors are clustered by stock and by quarter. Using the estimates from the second column, Panel B provides an F-test of the hypothesis that hedge fund ownership has the same effect on liquidity risk as ownership by other types of institutional investors. Coefficients significant at the 5% (1%) level are marked with one (two) asterisks.

Panel A: Parameter Estimates

	(1)		(2)	
	Coefficient	T Statistic	Coefficient	T Statistic
Banks	-0.104**	-7.62	-0.079**	-5.73
Insurance	-0.003	-0.18	0.002	0.08
Mutual Funds	-0.026**	-4.12	-0.014*	-2.16
Investment Advisers	0.042	1.86	0.019	0.83
Hedge Funds	0.192**	7.13	0.191**	6.98
Others	-0.143**	-5.97	-0.123**	-5.07
Own. Concentration			-0.005	-1.04
Avg. Effective Spread			0.029**	7.63
Market Beta			-0.009**	-3.92
Standard Deviation			-0.001	-0.62
Average Return			0.013**	5.62
Leverage			-0.008	-1.64
Book-to-Market			-0.019**	-5.07
Market Cap.			0.002	0.36
NASDAQ			0.003	0.14
PIN			0.019**	6.40
Observations	197390		197390	
No. of Stocks	8783		8783	
No. of Quarters	80		80	
R^2	0.006		0.009	

Panel B: Tests for Differences between Hedge Funds and Other Institutional Investors

	Difference	F-Statistic
Hedge Funds - Banks	0.270**	57.9
Hedge Funds - Insurance Companies	0.190**	26.38
Hedge Funds - Mutual Funds	0.205**	38.66
Hedge Funds - Investment Advisers	0.172**	16.65
Hedge Funds - Others	0.314**	56.32

Table 1.18 Cross-Sectional Regressions for Sub-Periods

The table contains sub-period results from cross-sectional regressions of liquidity betas on institutional ownership and control variables. The liquidity betas are estimated with respect to changes in the market-wide effective bid-ask spread. All variables are standardized to have zero means and unit variances in each quarter. Shown is the time-series average of the quarterly cross-sectional slope coefficients and the Fama-MacBeth t-statistic corrected for serial correlation using the method of Newey-West with 4 lags. Panel B provides an F-test of the hypothesis that hedge fund ownership has the same effect on liquidity risk as ownership by other types of institutional investors. Coefficients significant at the 5% (1%) level are marked with one (two) asterisks.

Panel A: Parameter Estimates

	1990-1999		2000-2009	
	Coefficient	T-Statistic	Coefficient	T-Statistic
Banks	-0.123**	-6.33	-0.155**	-5.07
Insurance Companies	-0.032	-1.52	0.025	0.91
Mutual Funds	0.031*	2.40	0.006	0.37
Investment Advisers	0.061*	2.53	0.025	0.90
Hedge Funds	0.127**	3.37	0.255**	5.48
Others	-0.161**	-3.76	0.016	0.42
Own. Concentration	0.025**	3.68	-0.004	-1.03
Avg. Effective Spread	0.093**	5.26	0.032**	2.86
Market Beta	-0.002	-0.57	-0.016**	-3.50
Standard Deviation	0.005	1.39	0.003	0.62
Average Return	0.030**	3.34	0.012	1.02
Leverage	-0.005	-0.74	0.003	0.73
Book-to-Market	-0.023	-1.96	-0.010	-1.00
Market Cap.	-0.064**	-7.57	0.005	0.87
NASDAQ	0.067*	2.29	-0.018	-1.57
PIN	0.011	1.61	0.014	1.94
Lagged Liqidity Beta	0.046**	4.31	0.030**	3.41
Avg. R^2	0.0741		0.0328	
Quarters	40		40	
Observations	622247		135143	

Panel B: Tests for Differences between Hedge Funds and Other Institutional Investors

	Period 1990-1999		Period 2000-2009	
	Difference	F-Statistic	Difference	F-Statistic
Hedge Funds - Banks	0.249**	34.82	0.410**	54.28
Hedge Funds - Insurance Companies	0.159**	13.57	0.230**	18.39
Hedge Funds - Mutual Funds	0.095*	5.77	0.249**	26.12
Hedge Funds - Investment Advisers	0.066	2.17	0.230**	18.21
Hedge Funds - Others	0.287**	25.49	0.238**	15.27

Table 1.19 Cross-Sectional Regressions Using the Most Liquid Stocks

The table contains results from cross-sectional regressions of liquidity betas on institutional ownership and control variables using the sub-sample of the most liquid stocks. Included are only stocks that trade on every trading day during the estimation period for liquidity betas. The liquidity betas are estimated with respect to changes in the market-wide effective bid-ask spread. All variables are standardized to have zero means and unit variances in each quarter. Shown is the time-series average of the quarterly cross-sectional slope coefficients and the Fama-MacBeth t-statistic corrected for serial correlation using the method of Newey-West with 4 lags. Using the estimates from the third column, Panel B provides an F-test of the hypothesis that hedge fund ownership has the same effect on liquidity risk as ownership by other types of institutional investors. Coefficients significant at the 5% (1%) level are marked with one (two) asterisks.

Panel A: Parameter Estimates

	(1)		(2)		(3)	
	Coefficient	T-Stat.	Coefficient	T-Stat.	Coefficient	T-Stat.
Banks	-0.198**	-7.02	-0.103**	-3.51	-0.098**	-3.45
Insurance Companies	-0.050	-1.17	-0.028	-0.70	-0.037	-0.89
Mutual Funds	-0.007	-0.36	-0.024	-1.03	-0.018	-0.88
Investment Advisers	0.117	1.34	0.052	0.60	0.042	0.51
Hedge Funds	0.393**	4.60	0.312**	4.04	0.294**	3.90
Others	-0.120*	-2.44	-0.072	-1.51	-0.065	-1.40
Own. Concentration			0.042	1.34	0.043	1.37
Avg. Effective Spread			0.082**	2.86	0.081**	2.87
Market Beta			-0.022*	-2.38	-0.019*	-2.13
Standard Deviation			-0.002	-0.21	-0.001	-0.08
Average Return			0.012	1.01	0.010	0.78
Leverage			-0.001	-0.07	0.001	0.08
Book-to-Market			-0.010	-0.85	-0.012	-1.04
Market Cap.			-0.037*	-2.53	-0.035*	-2.55
NASDAQ			0.015	0.37	0.015	0.36
PIN			0.008	0.59	0.007	0.56
Lagged Liquidity Beta					0.041**	2.89
Observations	111678		111678		111678	
Quarters	80		80		80	
Avg. R^2	0.040		0.083		0.085	

Panel B: Tests for Differences between Hedge Funds and Other Institutional Investors

	Difference	F-Statistic
Hedge Funds - Banks	0.393**	23.66
Hedge Funds - Insurance Companies	0.331**	14.73
Hedge Funds - Mutual Funds	0.312**	15.93
Hedge Funds - Investment Advisers	0.252*	5.01
Hedge Funds - Others	0.360**	16.38

CHAPTER 2: Multimarket Trading and Corporate Bond Liquidity

Introduction

Rather than issuing bonds in domestic markets, many of the world's largest corporations have recently started to issue global bonds. Global bonds are offered simultaneously to investors in the two major markets for dollar-denominated debt, namely the U.S. bond market and Eurobond market. Unlike domestic bonds, global bonds are designed for multimarket trading. These bonds include features that facilitate their trading, clearing, and settlement in the U.S. bond market, the Eurobond market, as well as between markets. Although first issued by the World Bank in 1989, global bonds have recently become the debt instrument of choice for large corporate issuers, and corporate global debt issuance exceeded U.S. domestic bond issuance and Eurobond issuance in recent years[7].

