ILLIQUIDITY EFFECTS AND ASSET PRICING: EVIDENCE FROM JAPAN

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ABSTRACT

This dissertation extends the work of Amihud (2002) and Acharya and Pedersen (2005) on the Japanese stock market, the largest equity market outside the *U.S.* It investigates not only the cross-sectional and time-series effects of illiquidity on stock returns, but also asset pricing with liquidity risk through a liquidity-adjusted *CAPM* on the first section stocks listed on the *Tokyo Stock Exchange* during the period 1976 ~ 1999. The illiquidity measure employed here is the "Amihud ratio" developed by Amihud (2002), since the daily stock return and trading value data used to compute the ratio are available for long time series in the Tokyo stock market. As Amihud (2002) and Acharya and Pedersen (2005) have found support that the Amihud ratio and liquidity risks derived from it are priced in the *U.S.* market, the purpose of this study is to see whether they are also priced in the Japanese market.

The first part of this dissertation examines the cross-sectional effects of illiquidity on stock returns, where the results from annual and monthly cross-sectional regressions show that the expected stock illiquidity positively affects expected stock return when controlling for liquidity, risk and some additional variables.

The second part is the time-series test of illiquidity effects. I find that the expected market illiquidity positively affects the expected return, while the unexpected market illiquidity is negatively related to the contemporaneous return on the whole market and also across size-based and *BM* ratio-based portfolios using either annual or monthly data. Monthly portfolio regressions also show size, *BM* and January effects from unexpected market illiquidity.

In the third part, asset pricing with liquidity risk is studied by testing the liquidity-adjusted *CAPM* proposed by Acharya and Pedersen (2005). Their model predicts that the stock return depends on its expected illiquidity, the market beta and three liquidity

betas, where the four betas are covariances between stock return or illiquidity with market return or illiquidity. The model is tested either in a constrained version restricted by the same risk premium for the four betas, or in an unconstrained version with different risk premium. Empirical evidence from the cross-sectional tests on the portfolios sorted by illiquidity, size and *BM*-ratio, show that the liquidity-adjusted *CAPM* does not seem to perform better than the standard *CAPM*. However, one source of liquidity risks, the liquidity sensitivity to market return, has a significant effect on portfolio returns.

CHAPTER I INTRODUCTION

1.1 Motivations and Contributions

Asset pricing theories and models have attracted wide attentions and extensive studies among academicians and practitioners. A variety of empirical measures have been used as proxies to capture certain aspects of market structure, firm characteristics or investor behavior in the capital markets. Among these, liquidity or illiquidity is of academic and practical concern because of its complication and its effects on stock return under different conditions of market structure, firm characteristics or investor behavior.

On one hand, market liquidity is defined in three aspects according to Kyle (1985):

(1) Tightness: the difference between trade price and actual price, usually measured as the bid-ask spread;

(2) Depth: the volume that can be traded at the current price level;

(3) Resiliency: the speed of convergence from the price level that has been brought about by random price changes.

On the other hand, Amihud and Mendelson (1991) decompose illiquidity costs into the following components:

(1) Bid-ask spread: dealers and market makers quote bid and ask prices, while public traders make orders with limit prices. The difference between the best price quoted on the sell side and that quoted on the buy side constitutes the bid-ask spread, which is inversely related to asset liquidity. It is the largest component of the market impact in a price-driven dealers' market like the *NASDAQ*.

(2) Market-impact costs: an intangible transaction cost defined as the price difference between the time the order is submitted and the time the actual trade occurs. It is

incurred when an investor trading a large quantity drives the market price up when buying, or down when selling, beyond the best bid and ask prices; the larger the order, the greater the price concession the seller has to make, and the greater the price premium the buyer has to pay for an immediate trade.

(3) Delay and search costs: also an intangible cost incurred when a trader delays the execution of a transaction in an attempt to accomplish better trading terms. These costs are significant in order-driven auction markets such as the *TSE*. The trader faces a tradeoff between transacting immediately and bearing the bid-ask spread and market impact costs, or opting for a better price and bearing the delay and search costs. Non-execution may result in high costs, since failure to fulfill the order can leave the investor without the security.

4) Direct (or tangible) transaction costs: include brokerage commissions, exchange fees, fees for post-trade settlement and transaction taxes.

Based on the above definition and decomposition of liquidity, numerous papers have studied liquidity effects in sophisticated theoretical frameworks. Among these, both Amihud and Mendelson (1980) and Glosten and Milgrom (1985) study sequential trade models with adverse selection costs and inventory costs, while Kyle (1985) studies the strategic trade model of continuous auction, to name a few.

With these theoretical models as a solid foundation, a large number of empirical studies employ various market microstructure measures to study the liquidity effects as well. Amihud and Mendelson (1986) and Eleswarapu (1997) use quoted bid-ask spreads, Chalmers and Kadlec (1998) use amortized spread, Brennan and Subrahmanyam (1996) use price impact and the fixed cost of trading, and Easley, Hvidkjaer and O'Hara (2002) use the probability of information-based trading (*PIN*). All of these papers document a positive relation between illiquidity and stock return.

As indicated by Amihud (2002), despite the relative accuracy of these liquidity measures, the data necessary for the calculation are difficult to acquire and may have a limited time span that is insufficient to meet the statistical requirements for asset pricing in most stock markets.

Although academic literature has also employed some easily available but less accurate proxies such as size, trading value and turnover, Lesmond (2002) points out that they may capture the effect of variables that are not related to liquidity.