Despite the increasing importance of global bonds, the effects of multimarket trading on corporate bond value are not understood well. Miller and Puthenpurackal

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[7] According to the SDC New Issues Database, the proceeds from issuing global bonds exceeded the proceeds from issuing U.S. domestic bonds or Eurobonds in 2006, 2007, and 2008. Compared are all corporate issues of public, senior and unsecured bonds that are denominated in U.S. dollars.

(2005) study global bond offerings from the issuer's perspective, and find that firms can lower their cost of debt by issuing global rather than domestic bonds. However, why global bond offers reduce borrowing costs remains unclear. The main objective of this paper is to identify and measure the benefits that global bonds offer to investors. The paper provides new evidence from secondary markets that can clarify why global bond issuance reduces the cost of debt. I examine global bond liquidity and transaction prices in secondary markets, and relate the cost advantage of global bonds to the liquidity effects of multimarket trading.

Global bonds have key similarities when compared with U.S. domestic bonds. They are registered with the SEC, have similar indentures to U.S. bonds, and pay interest semiannually. The distinctive property of global bonds is their multimarket trading. They are designed to trade simultaneously in the U.S. bond market and the Eurobond market, and have features that minimize cross-market transaction costs. Multimarket trading could be a source of value to investors because it improves corporate bond liquidity. Specifically, by virtue of trading in several markets, global bonds have the potential to reach a wider international investor base and become more liquid. Since prior research shows that liquidity has a large positive effect on corporate bond prices (see, e.g., Longstaff, Mithal, and Neis (2005), Chen, Lesmond, and Wei (2007), Bao, Pan, and Wang (2011)), multimarket trading could have important wealth implications for both issuers and investors.

This paper examines the effects of multimarket trading on corporate bond liquidity and prices. To explore these effects, I first compare secondary market transaction prices of global and domestic bonds issued by the same obligor. Secondary market transactions in the U.S. bond market are obtained from TRACE[8], and in the Eurobond market from TRAX[9]. Next, I compute multiple trade-based measures of corporate bond liquidity, and test whether global bonds are more liquid than comparable domestic bonds. Finally, I test whether liquidity and transaction costs can explain the price premiums that investors pay for global bonds. The methods used to analyze bond liquidity and pricing also represent an improvement over previous papers on corporate bonds. This study exploits the fact that global bonds are typically issued by large corporations that have multiple debt issues outstanding in the domestic market as well as the global market, and collect a matched sample of global and domestic bonds issued by the same companies. Matching by issuer allows me to fully control for the issuer credit risk in the analysis of corporate bond liquidity and prices. In addition, the matched sample of bonds issued by the same obligors does not suffer from endogenous self-selection of firms into the group of global or domestic issuers.

The results support the hypothesis that multimarket trading improves the liquidity of corporate bonds. Compared to the outstanding domestic bonds of the same issuers, global bonds are more liquid. Even after controlling for well-known determinants of corporate bond liquidity, such as bond age and issue size, global bonds exhibit greater trading volumes in the U.S. bond market and in the Eurobond market, trade more frequently, and their prices are less volatile and less strongly affected by large trades. Several measures of transaction costs, including the measure of price impact proposed by Amihud (2002), and the measure of price reversals suggested by Roll (1984), and Bao,

[8] TRACE is the Trade Reporting and Compliance Engine, sponsored by the U.S. Financial Industry Regulatory Authority (FINRA).
[9] TRAX is the trade matching and regulatory system for the Eurobond market, sponsored by the International Capital Markets Association (ICMA).

Pan, and Wang (2011), are significantly smaller for global bonds than for domestic bonds. Furthermore, the liquidity advantage of global bonds is priced. When two bonds of the same issuer, one global and one domestic, trade on the same day, the yield on the global bond is on average 23.8 basis points lower. The yield spread between global and domestic bonds is greater for speculative grade bonds (-51.5 basis points) than for investment grade bonds (-11.6 basis points), and it increases during liquidity crises. Finally, I find that the trade-based liquidity measures can explain a large part of the yield difference between global and domestic bonds, and up to 20% of the cross-sectional variation in yield spreads between different bonds of the same company.

Overall, the empirical findings in this paper document a strong relationship between multimarket trading and corporate bond liquidity. Bonds that can be traded and settled efficiently in multiple markets exhibit a significant liquidity advantage over domestic bonds issued by the same firms. These findings are consistent with microstructure models that predict a positive relationship between the number of potential investors and liquidity in over-the-counter markets (e.g., Duffie, Garleanu, and Pedersen (2005, 2007)). Further, the liquidity advantage of global bonds is priced in the cross-section, and can explain prior evidence that firms can lower their cost of debt by issuing global bonds (Miller and Puthenpurackal (2005)). The findings also provide an explanation for the tendency of large corporations to issue global rather than domestic bonds.

The remainder of the paper is organized as follows. Section I develops the hypotheses, and Section II describes the data. Section III shows the empirical results, including the analysis of bond transaction prices and liquidity. Section IV provides a discussion of the results and a conclusion.

2.1 Hypotheses

2.1.1 Liquidity

The most important channel through which multimarket trading can increase corporate bond value is liquidity. Bonds that allow for multimarket trading could be more liquid because they have a greater issue size, or because they have a wider investor base and a greater number of dealers. For one thing, global bonds are often placed with investors in multiple markets, allowing them to have a greater issue size. However, prior research on the relationship between bond issue size and its liquidity is inconclusive. On the one hand, Edwards, Harris, and Piwowar (2007), Chen, Lesmond, and Wei (2007), and Mahanti et al. (2008) argue that larger issues are more liquid. On the other hand, Crabbe and Turner (1995) find no difference in yields attributable to size in a sample of bonds and medium-term-notes that have the same corporate issuer. Crabbe and Turner argue that large and small securities issued by the same borrowers are close substitutes. I contribute to this debate by testing whether global bonds have a liquidity advantage due to their greater issue size.