Fortunately, the data limitation of these measures has been overcome by two new illiquidity measures: the incidence of zero returns created by Lesmond, Ogden and Trzcinka (1999) and the liquidity ratio (referred to as "Amihud ratio" thereafter) brought forward by Amihud (2002).

Lesmond, Ogden and Trzcinka (1999) present a model that requires only the time series of daily security returns to endogenously estimate the effective transaction costs using the incidence of zero returns. The rationale behind this estimate is that the informed trader's reservation price must exceed the transaction costs of each stock before informed trade will occur. Zero returns are observed if the transaction costs exceed the value of information for the informed trader. Hence, zero returns reflect the liquidity concerns of informed trade on security returns.

On the other hand, the Amihud ratio developed by Amihud (2002) is calculated as the ratio of the absolute daily return to the daily trading value for a specific stock. This is consistent with Kyle's (1985) concept of illiquidity, *i.e.* the response of price to order flow, and Silber's (1975) thinness measure, *i.e.* the ratio of absolute price change to absolute excess demand for trading. After comparing a few alternative liquidity measures, Hasbrouck (2002) concludes that the Amihud ratio appears to be the best proxy for liquidity. Serving as a rough measure of price impact, the Amihud ratio allows one to construct the kind of long time series of illiquidity data necessary for tests on stock return over time, which cannot be performed by traditional microstructure measures.

Although the "Lesmond measure" has gained empirical support from international evidence[1], the Amihud ratio has not. Moreover, very few studies have examined the illiquidity and stock return relationship over time. As pointed out by Amihud (2002), this is probably due to the fact that the illiquidity measures based on microstructure data are not available in most markets around the world for long time periods. In contrast, the Amihud ratio only uses daily data that are usually available in most markets over long periods of time, which are essential for the study of time series effects of liquidity. With this new measure, Amihud (2002) postulates and tests the hypotheses that over time, the ex ante stock excess return is increasing in expected illiquidity, while unexpected illiquidity lowers the contemporary stock return. His empirical results are consistent with these hypotheses.

Liquidity has been rendered with determinacy in previous theoretical studies on asset pricing; however, its empirical proxies seem to vary over time, *i.e.*, transaction costs are stochastic. Therefore, it is crucial to investigate the influence of the liquidity risk involved with this uncertainty other than beta risk on asset prices in equilibrium.

The Amihud ratio is employed by Acharya and Pedersen (2005) in testing their liquidity-adjusted *CAPM*. They propose that not only the level of illiquidity, but also the uncertainty of illiquidity, should be priced in the market. Their results indicate that three sources of illiquidity betas are priced and the liquidity-adjusted *CAPM* is better than the standard *CAPM* in terms of goodness-of-fit.

[1] Adopting the methodology in Lesmond, Ogden and Trzcinka (1999), Lesmond (2002) estimates liquidity measures in 31 emerging markets from 1991 to 2000. He finds that the liquidity measure is highly associated with the proportional bid-ask spread, and it increases with increasing trade difficulty. It is also superior to trade difficulty variables or turnover at explaining the spread-plus-commission costs.

Previous academicians (Chordia, Roll and Subrahmanyam (2000), Hasbrouck and Seppi (2001), and Huberman and Halka (2001)) have documented the phenomenon of "commonality-in-liquidity" that most stocks' illiquidity is positively related to market illiquidity, which is the first source of illiquidity betas. The second source is the return sensitivity to market illiquidity, which has a negative impact on the expected return. Theoretical and empirical supports for such an effect have been provided by Holmstrom and Tirole (2000), Lustig (2004), Pastor and Stambaugh (2003), and Wang (2003). The third source is the illiquidity sensitivity to market return that also has a negative impact on the expected return, and this was first put forward by Acharya and Pedersen (2005).

Although the Amihud ratio has been used in cross-sectional and time-series tests of illiquidity in Amihud (2002) and asset pricing with liquidity risk in Acharya and Pedersen (2005) using *U.S.* data, it has not been employed to test the illiquidity and stock return relationship outside the *U.S.* If the Amihud ratio is a simple but effective measure of illiquidity across markets and over time, and if illiquidity does have a general impact on stock returns over time as documented in the previous literature, the results of Amihud (2002) and Acharya and Pedersen (2005) should be replicable using data from outside the *U.S.*

Hence, I will focus on the second largest stock market in the world, next only to the *U.S.* market in terms of both market capitalization and number of securities --- the Japanese market --- to explore the reliability of the Amihud ratio as a liquidity measure in a study of illiquidity effects and asset pricing with liquidity risk. Despite its rapid growth after the reform of the financial system against the economic bubble, the Tokyo stock market has not received enough attention from academic researchers in either the asset pricing literature or the market microstructure literature, especially in liquidity.

As is pointed out in Chan, Hamao and Lakonishok (1991), who study the cross-sectional behavior of stock returns in the *Tokyo Stock Exchange* (*TSE* thereafter) using accounting variables which they name as "fundamentals," a study of the Japanese stock market alongside that of the *U.S.* is of importance to the evaluation and comparison of empirical models of the cross-section of stock returns. A confirmation of the same determinants in the two countries would strengthen the confidence in the evidence found in the *U.S.* market, while the distinctiveness of the determinants would induce further exploration of institutional or behavioral discrepancies between the two countries. In addition, evidence from the Japanese market may shed further light on the subsumption of explanatory variables and the robustness of time period and sample selection.

In a word, the study of Japanese stock market in this thesis is motivated by the fact that asset pricing in Japan is unique to a certain extent compared to the *U.S.* market, and that liquidity pricing may differ as well because of the differences of the market structure and the associated liquidity prevision between the two markets.

The following papers have study the Japanese market from various perspectives in the past decade. Chan, Hamao and Lakonishok (1991) relate cross-sectional differences in returns on Japanese stocks to the underlying behavior of earnings yield, size, book-to-market ratio, and cash flow yield. They find a significant relationship between these variables and expected returns in the Japanese market, which is largely consistent with findings in the *U.S.* Using market microstructure data from Japan, Lehmann and Modest (1994) offer a bird's eye view of trading and liquidity on the *TSE* and compare it with that on the *NYSE*. Hu (1997) finds a negative relation between turnover and expected returns of the *TSE* stocks. Bremer and Hiraki (1999) find the evidence linking short-term returns for individual *TSE* stocks and lagged trading volume, which is consistent with the results found in the *U.S.* stock market. Hodoshima *et al.* (2000) examine cross-sectional returns and beta in Japan. Hamori (2001) studies seasonality and stock returns in Japan. Ahn, Cai, Hamao and Ho (2002) find that stock returns are positively related to illiquidity measures. However, they also find a number of results that are different from those found on the *NYSE*.

Taking into account the literature, I examine (1) if the Amihud ratio is correlated with other readily available traditional liquidity proxies, and if the Amihud ratio is positively related to stock returns across companies in the following chapter; (3) if expected (unexpected) illiquidity is positively (negatively) related to expected (contemporaneous) stock returns in the third chapter; and (4) if liquidity-adjusted *CAPM* holds better than standard *CAPM* in Japan in the fourth chapter. The final chapter concludes the whole thesis.

My study provides international evidence for the relationship between stock returns and illiquidity; in addition, it is more than just a simple replication of the studies by Amihud (2002) and Acharya and Pedersen (2005) using data from the *TSE*. The procedure allows us to examine the international robustness of the theory and hence to compare the results with those for the *U.S.* evidence of the risk premia on multiple factors.

I not only take into consideration factors unique to the Japanese market in my test design, but also make separate regressions for observations of positive and negative market premium to see if the standard beta is priced in the data.

The remainder of this chapter is organized as follows: the following section provides a detailed literature review on liquidity (risk), liquidity effects, and related asset pricing theories. The final section discusses the similarities and discrepancies between the trading mechanisms in Japan and the *U.S*.

1.2 Literature Review

In this section, I will review both the market microstructure and asset pricing literature on liquidity and liquidity risks using data from various markets.

Theoretical market microstructure has two main sorts of asymmetric information models: sequential trade models in which randomly-selected traders arrive at the market singly, sequentially and independently (Amihud and Mendelson (1980), Glosten and Milgrom (1985)); and strategic trader models featuring a single informed agent who can trade at multiple times (Kyle (1985)).

In the sequential trade models of asymmetric information, a seller may concede a discount and a buyer may pay a premium when executing a market order; thus, adverse selection costs and inventory costs lead to illiquidity that is reflected in the impact of order flow on price. Amihud and Mendelson (1980) study market-making with inventory in a dealership market, and the characteristics of the optimal policy are embodied in the preferred inventory position and the downward monotonicity of the bid-ask prices. In comparison, Glosten and Milgrom (1985) study the relation of the bid-ask spread with transaction prices in a specialist market with heterogeneously informed traders. Bid-ask spread implies a divergence between observed returns and realizable returns.

The strategic trade model of asymmetric information, which is also described as "continuous auction", began with Kyle (1985). In a dynamic model of insider trading with sequential auctions, he examines the informational content of prices, the liquidity characteristics of a speculative market, and the value of private information to an insider. He shows that market makers set prices as an increasing function of the imbalance of order flow, as they cannot distinguish between those from informed traders and those from liquidity traders.

Based on these theoretical models, a large number of empirical studies have investigated the cross-sectional effect of illiquidity on expected stock returns, using a variety of liquidity measures (Amihud and Mendelson (1986), Eleswarapu (1997), Chalmers and Kadlec (1998), Brennan and Subrahmanyam (1996), Easley, Hvidkjaer and O'Hara (2002)). Amihud and Mendelson (1986) study *NYSE* and *AMEX* stocks during 1961~1980, while Eleswarapu (1997) studies *NASDAQ* stocks during 1974~1990. Both papers find a significant positive relation between quoted bid-ask spreads and stock returns. And the stronger evidence on the *NASDAQ* stocks is conjectured to be due to the dealers' inside spreads being a better proxy for the actual cost of transacting than the quoted spreads.

Amihud and Mendelson (1986) is a seminal paper that relates market microstructure to asset pricing literature. They put forth a theoretical model that delineates a positive relationship between stock return and its illiquidity measured by bid-ask spread in an economy where investors are heterogeneous in their expected holding periods. The key intuition of the model that investors with longer horizons tend to hold assets with relatively high spreads induces a concave relationship between return and spread.

Chalmers and Kadlec (1998) employ the amortized spread in their study which measures the spread's cost over investors' holding periods, which is approximately equal to the spread times share turnover. They find stronger evidence for pricing of amortized spreads than of unamortized spreads, in their examination for *AMEX* and *NYSE* stocks over the period 1983~1992.

Brennan and Subrahmanyam (1996) also find a positive relation between stock illiquidity and return when using the price impact and the fixed cost of trading as proxies. Price formation models suggest that privately informed investors create significant illiquidity costs for uninformed investors, thus implying higher required rates of return for illiquid securities.

Easley, Hvidkjaer and O'Hara (2002) introduce a new measure of microstructure risk, the probability of information-based trading (*PIN*), using the structure of the sequential trade model. The new measure reflects the adverse selection cost resulting from asymmetric information, as well as the risk that the stock price can deviate from its full information value. Estimated from intra-daily transaction data, *PIN* has a large positive and significant effect on stock returns.