In addition to their greater issue size, global bonds could be more liquid because they have a greater number of dealers and a wider investor base. Firstly, both the dealers in the U.S. market and the dealers in the Eurobond market stand ready to buy and sell global bonds. The microstructure models of Demsetz (1968), Ho and Stoll (1983), Glosten and Harris (1988) and others predict a positive relationship between the number of dealers making the market in a given security and its liquidity. A greater number of dealers leads to more competitive dealer markets (Demsetz (1968)), and facilitates inventory risk management through inter-dealer trading (Ho and Stoll (1983), Reiss and Werner (1998)). Lower inventory risk and more intense competition among market makers, in turn, reduce transaction-costs.

Liquidity may also be greater for bonds with a wider investor base. Since global bonds can be marketed to investors in both the U.S. market and the Eurobond market, their pool of potential investors is larger. Duffie, Garleanu, and Pedersen (2005, 2007) develop a model in which transactions costs and liquidity in over-the-counter markets, such as the corporate bond market, depend on the number of potential investors. Their model predicts that illiquidity discounts are smaller if investors have access to multiple market makers, and the number of qualified investors is larger. Thus, global bonds that have an international investor base and a large network of dealers should be more liquid than domestic issues.

Several recent papers find a positive relationship between corporate bond prices and their liquidity (e.g., Longstaff, Mithal, and Neis (2005), Chen, Lesmond, and Wei (2007), Bao, Pan, and Wang (2011)). For instance, Bao, Pan, and Wang argue that illiquidity is as least as important in explaining cross-sectional differences in corporate bond yield spreads as credit risk. In times of crisis, the contribution of illiquidity to yield spreads can overshadow credit risk. These findings imply that global bonds may command a liquidity premium relative to domestic bonds, in particular during liquidity crises.

2.1.2 Bond Market Segmentation

The original rationale for creating the global bond instrument in 1989 was bond market segmentation. The World Bank observed yield disparities on its dollar-denominated debt outstanding in the Eurobond market and in the U.S. market, and issued the first global bond to take advantage of these disparities. By virtue of trading in both the U.S. bond market and the Eurobond market, its global bonds would overcome market segmentation, become more liquid, and command a higher price (see, e.g., Karpur et al. (1997), Fabozzi and Mann (2005)).

Even today, explicit and implicit barriers to international investments may prevent full integration of Eurobond and U.S. domestic bond markets. Non-U.S. investors face significant costs associated with cross-border clearing and settlement if they invest directly in bonds in the U.S. domestic market. They may therefore prefer global bonds that can be traded and settled more efficiently.[10] U.S. investors, on the other hand, have to overcome several regulatory hurdles if they want to invest in Eurobonds. The U.S. Tax Equity and Fiscal Responsibility Act of 1982 attempts to discourage the holding of anonymous bearer instruments such as Eurobonds by imposing tax sanctions on the issuer and U.S. holders of these bonds. To satisfy regulatory requirements, Eurobonds are "locked up" for 40 days and offered exclusively to non-U.S. investors. As a result, Eurobonds are rarely held by U.S. investors, who prefer global bonds to gain exposure to the Eurobond market (Wood (2008)).

[10] U.S. investors settle global bond transactions through DTC as they would settle domestic bond transactions. Overseas investors settle global bond transactions through Clearstream or Euroclear as they would settle Eurobond transactions. Cross-market trades in global bonds are efficiently settled between the depositories.

Market segmentation could not only inhibit the liquidity of bonds traded only in one of the two markets, but it could also result in price disparities (see, e.g., Stulz (1981), Errunza and Losq (1985), Kim and Stulz (1992)). However, as long as global bonds can be traded in both the Eurobond market and the U.S. bond market, price disparities should not exceed a band determined by transaction costs. Since transactions costs are the ultimate factor limiting arbitrage between equivalent bonds traded in different markets, illiquidity and market segmentation are closely related.

2.2 Data

The data for this study come from several sources. The SDC database provides information on new issues, including bond type, issue size, and domestic and foreign issuance proceeds. I obtain information on all corporate bond issues that are offered by public corporations, denominated in U.S. dollars, and publically traded in the U.S. bond market, the Eurobond market, or both markets (global bonds). The sample is further restricted to bonds offered by global bond issuers. In addition, I keep only bonds that are straight, senior, non-convertible, non-asset backed, and without credit enhancements. Sample bonds are issued between January 1998 and December 2008, and have a maturity of five years or more at the time of issuance. Short-term notes are excluded because they are not comparable with longer-term bonds. Overall, 2329 new issues from SDC pass these filters, but the final sample is comprised of a subset of 930 bonds that are actively traded in secondary markets.

The source of secondary market prices for global and U.S. bonds is the Trade Reporting and Compliance Engine, commonly referred to as TRACE. Since June 2002, all broker-dealers active in the U.S. market have an obligation to report transactions in publicly registered corporate bonds to TRACE. Because global bonds, like U.S. domestic public bonds, are registered with the SEC, they are subject to TRACE reporting and dissemination. Eurobonds, in contrast, are not subject to TRACE reporting, and are not included in the sample. The information disseminated by TRACE includes bond CUSIP, transaction price, date, time, and volume. I complement this data with bond descriptive information and bond ratings from the Fixed Income Securities Database (FISD).

The sample of secondary market transactions starts in 2003, the first full year of TRACE reporting. It is comprised of a subset of actively traded bonds. Specifically, a global (domestic) bond is required to trade on the same day as another domestic (global) bond of the same issuer in order to enter the sample. Further, sample bonds are required to have at least 5 years to maturity at the time of trading. There are 930 such bonds issued by 135 issuers; 480 are global bonds and 450 are U.S. domestic bonds. The issuers of the sample bonds are typically well-known corporations with multinational operations and global reputation. Appendix A provides the names of the 45 largest issuers.

Several filters are applied to the sample trades. First, only trades on volume of $100,000 or greater are included. Retail-sized trades are discarded because their transaction costs account for a non-negligible percentage of the traded price (see, e.g., Edwards et al. (2007)). Nevertheless, even retail trades are considered when calculating measures of corporate bond liquidity. In addition, the data are purged of trade reports that were subject to corrections, are missing key information, include commission in the price, were entered by multiple dealers, or appear to be outliers. To identify outliers in the transactions data, I employ the algorithm proposed by Brownlees and Gallo (2006):

$$\left(p_i - \bar{p}_i(30)\right) > 3s_i(30) + \ 0.5 = true, observation\ i\ is\ removed, \qquad (12)$$

where $\bar{p}_i(30)$ and $s_i(30)$ denote respectively the sample mean and sample standard deviation of a neighborhood of 30 observations around observation i, trimmed by excluding the minimum and the maximum values. The value of 0.5 is added to avoid zero variances produced by sequences of equal prices. The idea behind the algorithm is to assess the validity of an observation on the basis of its relative distance from a neighborhood of the closest valid observations for a given bond. The algorithm removes 0.6% of trades from the sample. Altogether, there are 558,362 valid trades in the sample. These trades take place between January 2003 and March 2009 (see Table 2.1).

In order to compare prices of bonds that do not mature exactly on the same day, I transform bond prices into spreads over U.S. Treasury yields. Prices are first adjusted for accrued interest and converted into yields to maturity. Then, yield spreads are calculated by subtracting the nearest corresponding constant maturity Treasury rates from the yields.

Table 2.2 provides summary statistics for sample bonds. All sample bonds are large, but the average global bond issue of $1,652 million is more than two times larger than the average domestic bond issue of $712 million. Foreign placements amount to 32.4% of the total proceeds for the average global bond, and 10.5% for the average domestic bond. The foreign placements for domestic bonds are private placements. Whereas the median domestic bond involves no foreign placements, 39.4% of the proceeds from the median global bond come from non-U.S. investors.

Also shown in Table 2.2 are trading yields and yield spreads. The summary measures have been obtained by first averaging yields and spreads across all sample trades for each bond and then across bonds. Trading yields are 5.95% for the average global bond, and 6.10% for the average domestic bond. Trading yield spreads average 2.28% for global bonds, and 2.43% for domestic bonds, but they change greatly over the sample period. The spreads range from just above 1% in January 2003 to more than 6% in September 2008. The summary statistics further suggest that yield spreads tend to be lower for global bonds than for domestic bonds, but a simple comparison of yield spreads without controlling for issuer and time effects could be misleading.

The summary table indicates next that global and U.S. bonds are comparable with respect to their maturity, embedded call options, and ratings. A large part of the sample bonds are callable, and the call option feature must be taken into account in the analysis. It is also important to control for differences in bond age. Global bonds tend to have a lower age (1.37 years) than domestic bonds (3.23 years) because firms rarely offer domestic bonds again after issuing global bonds.

2.3 Empirical Analysis

2.3.1 Secondary Market Prices

Prior research shows that global bond offerings are associated with higher prices and lower borrowing costs than comparable domestic offerings (Miller and

Puthenpurackal (2005)). However, different offer prices of global and domestic bonds do not necessarily imply that secondary market prices also differ. The prices of new corporate bond issues could also be affected by transitory factors such as underpricing (Cai et al. (2009)) or issuance price pressure (Newman and Rierson (2004)). Underpricing could be less prevalent among new global issues if there is better information dissemination surrounding global offerings or more competition among underwriters for global issues. Issuance price pressure may be smaller for global issues if the supply shocks associated with large bond offerings are in part absorbed by foreign investors.

To examine whether investors value more highly bonds that allow for multimarket trading, this section compares the trading prices of global and domestic bonds in secondary markets. As a first step in the analysis of trading yield spreads, I form a sample of trades in global and domestic bonds of the same issuer that occur on one day. In order to enter the sample, a global (domestic) bond is required to trade on the same day as another domestic (global) bond of the same issuer. However, the bonds may have different maturities and embedded call options. I use two methods to control for these characteristics. First, I create a paired sample of bonds that have no call options and mature within two years from each other. I conduct paired t-tests to examine if the bonds trade at different yields. The second method uses panel regressions to relate yield differentials to differences in bond characteristics.

Table 2.3 presents the results of paired t-tests. I construct a sample of 137 option-free bond pairs matched by issuer and time to maturity, and calculate the average difference in trading yield spreads for each pair of bonds. Presented are the mean and the median of the differences, t-test for the significance of the difference, and results of the non-parametric Wilcoxon signed rank test. The mean difference for the whole matched sample is negative and statistically significant. Global bonds trade on average at yield spreads 22 basis points below those on comparable domestic bonds of the same issuers. However, the mean difference is much greater for below-investment grade bonds (-61 basis points) than for investment grade bonds (-21 basis points). The difference is negative and significant in all sample years, but it is larger during the turbulent years of 2008 and 2009.

The paired t-tests offer a simple method of testing for differences in yields, but restrict the sample to a small number of non-callable bonds with similar maturities. In addition, they do not allow me to relate yield differentials to bond liquidity. Next, I estimate panel regressions that address these concerns. The regression model is as follows:

$$\widetilde{Yield\ Spread}_{ijdt} = \beta_0 + \beta_1 \widetilde{Global}_{ijdt} + \beta_2 \widetilde{Maturity}_{ijdt} + \beta_3 (\widetilde{Maturity}_{ijdt})^2 + \beta_4 \widetilde{Call\ Option}_{ijdt} + \varepsilon_{ijdt}, \tag{13}$$

where each observation on the *i*-th issue of firm *j* has been transformed by subtracting the panel mean for all bonds of firm *j* traded on day *d* (i.e. the issuer/day fixed effect). The transformation within each panel removes the firm-specific effect that may be correlated with the error terms. It is akin to computing the mean of the differences in spreads between global and domestic bonds of one issuer traded on the same day, and testing if the mean difference is statistically different from zero. However, the fixed effects transformation allows for the difference in spreads between bonds to be explained by a vector of independent variables. The vector includes controls for the maturity structure of credit spreads and embedded call options.

Table 2.4 presents the parameter estimates. Reported are also robust t-statistics adjusted for clustering by bond (i.e. both within and between panels). The coefficient on global is -23.8 basis points, significant at the 1 percent level, showing that global bonds trade at lower yield spreads (i.e. higher prices) than comparable domestic bonds issued by the same firms. If the sample is divided into 888 investment grade bonds and 116 speculative grade bonds, global bonds in both subsamples earn significantly lower yield spreads. However, the effect of global trading is much smaller in absolute value for investment grade bonds (-11.6 basis points) than for non-investment grade bonds[11] (-51.5 basis points). This finding is in accordance with the liquidity hypothesis. Most prior studies of corporate bond liquidity find that illiquidity has a stronger impact on speculative grade bond prices than on investment grade bond prices (e.g., Longstaff, Mithal, and Neis (2005), Chen, Lesmond, and Wei (2007)).

In line with Merton's (1974) model of the maturity structure of credit risk, time to maturity has a significant positive effect on yield spreads of investment grade bonds. Yield spreads of speculative bonds also increase with time to maturity, which agrees with the findings of e.g., Helwege (2002), and Chen et al. (2007). The contribution of the call option feature to yield spreads is positive, and it is larger for speculative grade bonds (29

[11] Most speculative bonds are issued as investment grade bonds but later enter the speculative sample due to downgrades.

basis points) than for investment grade bonds (6 basis points). These estimates are in agreement with the findings of King (2002) regarding call option values implicit in U.S. corporate bonds. Overall, the regression model explains 18% of the differences in yield spreads between different bonds of the same issuers, and the contribution of the global dummy to the R-squared is around 2%.