Other than these market microstructure measures, there are still many other measures that can be used to proxy liquidity, such as size, trading value and turnover (Banz (1981), Reinganum (1981), Fama and French (1992), Brennan, Chordia and Subrahmanyam (1998), Datar, Naik and Radcliffe (1998), Chordia, Subrahmanyam and Anshuman (2001)). The market value, or size, can be related to liquidity since a larger stock issue has a smaller price impact and bid–ask spread for a given order flow. The negative relation between size and stock returns has been documented in many papers that study the size effect.

Banz (1981) claims that the "size effect" (that smaller firms have higher risk-adjusted returns than larger firms) is an evidence of the misspecification of *CAPM*. However, he cannot offer an explanation regarding whether it is size *per se* or unknown factors that are responsible for the effect. Reinganum (1981) documents empirical anomalies based on earnings yield and market values to suggest either the misspecification of *CAPM* or the inefficiency of the capital markets. He concludes that the two anomalies seem to be related to the same set of missing factors that are more associated with firm size. Moreover, Fama and French (1992) find that size and *BM* ratio combine to capture the cross-sectional variation of stock returns when controlling for market beta, leverage and earnings yield.

Brennan, Chordia and Subrahmanyam (1998) examine whether the non-risk characteristics have marginal explanatory power relative to the arbitrage pricing theory benchmark. They find that trading value not only has a significant negative effect, but subsumes the negative size effect on the cross-section of stock returns.

Datar, Naik and Radcliffe (1998) find that turnover rate plays a significant role in explaining the cross-sectional variation in stock returns after controlling for firm-size, book-to-market ratio and the firm beta in an alternative test of Amihud and Mendelson's (1986) model.

Motivated by the observation that the second moment of liquidity should be positively related to asset returns, Chordia, Subrahmanyam and Anshuman (2001) find a negative and surprisingly strong relation between stock returns and the variability of trading volume and share turnover after controlling for size, book-to-market ratio, momentum, etc.

Chan and Faff (2002) explore whether liquidity is priced in an Australian setting, using monthly data over the period 1990 to 1999. They find that liquidity (as proxied by turnover) is negatively related to stock returns, and its importance persists even after controlling for book-to-market, size, stock beta and momentum. They also show that turnover is not simply capturing the momentum effect but seems to be an adequate proxy for liquidity.

Piqueira (2004) analyzes the importance of trading activity in explaining cross-sectional variation in stock returns. They test the impact of trading activity in monthly stock returns, after controlling for the usual factors (firm size, book-to-market-ratio and momentum) and illiquidity costs from 1993 to 2002 for a large sample of *NYSE* and *NASDAQ* stocks. Their results provide evidence that higher turnover rates predict lower future returns and the effect of trading activity for glamour stocks is statistically and economically significant.

In a word, although previous literature has found positive relations between microstructure measures and stock return as well as negative relations between proxies using daily data and stock return, the fine microstructure measures of illiquidity require data on transactions and quotes that cannot be available for long periods of time in most of the stock markets, while the easily available daily measures may capture other effects beside liquidity.

The Amihud ratio developed in Amihud (2002) supplements the aforementioned measures. It uses daily data that are usually available in most markets over long periods of time, which is essential for asset pricing with liquidity effects. This ratio gives the absolute price change per dollar of trading value that follows Kyle's concept of illiquidity, *i.e.*, the response of price to order flow, and Silber's (1975) thinness measure, *i.e.*, the ratio of absolute price change to absolute excess demand for trading. It is also strongly related to the Amivest measure, which is the ratio of the sum of the daily volume to the sum of the absolute return, employed in Coopu, Goth and Avera (1985) and Khan and Baker (1993). Finally, the Amihud ratio is related to another interpretation of consensus belief in new information suggested by Harris and Raviv (1993), where the stock price changes without trading when investors agree about the implication of news, while disagreement induces an increase in trading volume.

Another measure that overcomes the two problems of the traditional liquidity proxies is developed by Lesmond *et al.* (1999). They present a model that requires only the time series of daily security returns to endogenously estimate the effective transaction costs using the incidence of zero returns. Zero returns are observed if the transaction costs exceed the value of information for the informed trader; hence, it reflects the liquidity concerns of informed trade on security returns. Their model provided continuous estimates of average round-trip transaction costs from 1963 to 1990 of 1.2% and 10.3% for large- and small-decile firms, respectively, which correlates highly (85%) with the most commonly used transaction cost estimators.

More recently, Bekaert, Harvey and Lundblad (2003) study liquidity and expected returns from emerging markets. Using the average proportion of zero daily returns as a measure of liquidity, they find that it significantly predicts future returns, and that unexpected liquidity shocks are positively correlated with return shocks and negatively correlated with shocks to the dividend yield.

Previous theoretical literature on asset pricing has endowed liquidity with stationarity (Amihud and Mendelson (1986), Constantinides (1986), Vayanos (1998), Vayanos and Vila (1999), Garleanu and Pedersen (2000), Huang (2002)). Vayanos (1998) studies the effects of transaction costs on asset prices and turnover using a dynamic equilibrium model. He finds that stock price may increase in transaction costs and a frequently traded stock may be less affected by increasing transaction costs. In line with this paper, Vayanos and Vila (1999) assume two riskless assets in the economy. When transaction costs increase, the price of the liquid one increases, while that of the illiquid one decreases if in small supply, but increases if in large supply.

Garleanu and Pedersen (2000) study the impact of present and future adverse selection costs on asset prices. Huang (2002) suggests that illiquidity can have large effects on asset returns when agents face liquidity shocks and borrowing constraints, which can help illustrate the reason that some securities have high liquidity premia despite low turnover.

On the contrary, empirical papers on liquidity allow the transaction costs to vary over time, both for individual stocks and for the market, and two implications from the liquidity-adjusted *CAPM* developed in Acharya and Pedersen (2005) have seen broad empirical support from previous studies.

Several papers document the well-known phenomenon of "commonality in liquidity", meaning that investors require a premium for an illiquid security in an illiquid market (Chordia, Roll and Subrahmanyam (2000), Hasbrouck and Seppi (2001), Huberman and Halka (2001)). Using daily data for *NYSE* stocks in 1992, Chordia, Roll and Subrahmanyam (2000) find that quoted spreads, quoted depth and effective spreads significantly co-move with market- and industry-wide liquidity after controlling for individual liquidity determinants such as volatility, trading volume and price.

Hasbrouck and Seppi (2001) investigate common factors in prices, order flows, and liquidity for 30 Dow stocks over 15-minute intervals during 1994. They find that commonality in the order flows explains roughly two-thirds of the commonality in returns, and liquidity proxies help explain time variation in trade impacts. Huberman and Halka (2001) document the presence of a systematic, time-varying component of liquidity for *NYSE* stocks in 1996 that neither the inventory-based nor the asymmetric information-based approach to liquidity could explain.

The pricing implication that the required excess return decreases on the covariance between the stock return and the market illiquidity results from the situation that investors would like to pay a premium for an asset with high return in an illiquid market (Holmstrom and Tirole (2000) and Lustig (2004) with theoretical supports;

Pastor and Stambaugh (2003), Sadka (2003) and Wang (2003) with empirical supports).

Theoretical studies of this effect arise in the models of Holmstrom and Tirole (2000) who examine implications of corporate demand for liquidity, and propose a liquidity-based asset pricing model (*LAPM*) that generates the above-mentioned effect. Another theoretical paper by Lustig (2004) studies the equilibrium implications of solvency constraints in the investigation of the market price of aggregate risk and the wealth distribution that educes the same effect.

Using monthly data over 34 years with a measure based on the return reversals-induced order flow, Pastor and Stambaugh (2003) find that expected stock returns are related to return sensitivities to market liquidity, and the average return on stocks with high liquidity risk exceeds that for stocks with low liquidity risk by 7.5% annually. Sadka (2003) demonstrates the importance of liquidity for asset pricing and especially for the momentum anomaly. He shows that systematic liquidity risk is important in explaining the cross-sectional variation of expected returns, and its compensation partially contributes to the momentum returns. Because a positive correlation exists between active participation from institutional investors and the market liquidity, Wang (2003) adopts aggregate institutional equity acquisitions as a proxy for market liquidity and finds that stocks whose returns are more sensitive to the liquidity shocks have higher returns to compensate for exposure to liquidity risk.

In the study of liquidity persistence that predicts future returns and co-moves with contemporaneous returns, Amihud (2002) finds a positive relation between expected illiquidity and expected return and a negative relation between unexpected illiquidity and contemporaneous return in the time-series tests. Amihud, Mendelson and Wood (1990) find that stocks whose liquidity worsened more during the 1987 crash had more negative returns, and that the crash was in part due to an increase in market illiquidity. Chordia, Roll and Subrahmanyam (2001), Chordia, Roll and Subrahmanyam (2000), Hasbrouck and Seppi (2001), Huberman and Halka (2001), Jones (2001), and Pastor and Stambaugh (2003) find a negative relation between market return and market illiquidity in time-series.

In particular, Jones (2001) assembles an annual time series of bid-ask spreads on Dow Jones stocks from 1898 to 1998, and presents evidence that high spreads and low turnover predict high stock return, up to one year ahead. Chordia, Roll and Subrahmanyam (2001) find that daily changes in market liquidity and trading activity are highly volatile and negatively serially dependent; liquidity plummets significantly in down markets and market volatility induces a decrease in trading activity and spreads.

Finally, academicians study the stocks listed on the *TSE* from market microstructure or asset pricing perspectives (Chan, Hamao and Lakonishok (1991), Lehmann and Modest (1994), Hu (1997), Bremer and Hiraki (1999), Hodoshima *et al.* (2000), Hamori (2001), Ahn, Cai, Hamao and Ho (2002)).

Chan, Hamao and Lakonishok (1991) relate cross-sectional differences in returns on Japanese stocks to the underlying behavior of earnings yield, size, book-to-market ratio, and cash flow yield. They find a significant relationship between these variables and expected returns in the Japanese market, which is largely consistent with findings in the *U.S.*

Using market microstructure data from Japan, Lehmann and Modest (1994) offer a bird's eye view of trading and liquidity on the *TSE* and compare it with that on the *NYSE*.

Consistent with the prediction that turnover measures investors' trading frequency, Hu (1997) reports a negative relation between turnover and expected return in his study of *TSE* stocks. His results are also consistent with the hypotheses that the cross-sectional expected return is a concave function of the turnover, while the time-series expected return is an increasing function of it.

Bremer and Hiraki (1999) apply a simple contrarian trading strategy to explore the evidence linking short-term returns for individual *TSE* stocks and lagged trading volume from January 1981 to June 1998. Consistent with the results for *U.S.* stock markets, they find that the *TSE* stocks with losses in week *t*-1 experience price reversals in week *t*; furthermore, the *TSE* loser stocks with high trading volume in week *t*-1 tend to have larger price reversals in the following week.