In order to better understand the factors explaining the yield spread between global and domestic bonds, I estimate Equation (13) year-by-year and conditional on the occurrence of a liquidity crisis. A liquidity crisis is said to occur when the spread between the three-month LIBOR and the three-month Treasury bill rate (the TED spread) exceeds 2%. This definition of crisis corresponds to roughly 5% of the sample days, mostly during the second half of 2008 and in 2009. As the estimates in Table 2.5 show, the yield spread between global and domestic bonds remains negative over the entire sample period from 2003 to 2009, ranging from 20 to 45 basis points. However, some of the greatest spreads are observed during the liquidity crisis. During the crisis period, global bonds trade at yields 74 basis points below domestic bonds, which is greater than the average difference of 24 basis points. These observations suggest that the price difference between global and domestic bonds could be related to liquidity.

2.3.2 Global and Domestic Bond Liquidity

The major argument in favor of global bond issuance is greater liquidity. Global bonds could be more liquid because they are larger issues, or because they have a greater number of market makers and a wider investor base. This section examines whether global bonds are more liquid than bonds issued in the U.S. domestic market by the same corporations. I also test if liquidity is related to the yield spread between global and domestic bonds.

Liquidity has multiple dimensions, and many alternative measures of corporate bond liquidity have been proposed in the literature. Therefore, I compute multiple liquidity measures, including bond age, principal, trading volume, trading frequency, price volatility, the price impact of trades, and the autocovariance of daily returns. Bond age and principal are widely used liquidity proxies that do not require transaction data. Alexander et al. (2000) and Edwards et al. (2007) show that trading volume of corporate bonds declines as they become older and settle into institutional portfolios. I measure bond age at the time of trading in years, and total principal issued in all markets in millions of dollars (see Table 2.2).

The transaction-based measures of corporate bond liquidity use data from TRACE for the U.S. bond market complemented with additional information from TRAX for the Eurobond market. I compute the monthly trading volume in the U.S. bond market as the sum of trading volume from all TRACE transactions over a period of 20 trading days preceding each observation. For confidentiality reasons, TRACE does not disseminate the exact trading volume for transactions larger than the cap value of $5 million ($1 million for high yield bonds). I assume that the actual transaction volume is equal to the cap value. The monthly trading volume for the Eurobond market is obtained by multiplying the average daily volume for the previous month provided by TRAX by 20. In contrast to reporting to TRACE, which is mandatory for all broker-dealers registered in the U.S., only ICMA members have an obligation to report their trades to TRAX[12]. Thus, the TRAX volume may be an imperfect proxy for trading activity in the Eurobond market. The total trading volume is estimated for each bond as the sum the TRACE and TRAX volumes.

Next, I compute three measures of trading frequency: The monthly number of trades from TRACE, the monthly number of large trades from TRACE, and the monthly number of zero-volume days by counting days on which no large trades occur. Large trades are defined as transactions on volume of $100,000 or greater. Smaller, retail-sized trades may not be indicative of greater liquidity (see, e.g., Edwards et al. (2007)). The number of zero volume days is counted over the last 20 trading days preceding each trade, and only large trades are counted.

Price volatility is related to liquidity through dealer inventory risk (see, e.g., Stoll (1978)). I compute two measures of price volatility: the monthly price range as a percentage of the average price, and the coefficient of variation of the transaction price. The coefficient of variation is the monthly standard deviation scaled by the average price. Both measures are computed from intraday price changes over the period of 20 trading days preceding an observation, and only large trades are used in their calculation.

Further, I consider two return-based measures derived from daily closing prices: the Amihud ratio and the gamma measure. Let P_t denote the closing price on day t, adjusted for the interest accrued since the last coupon date. Closing prices are obtained from the last large transaction on each day. For bonds trading on two consecutive

[12] The ICMA currently has 400 members in 50 countries, and its TRAX system covers the greater part of the over-the-counter market for international securities.

business days, I calculate the daily percentage return as $r_t = 100*(\ln P_t - \ln P_{t-1})$. Both return-based measures are computed only for the subset of bonds with 15 or more daily return observations over a 20-day period.

Liquidity can be defined as the ability to buy or sell an asset in large quantity quickly and without affecting the market price. To measure illiquidity as the price impact of trading, I calculate the ratio proposed by Amihud (2002):

$$Amihud = \frac{Abs(r_t)}{V_t}, \tag{14}$$

where V_t is the daily trading volume measured in millions of dollars. The Amihud ratio is calculated for each non-zero return day, and averaged over the period of 20 business days.

Finally, I construct a liquidity measure from the autocovariance in returns. Roll (1984) first considered a similar measure as a proxy for the bid-ask spread, but Bao, Pan, and Wang (2011) argue that the measure can capture additional aspects of liquidity such as market depth and resilience. Furthermore, Bao et al. also show that the measure explains individual bond yield spreads with large economic significance. Following Bao et al., I define the measure of illiquidity γ by:

$$\gamma_{20} = -Cov(r_{t,} r_{t-1}). \tag{15}$$

The trade-based liquidity measures are summarized in Table 2.6. Trading volume is several times greater for global bonds than for domestic bonds. The average monthly trading volume for the median global bond is $74.2 million, whereas the median domestic bond has an average monthly trading volume of $14.48 million. The median global bond trades 104 times per month, of which 40 trades are large (on volume of at least $100,000). In contrast, the median domestic bond trades only 30 times per month, of which merely 10 trades are large. Considering only large trades, the number of zero volume days per trading month is 15 for the median domestic bond, and 7.6 for the median global bond. Thus, although global bonds are significantly more liquid than domestic bonds, they still do not trade on almost one out of three business days. This result reflects the well-known fact that illiquidity is much more important in the corporate bond market than in the stock market.

Table 2.6 further shows that prices of global bonds are less volatile than prices of domestic bonds. Global bonds have a significantly smaller price range and coefficient of variation. Next, the Amihud measure indicates that global bond prices are less impacted by large trades than domestic bond prices. The estimated price impact of trading $1 million is 59 basis points for the median global bond, and 74 basis points for the median domestic bond. Finally, global bonds exhibit significantly less illiquidity as measured by gamma. The median global bond in the sample has a gamma coefficient of 0.09, whereas the median domestic bond has a gamma of 0.29. Overall, the estimates of gamma are in the same range as those obtained by Bao et al. (2011) using only large trades.

The summary statistics indicate that global bonds are considerably more liquid than domestic bonds. However, it is not clear whether the liquidity advantage of global bonds is related to their multimarket trading, or if it merely reflects their larger issue size or other characteristics. Therefore, I further test whether global bonds are more liquid than domestic bonds after controlling for bond characteristics such as age, issue size, maturity, and embedded call options. Like in the analysis of yield spreads, I use issuer/day fixed effects to control for credit risk and other firm-specific determinants of liquidity. The dependent variables in these regressions are the log-transformed (except gamma and the number of zero-volume days) liquidity measures.