Hodoshima *et al.* (2000) examine cross-sectional returns and beta in Japan and claim that taking into account the difference between positive and negative market excess returns yields significant conditional relationships between return and beta.

Hamori (2001) studies seasonality and stock returns in Japan from 1971 to 1997. He reports that although the monthly effects on various indices are confirmed for the whole sample period, they disappear in the latter half of the period.

Ahn, Cai, Hamao and Ho (2002) find that stock returns are positively related to illiquidity measures. However, they also find a number of results that are different from those found on the *NYSE*.

Although the fundamental methodology of this thesis is based on two papers that study the *U.S.* market (Amihud (2002) and Acharya and Pedersen (2005)), taking into consideration those factors that are unique to the Japanese market or that have been documented by the above papers that have significant effects on Japanese stock returns will help us understand the similarities and differences between the two markets from the perspectives of market microstructure, firm characteristics as well as investor behavior.

1.3 Institutional Features

This section offers a detailed description of the trading mechanism of the *TSE*, especially those factors unique to the Japanese market that are essential for the study in this thesis that follows.

In recent years, limit-order trading has received growing attention as more exchanges like the *TSE* implement electronic limit-order books and open up the market-making process. Foucault (1999) offers an equilibrium model for order flow composition and trading costs in a limit-order market. Ahn, Bae and Chan (2001) analyze the interaction between transitory volatility and order flow composition on the Stock Exchange of Hong Kong. Chung, Van Ness and Van Ness (1999) and Kavajecz (1999) examine whether quoted spreads reflect the trading interest of specialists or limit-order traders. Ahn, Cai, Hamao and Ho (2002) analyze the components of the bid–ask spread in the limit-order book of the *TSE*. They find that both the adverse selection and order handling cost components exhibit *U*-shape patterns independently, and that the adverse selection cost increases with trade size while the order handling cost decreases with it. Thus, it is important to study the characteristics of limit-order trading to see if they will affect the sample selection in this thesis.

Bremer and Hiraki (1999) state that the trading mechanism of the *TSE* provides an interesting alternative model to those commonly followed in North American and European financial markets. Understanding its strengths and weaknesses as well as its similarities to and differences from more familiar markets will contribute to a better knowledge of how financial markets work in general.

Nishide (2004) discusses the liquidity of the auction market from the perspective of investors as well as suppliers of liquidity--market makers and market participants who place limit orders. From the investor's perspective, market liquidity in an auction market like the *TSE* is guaranteed by the depth of limit orders. The auction market works well and ensures high liquidity as long as the market is stable, but tends to break down under adverse conditions. From the perspective of liquidity providers, the execution of limit orders is uncertain, and adverse selection risk may arise if other participants have newer and better information. Moreover, the existence of limit orders can be explained by inventory cost or the existence of irrational investors and investment strategies that defy theory. Therefore, limit orders can be an effective strategy in a market where investors have different trading attitudes and risk tolerances.

Muranaga (2000) analyzes bid-ask spread, market impact and market resiliency as the three indicators of market liquidity, using tick-by-tick data for the first section stocks of the *TSE*. The cross-sectional analysis shows that trade frequency is positively correlated with each of the three indicators. After examining the various indicators for 55 days around the reduction in tick size of the *TSE* on April 13, 1998, they find that the tick-size change reduced the bid-ask spread and price volatility and increased trade frequency, thus improving market liquidity and efficiency.

Lehmann and Modest (1994) summarize in their introduction that there are roughly four aspects of contrasts between the trading mechanism of the *TSE* and that of the *U.S.* market as follows:

(1) Exchange-designated intermediaries (*saitori*) on the *TSE* can log limit orders and match them to market orders, but provide no market-making, while the specialists

on the *U.S.* market have affirmative obligations to provide continuous liquidity and to maintain a private limit order book with the public limit orders.

(2) Public limit orders on the *TSE* constitute the bids and offers, while specialists on the *U.S.* market offer quotes to both buy and sell.

(3) The market mechanism on the *TSE* places limits on the magnitude of consecutive prices, and liquidity is realized through temporary trading halts that induce additional liquidity and smooth quote adjustments, while specialists on the *U.S.* market supply sufficient liquidity.

(4) In Japan, trading in listed securities is largely consolidated on the *TSE*, and the regional exchanges are organized in the same manner; however, in the *U.S.*, there is spatial fragmentation for orders of different sizes and by different types of customers.

Tokyo Stock Exchange Fact Book 2004 offers a detailed description of the trading mechanism of the Exchange, as follows.

The *TSE* market operates as a continuous auction where buy and sell orders interact directly with one another. All limit and market orders are placed by broker/dealer trading participants and are matched in accordance with price priority and time priority rules.

Under the price priority rule, a sell (buy) order with the lowest (highest) price takes precedence. Under the time priority rule, an earlier order takes precedence over others at the same price. Thus, when the lowest sell and highest buy orders match in price, the transaction is executed at that price. In short, the *TSE* market is a pure order-driven market without market-makers.

There are two transaction methods on the *TSE*: the *itayose* and *zaraba* methods. The *itayose* method is used mainly to decide opening and closing prices, to which the time priority rule is not applied and in which numerous orders placed before price setting are matched in aggregate and will be executed at the opening price, regardless of size. In contrast, under the *zaraba* method, both the price priority and time priority rules are applied, and pairs of buy and sell orders are matched continuously.

In addition, the *TSE* adopts the following unique measures to prevent wild, short-term fluctuations in prices. These measures not only help ensure price continuity, but also in effect work as "circuit breakers" in an emergency:

(1) Special Bid and Ask Quotes

When there is a major imbalance in orders, special bid or ask quotes are indicated. Special quotes are disseminated publicly through the *TSE* market information system. If counter-orders come into the market and the orders are matched at that price, the quote is withdrawn. Conversely, if the imbalance continues, the special quotes are revised up or down within certain parameters, at intervals of at least five minutes, until the imbalance is resolved.

(2) Daily Price Limits

In addition to special quotes, the *TSE* sets daily price limits for individual stocks to prevent day-to-day wild swings in stock prices and to provide for "time-out" in the event of a sharp rise or decline in price and the resulting reaction from the investing public. Daily price limits are set in terms of absolute yen values, according to the price range of each stock. As the price limits prohibit bids and offers at prices beyond the set limits, the market for a stock is open for trading within these limits, even though the stock may have hit a limit. Daily price limits also apply to special quotes. Consequently, special quotes cannot be indicated outside the daily price limit.

Tables 1, 2 and 3 present the classifications for tick size, daily price limits and special quotes, respectively.

CHAPTER II THE CROSS-SECTIONAL EFFECTS OF ILLIQUIDITY ON JAPANESE STOCK RETURNS

2.1 Introduction

This chapter studies the cross-sectional effects of illiquidity on stock returns using data of the *TSE* stocks.

Previous market microstructure papers incorporate fine liquidity measures such as quoted bid-ask spread, amortized bid-ask spread, and *PIN* that cannot be available for long periods of time as indicated by Amihud (2002); moreover, some coarse measures such as size or turnover may capture other effects than liquidity according to Lesmond (2002). Fortunately, both of these two papers have created two new liquidity measures that solve the two problems. Although the Lesmond measure has been supported by international evidence, the Amihud ratio has not; therefore, my task in this thesis is to seek evidence from another market to investigate the validity of the Amihud ratio as a liquidity measure and its relation to stock return.

Combining other stock characteristics (size, beta, volatility, dividend yield and past returns), Amihud (2002) uses the Amihud ratio as a liquidity proxy to investigate the cross-section of stocks listed on the *NYSE* during 1963~1997. He finds a significantly positive relationship between illiquidity and stock return for the whole sample period with or without January, and for the two subperiods in Fama-MacBeth-type regression.

Following Amihud (2002), this chapter tests the cross-sectional effects of illiquidity on stock return using the data of first section stocks listed on the *TSE* during 1975 ~ 2000 from *PACAP* database. The stock characteristics that are incorporated in the Fama-MacBeth regressions include illiquidity, size, beta, standard deviation, dividend yield and past returns, etc.; variables such as earnings yield, cash flow yield, *BM* ratio and lag monthly return that have been documented to have significant effects for the Japanese stocks have also been employed.

In a comparison with traditional liquidity measures, the Amihud ratio for the sample stocks has shown to have high correlation with size, trading value, and turnover in the sample period.

The empirical results show that although the Amihud ratio does have a positive relation to the monthly stock return, the other variables do not have the expected effects as in Amihud (2002). However, when the coefficients are divided into up and down markets, most of the effects have become significant.

Data and methodology for the cross-sectional tests of illiquidity effects will be described in the next section, the empirical results will be discussed in section 2.3, and the final section concludes this chapter.

2.2 Data and Methodology

In this section, I will describe the sample selection criteria in 2.2.1, the computation and implication for each stock characteristic from 2.2.2 to 2.2.4, and the model specifications in 2.2.5.

2.2.1 Sample Selection

The sample selection criteria for stocks in year *y* are as follows[2]:

(1) The stock must have valid observations of daily return and trading value data for more than 200 days during year *y*-1, so that the estimated parameters are more reliable;

[2] The sample applies to the whole dissertation.

(2) The stock price must be greater than ¥100 at the end of year *y*-1. Low-price stocks are excluded from the sample since their returns are more affected by the minimum tick size[3] of ¥1;

(3) After satisfying the above criteria, the stocks whose annual illiquidity in year *y*-1 is at the highest or lowest 1% tail of the distribution are excluded.

According to Ahn *et al.* (2002), for 156 of their 219 sample stocks, the price never hits the daily price limit during the entire 3-month sample period. Therefore, excluding the stocks in the 2% tails of the distribution in my sample might also exclude those stocks with greater price changes that may have hit the daily price limits, since the accuracy of the liquidity measure may be influenced by these stocks.

Table 4 shows the sample selection process over the sample period that satisfies the above criteria. There are 985 to 1350 stocks in the sample period from the original data, and the number of stocks included in the final annual samples range from 565 to 1124 after satisfying the above three criteria.

2.2.2 Liquidity and Risk Variables

The liquidity variables incorporated in the cross-sectional regression are the mean-adjusted annual stock illiquidity and the year-end stock market value.

The daily stock illiquidity ILL_d^i (the Amihud ratio) is computed as the ratio of the absolute daily return to the daily trading value, according to Amihud (2002):

$$ILL_d^i = |R_d^i| / VAL_d^i, \tag{2.1}$$

[3] Amihud (2002) confines his sample to stocks with year-end price greater than $5 to reduce the noise to the estimations according to Harris (1994) who studies the effects of minimum tick. See table 1 for the tick size classification in the *TSE* as of 2004.

where R_d^i is the return for stock *i* on day *d* and VAL_d^i is the trading value in million yen for stock *i* on day *d* retrieved from the daily stock price and return file from the *PACAP* database. This Amihud ratio represents the absolute percentage price change per million yen of trading value.