Table 2.7 contains the estimates. The first column shows that trading volume is larger for global bonds than for domestic bonds, even after taking into account the greater issue size of global bonds. Trading volume declines significantly as bonds age and settle in investors' portfolios. The total number of trades from TRACE is not significantly related to global issuance. It is greater for larger issues and bonds with embedded call options. However, the total number of trades may not be a good proxy for bond liquidity since the majority of trades are retail-sized. The number of large trades, which likely better measures liquidity, is positively related to global issuance. Additionally, the number of zero volume days is significantly smaller for global bonds than for domestic bonds.

The return-based liquidity measures also indicate that global securities are more liquid. Both the measures of price volatility, the price range and the coefficient of variation, are lower for global securities. The Amihud illiquidity, which is a proxy for the price impact of trading, is significantly lower for global bonds. As expected, illiquidity increases as bonds season, and larger issues are more liquid than smaller ones. Finally, the measure of price reversals (γ) is strongly negatively related to the global bond dummy variable, and the effect is highly statistically significant.

2.3.3 Liquidity and Bond Prices

Multiple liquidity measures indicate that global bonds have a liquidity advantage over domestic bonds. Therefore, I investigate next whether the liquidity measures are priced, and whether they can explain why investors require lower yields on global bonds. To examine these questions, I re-estimate the yield spread regressions (Equation (13)) with the liquidity measures among the dependent variables. The sample size is smaller than in Table 2.4 because return-based liquidity measures are only available for a subset of 528 bonds, of which 374 are global and 154 domestic bonds. However, the subsample yields similar coefficient estimates as the main sample without controlling for liquidity.

Table 2.8 contains the regression results. The yield spread between global and domestic bonds narrows sharply after controlling for liquidity. Thus, liquidity differences account for a major part of spread between global and domestic bonds issued by the same firms. The spread remains negative for the entire sample, but its size decreases from -28.4 basis points to -12.7 basis points. The spread for investment grade bonds narrows to -8.5 basis points, and the spread for speculative grade bonds becomes statistically insignificant.

Several liquidity measures, particularly the trade-based liquidity measures, are priced in the cross-section. Bond age has a significant positive effect on yield spreads, and each additional year since issuance increases the required yield by 4.5 basis points. A greater number of zero-volume days also increases yield spreads. Among the return-based measures, the coefficient of variation, Amihud illiquidity, and gamma have a strong positive effect on yield spreads. The coefficient of variation in intraday bond prices is priced, and its effect is larger on speculative grade bonds than on investment grade bonds. Further, investors require higher yields on bonds that are subject to a greater price impact of trades, as measured by the Amihud illiquidity. Again, this is particularly true for speculative grade bonds. Finally, the measure of price reversals (γ) advocated by Bao et al. (2011) is priced, and contributes to explaining yield spreads between global and domestic bonds.

Overall, the liquidity measures explain about 20% of the cross-sectional variation in yield spreads between different bonds issued by the same firms. The return-based measures contribute most to the explained variation, with the Amihud measure and gamma explaining roughly 5% each. Some of the other liquidity proxies, including bond principal, trading volume, and price range are not significantly priced after controlling for the return-based measures, and the number of trades enters the regression with a positive sign. This mirrors the findings in Bao et al. (2011) that many liquidity measures are insignificant once gamma is included in the regression, and zero return days come in with the wrong sign.

2.4 Discussion and Conclusions

Large multinational corporations increasingly raise funds by issuing global bonds. Global bonds resemble U.S. domestic bonds, but their distinctive features allow global bonds to be traded in multiple markets. They are placed simultaneously with U.S. and overseas investors, and can be traded in the U.S. bond market and the Eurobond market, as well as between markets. However, the effects of multimarket trading on corporate bond value are not well understood. This paper examines how multimarket trading affects corporate bond liquidity and prices in secondary markets.

The results confirm the hypothesis that multimarket trading improves corporate bond liquidity. Compared to domestic bonds issued by the same firms, global bonds are more liquid. They exhibit greater trading volumes in the U.S. bond market and in the Eurobond market, trade more frequently, and their prices are less volatile. Furthermore, the price impact of large trades is significantly reduced for global bonds, and the transitory price movements that lead to negatively serially correlated price changes are much smaller. The liquidity advantage of global bonds persists even after controlling for their greater issue size and other characteristics, and it can be attributed to the effects of multimarket trading. These findings are consistent with microstructure models that predict a positive relationship between the number of potential investors and liquidity in over-the-counter markets (e.g., Duffie, Garleanu, and Pedersen (2005, 2007)).

In addition, the liquidity advantage of global bonds is priced. I find that if two bonds of the same issuer, one global and one domestic, trade on the same day, the yield on the global bond is on average 23.8 basis points lower. The yield difference is greater for speculative grade bonds (-51.5 basis points) than for investment grade bonds (-11.6 basis points), and it increases during liquidity crises. Consistent with the liquidity hypothesis, the spread between global and domestic bonds is closely related to the differences in liquidity. In particular, several trade-based liquidity measures explain a large part of the yield difference between global and domestic bonds, and up to 20% of the cross-sectional variation in yield spreads between different bonds issued by the same firms.

Overall, the results show that investors value global bonds for their greater liquidity. The liquidity advantage of global bonds helps to explain prior evidence that global bond issues reduce the cost of debt (Miller and Puthenpurackal (2005)). The findings also contribute to our understanding of the factors that affect corporate bond liquidity. Specifically, the difference in liquidity and prices between global and domestic bonds implies that market segmentation inhibits corporate bond liquidity, and it has an important wealth impact on issuers and investors. International securities can overcome market segmentation, which can explain why global bonds have become in recent years the most preferred type of bonds for large corporations.

2.5 Appendix A: The 45 Largest Issuers of Sample Bonds

Parent CUSIP	Parent	Sample Trades	Sample Bonds	Credit Rating
617446	Morgan Stanley Dean Witter	4055	25	Inv
25746U	Dominion Resources Inc	3891	23	Inv
842587	Southern Co	1095	21	Inv
025537	American Electric Power Inc	602	19	Inv
060505	Bank of America Corp	32974	19	Inv
524908	Lehman Brothers Holdings Inc	14585	19	Inv/Spec
209115	Consolidated Edison Inc	2087	17	Inv
345370	Ford Motor Co	61734	17	Inv/Spec
149123	Caterpillar Inc	6894	16	Inv
264399	Duke Energy Corp	3544	16	Inv
590188	Merrill Lynch & Co Inc	24042	16	Inv
87612E	Target Corp	15516	16	Inv
026874	AIG	9148	15	Inv
00206R	AT&T Inc	2127	15	Inv
370442	General Motors Corp	127326	15	Inv/Spec
46625H	JPMorgan Chase & Co	12529	14	Inv
580135	McDonald's Corp	4002	14	Inv
78442P	SLM Corp	12767	13	Inv
035229	Anheuser-Busch Cos Inc	2040	12	Inv
125581	CIT Group Inc	10871	12	Inv/Spec
225401	Credit Suisse Group	13273	12	Inv
892331	Toyota Motor Corp	2237	12	Inv
92343V	Verizon Communications Inc	11215	12	Inv
949746	Wells Fargo,San Francisco,CA	3923	12	Inv
126408	CSX Corp	1712	11	Inv
438516	Honeywell International Inc	2108	11	Inv
98385X	XTO Energy Inc	3280	11	Inv
02209S	Altria Group Inc	17015	10	Inv
404280	HSBC	8013	10	Inv
494550	Kinder Morgan Energy Partners	2477	10	Inv
12189T	Burlington Northern Santa Fe	1923	9	Inv
244199	Deere & Co	3643	9	Inv
319963	First Data Corp	4653	9	Inv
441815	Household International Inc	646	9	Inv
45031U	iStar Financial Inc	1615	9	Inv/Spec
49811T	AIG Life Holdings (US) Inc	3941	8	Inv
079860	BellSouth Corp	11483	8	Inv
136375	Canadian National Railway Co	331	8	Inv
172967	Citigroup Inc	538	8	Inv
40414L	HCP Inc	647	8	Inv/Spec
929903	Wachovia Corp,Charlotte,NC	3034	8	Inv
002824	Abbott Laboratories	8217	7	Inv

136385	Canadian Natural Resources Ltd	658	7	Inv
263534	DuPont	8393	7	Inv

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Table 2.1 Sample of Secondary Market Transactions (TRACE Sample)

The table shows the distribution over time of the sample of secondary market transactions from TRACE. The sample is made up of transactions in U.S. and global bonds matched by issuer and trading day that occur between January 2003 and March 2009. The bonds are U.S. dollar-denominated, fixed coupon straight bonds with at least 5 years to maturity at the time of trading, senior and unsecured. All sample trades are on volume of $100,000 or greater.

Trading	Bond Type		
Year	Global	U.S.	Total
2003	31584	23076	54660
2004	37193	24115	61308
2005	75014	43674	118688
2006	61347	34550	95897
2007	61356	33948	95304
2008	70939	36965	107904
2009	15726	8875	24601
Total	353159	205203	558362

Table 2.2 Summary Statistics

The table summarizes information for sample bonds. The SDC data base provides information on new issues, including bond type, total principal issued, and foreign placements. Total principal is the principal amount placed in all markets. Foreign principal as % of total principal shows the percentage of the total principal issued that is initially placed with non-U.S. investors. Trading yields and yield spreads are derived from secondary market transaction prices reported on TRACE. The summary measures are computed by first averaging across the sample trades for each bond and then across bonds. Differences marked with ** (*) are significant at the 5% (10%) levels.

	Sample Mean			Sample Median		
	Global	Domestic	Difference	Global	Domestic	Difference
Total principal ($ M)	1652.42	712.08	940.34**	1197.25	462.05	735.20**
Foreign principal as % of total principal	32.37	10.54	21.83**	39.44	0.00	39.44**
Trading yield (%)	5.95	6.10	-0.16*	5.79	5.93	-0.14*
Trading yield spread (%)	2.28	2.43	-0.15*	1.87	2.05	-0.18**
Time to maturity (yrs at time of trading)	10.51	10.58	-0.07	7.82	7.05	0.77
Age (yrs at time of trading)	1.37	3.23	-1.86**	0.86	2.66	-1.80**
% of callable bonds	0.63	0.68	-0.04	1.00	1.00	0.00
% of investment grade bonds (when traded)	0.85	0.84	0.01	1.00	1.00	0.00
No. of sample trades per bond	736	456	280**	296	99	197**
No. of bonds (930)	480	450	-	480	450	-
No. of issuers (135)	135	135	-	135	135	-

Table 2.3 Analysis of Trading Yield Spreads: Paired T-tests

The table shows mean and median differences of yield spreads for a paired sample of 137 global and domestic bonds. The bonds making up the pairs are non-callable and mature within two years from each other. Also shown is the paired t-test for differences in yield spreads between global and domestic bonds, and the Wilcoxon signed rank test. Mean (median) differences marked with ** (*) are significant at the 5% (10%) levels according to the t-test (Wilcoxon signed rank test).

	No of Matched Pairs	Mean Difference (%)	T-statistic	Median Difference (%)
		All Bonds		
All bonds	137	-0.22**	-5.31	-0.09**
		By Rating		
Investment grade	132	-0.21**	-5.19	-0.09**
Speculative grade	25	-0.61*	-1.82	-0.24*
		By Year of Trading		
2003	26	-0.41**	-2.60	-0.12**
2004	25	-0.13**	-2.34	-0.10**
2005	36	-0.07*	-1.93	-0.05*
2006	61	-0.07**	-3.01	-0.05**
2007	76	-0.05*	-1.81	-0.04**
2008	71	-0.26**	-3.82	-0.14**
2009	32	-0.50*	-1.81	-0.31**

Table 2.4 Analysis of Trading Yield Spreads: Panel Regressions with Issuer/Day Fixed Effects

The table presents estimates from regressions of trading yield spreads on a dummy variable that takes a value of one for global bonds, and on controls for the maturity structure of credit spreads and embedded call options. The regressions are estimated on panel data transformed by subtracting the issuer/day fixed effects from all transactions in bonds of an issuer that occur on the same day. Robust t-statistics adjusted for clustering by bond are in parentheses. Coefficients marked with ** (*) are significant at the 5% (10%) levels.

	All Bonds	Investment Grade	Speculative Grade
Global bond	-0.238**	-0.116**	-0.515**
	(-4.760)	(-4.520)	(-2.970)
Maturity (yrs)	0.103**	0.086**	0.092**
	(5.420)	(9.470)	(2.090)
Maturity squared	-0.002**	-0.002**	-0.002
	(-4.560)	(-8.070)	(-1.510)
Callable bond	0.205**	0.063*	0.287
	(2.150)	(1.910)	(1.410)
R-squared	0.18	0.18	0.21
No. of trades	558362	412045	146317
No. of bonds	930	888	116
No. of issuers	135	127	18

Table 2.5 Yield Differentials by Year and during Liquidity Crisis

The table presents year-by-year coefficient estimates of the difference between global and domestic yield spreads from the model in Table 2.4. Liquidity crisis refers to the period when the spread between the three month LIBOR and the three-month Treasury bill rate exceeds 2%. Robust t-statistics adjusted for clustering by bond are in parentheses. Coefficients marked with ** (*) are significant at the 5% (10%) levels.

Time Period	Global Bond	No. of Trades	No. of Bonds	R-squared
2003	-0.368**	54660	190	0.344
	(-3.340)			
2004	-0.174**	61308	210	0.686
	(-3.670)			
2005	-0.200*	118688	241	0.329
	(-2.040)			
2006	-0.451**	95897	365	0.398
	(-3.260)			
2007	-0.082	95304	609	0.189
	(-1.580)			
2008	-0.321**	107904	674	0.091
	(-4.990)			
2009	-0.255**	24601	485	0.117
	(-4.790)			
01/2003 - 03/2009	-0.238**	558362	930	0.177
	(-4.760)			
Liquidity Crisis	-0.739**	24549	549	0.194
	(-5.840)			

Table 2.6 Summary of Liquidity Measures

The table presents summary statistics for the transaction-based measures of corporate bond liquidity. Monthly volume is the total volume in the U.S. bond market and the Eurobond market. Other liquidity measures are based on data from the U.S. bond market. Large trades are trades on volume of $100,000 or greater. Price range is scaled by the average price. Coefficient of variation is the standard deviation of price scaled by the average price. Amihud illiquidity is defined as the price range divided by the total volume in millions of dollars. Gamma is the negative of the autocovariance in daily returns. Only large trades are used to compute the number of zero volume days, price range, coefficient of variation, Amihud illiquidity, and gamma. Gamma and Amihud illiquidity are only available for a sample of 528 bonds. Differences marked with ** (*) are significant at the 5% (10%) levels.

	Sample Mean			Sample Median		
	Global	Domestic	Difference	Global	Domestic	Difference
Monthly volume ($M)	124.30	46.20	78.09**	74.20	14.48	59.72**
Monthly # of trades	186.23	79.93	106.30**	104.36	29.76	74.60**
Monthly # of large trades	59.07	21.92	37.15**	40.23	10.05	30.18**
Monthly # of zero volume days	8.11	13.63	-5.52**	7.57	15.00	-7.43**
Price range (%)	6.59	9.64	-3.05**	4.93	6.02	-1.09**
Coefficient of variation (%)	1.80	2.88	-1.08**	1.34	1.92	-0.58**
No. of bonds (930)	480	450		480	450	
Amihud illiquidity (%)	0.67	0.87	-0.20**	0.59	0.74	-0.15**
Gamma (%)	0.26	0.66	-0.40**	0.09	0.29	-0.20**
No. of bonds (528)	374	154		374	154	

Table 2.7 Liquidity of Global Bonds: Panel Regressions with Issuer/Day Fixed Effects

The table presents estimates from regressions of several measures of corporate bond liquidity on a dummy variable that equals one if the bond is global, and on controls for bond age, issue size (principal), bond maturity, and embedded call options. The dependent variables are the log-transformed (except for gamma and zero-volume days) liquidity measures. The regressions are estimated on panel data transformed by subtracting the issuer/day fixed effects from all transactions in bonds of an issuer that occur on the same day. Robust t-statistics adjusted for clustering by bond are in parentheses. Coefficients marked with ** (*) are significant at the 5% (10%) levels.

	Dependent Variable							
	Total Trading Volume	No. of Trades	No. of Large Trades	Zero Volume Days	Price Range	Coef. of Variation	Amihud Illiquidity	Gamma
Global bond	0.264**	0.017	0.120*	-1.189**	-0.003**	-0.016**	-0.017**	-0.968**
	(2.55)	(0.24)	(1.70)	(-5.99)	(-2.40)	(-2.76)	(-4.99)	(-7.15)
Age	-0.171**	0.017	-0.078**	0.193**	-0.037**	0.012**	0.032**	0.065**
	(-10.07)	(0.93)	(-5.37)	(3.26)	(-7.87)	(3.28)	(3.58)	(2.04)
Principal (log)	0.653**	0.454**	0.486**	-1.978**	-0.002*	-0.037**	-0.114**	-0.099
	(9.71)	(8.59)	(9.33)	(-9.72)	(-1.75)	(-7.87)	(-3.87)	(-0.860)
Maturity	0.009	-0.025	-0.013	0.137**	0.005**	0.055**	0.036**	0.149**
	(0.21)	(-1.37)	(-0.58)	(2.56)	(13.240)	(22.29)	(2.58)	(3.11)
Maturity squared	0.000	0.001	0.001	-0.003*	0.001**	-0.001**	-0.001**	-0.004**
	(0.38)	(1.14)	(0.98)	(-1.90)	(-10.57)	(-16.06)	(-2.61)	(-2.62)
Callable bond	0.037	0.257**	0.161*	-0.430	0.005**	0.030	0.059*	0.216*
	(0.36)	(2.96)	(1.97)	(-1.50)	(2.96)	(1.44)	(1.97)	(1.89)
R-squared	0.38	0.16	0.31	0.19	0.18	0.31	0.19	0.22
No. of trades	558362	558362	558362	558362	558362	558362	355357	355357
No. of bonds	930	930	930	930	930	930	528	528
No. of issuers	135	135	135	135	135	135	98	98

Table 2.8 Trading Yield Spreads and Liquidity: Panel Regressions with Issuer/Day Fixed Effects

The table presents estimates from regressions of trading yield spreads on a dummy variable that takes a value of one for global bonds, and on various measures of corporate bond liquidity. All the liquidity measures, except for age, gamma, and the number of zero-volume days, are log-transformed. Robust t-statistics adjusted for clustering by bond are in parentheses. Coefficients marked with ** (*) are significant at the 5% (10%) levels.

Variable	All Bonds	All Bonds	Investment Grade	Speculative Grade
Global bond	-0.284**	-0.127**	-0.085**	-0.172
	(-3.83)	(-2.51)	(-3.10)	(-0.95)
Maturity (yrs)	0.114**	0.014	0.072**	-0.077
	(4.81)	(0.65)	(6.87)	(-1.59)
Maturity squared	-0.003**	-0.001	-0.002**	0.002
	(-3.99)	(-1.02)	(-6.50)	(1.33)
Callable bond	0.215*	0.160*	0.049*	0.193
	(1.81)	(1.90)	(1.72)	(1.27)
Age		0.045**	0.048**	0.042
		(2.62)	(5.25)	(1.10)
Principal		-0.002	0.007	0.003
		(-0.04)	(0.22)	(0.03)
Trading volume		0.006	0.031	-0.203
		(0.12)	(1.52)	(-1.36)
No. of trades		0.343**	0.159**	0.630**
		(4.61)	(4.86)	(3.08)
Zero volume days		0.030**	0.020**	0.014
		(2.91)	(5.23)	(0.47)
Price range		1.185	0.020	1.287
		(0.74)	(0.02)	(0.55)
Coefficient of variation		0.982**	0.244**	1.609**
		(3.41)	(2.09)	(3.93)
Amihud illiquidity		0.733**	0.282**	1.175**
		(7.47)	(5.73)	(5.28)
Gamma		0.098**	0.067**	0.080**
		(4.97)	(3.04)	(2.65)
R-squared	0.21	0.41	0.42	0.49
No. of trades	355357	355357	226286	129071
No. of bonds	528	528	509	61
No. of issuers	98	98	94	12

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"Institutional Investors and Liquidity Risk", Job Market Paper, 5/2010.

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