Because the annual stock illiquidity varies dramatically over time, the liquidity variable included in the cross-sectional regression is the mean-adjusted annual stock illiquidity $ILLM_y^i$ computed as the ratio of stock illiquidity to market illiquidity for stock *i* in year *y*:

$$ILLM_y^i = ILL_y^i / ILL_y^M , \tag{2.2}$$

where ILL_y^i is the average illiquidity for stock *i* across days in year *y*, and the annual market illiquidity ILL_y^M is the average illiquidity across stocks in market portfolio *M* in year *y*. A description of the time-series pattern of the annual market illiquidity and the Nikkei 225, as well as the development of Japanese stock market during the sample period, is provided in Appendix A and Figure 1.

Another liquidity proxy incorporated in the regression is the log value of size variable CAP_y^i, which is the market capitalization for stock *i* at the end of year *y* retrieved from the monthly stock price and return file. Chan, Hamao and Lakonishok (1991) state that the performance of the size variable is highly dependent on the model specification and time period. Berk (1995) argues that the size effect should not be regarded as an anomaly because the size variable is related to a function of the reciprocal of expected return in an incorrectly specified asset pricing model; thus the size-related measures should be used in the cross-sectional tests to detect model misspecifications.

According to Amihud (2002), the Amihud ratio not only gives the daily price impact of the order flow that follows Kyle's concept of and Silber's measure of thinness, but is strongly related to the Amivest measure, the ratio of the sum of the daily volume to the sum of the absolute return. The Amihud ratio should be positively related to variables that measure illiquidity from microstructure data.

Using estimates of the price impact measure by Kyle (1975) and the fixed cost component of the bid-ask spread by Brennan and Subrahmanyam (1996) for 1984, a cross-sectional regression on the Amihud ratio by Amihud (2002) shows that it is positively and strongly related to microstructure estimates of illiquidity.

Thus, I run pooled-regressions between illiquidity and each of the three traditional liquidity proxies (logarithm of size, logarithm of trading value and turnover) for the sample stocks, as follows:

$$ILL_y^i = 1.5908 - 0.0598 \ln CAP_y^i$$
$$(t = 116.46)\ (t = \text{-}110.06)$$
$$R^2 = 0.357\ ,\ \mathrm{r} = \text{-}0.597$$
$$ILL_y^i = 0.7225 - 0.0616 \ln VAL_y^i$$
$$(t = 159.31)\ (t = \text{-}141.01)$$
$$R^2 = 0.474,\ \mathrm{r} = \text{-}0.688$$
$$ILL_y^i = 0.1082 - 0.0332 TRN_y^i$$
$$(t = 94.55)\ (t = \text{-}25.58)$$
$$R^2 = 0.029,\ \mathrm{r} = \text{-}0.170$$

The above results show that the Amihud ratio is highly correlated with size and trading value for the Japanese data in my sample.

As papers on the Japanese data have shown negative effects of size on stock returns (Kato and Schallheim (1985), Chan, *et al.* (1991), *etc.*), I expect a positive relation between illiquidity and stock return for brevity.

I use beta to proxy for market risk, and the standard deviation of daily return to proxy for total risk in the cross-sectional regression. To estimate the portfolio beta[4] using the market model, I sort the sample stocks into 25 portfolios based on year-end market capitalization (*SZ* thereafter) or *BM* ratio[5]. Size is adopted here as a sorting means because (1) size data suffers least from missing observations in the database, and (2) there is empirical evidence of a relation between size and returns, similar to that found in the *U.S.* data according to Hamao (1988).

The market beta for portfolio *p* in year *y* is estimated by running a time-series regression of daily return for portfolio *p* on the lag, current and lead daily market return across days in year *y* according to the Dimson (1979) method,

$$R_d^p = \alpha + \beta_y^{ap} * R_{d-1}^M + \beta_y^{bp} * R_d^M + \beta_y^{cp} * R_{d+1}^M + \varepsilon , \qquad (2.3)$$

where R_d^p is the average return across stocks in portfolio *p* on day *d*, and R_d^M is the market return on day *d* retrieved from daily market return file. The portfolio beta is the sum of the three slope coefficients of the market returns and the annual stock beta is the beta of the portfolio it belongs to:

$$\beta_y^{1i} = \beta_y^{1p} = \beta_y^{ap} + \beta_y^{bp} + \beta_y^{cp} \qquad (2.4)$$

The total risk of a stock STD_y^i is the standard deviation of return for stock *i* across days in year *y* and is scaled by 10^2. Amihud (2002) argues that the standard deviation should be included in the cross-sectional test because the numerator of the Amihud ratio is the absolute return, which is related to standard deviation[6]. Previous papers have studied the relation between liquidity measures and risk measures. In an empirical study of *NASDAQ* stocks, Stoll (1978) proposes a positive relation between

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[4] Fama and French (1992) suggest that the precision of portfolio beta more than makes up for the variation of stock betas in a portfolio.
[5] This portfolio formation strategy will also be applied in the following chapters.
[6] Although illiquidity and stock volatility are positively correlated, their correlation is quite low (0.163 for the *TSE* stocks in my study, and 0.278 for the *NYSE* stocks in Amihud (2002)).

the bid-ask spread and the stock's risk; Copeland and Galai (1983) also report a positive relation to the volatility when studying the information effects of bid-ask spread. In an intertemporal portfolio selection model, Constantinides (1986) finds that transaction costs have only a second-order effect on the liquidity premia, which implies that the stock variance positively affects its return, since frequently rebalancing a portfolio imposes higher trading costs. Furthermore, several papers have made opposite predictions about the relation between stock return and its standard deviation. Both Levy (1978) and Merton (1987) predict a positive relation since a higher return is required to compensate for constrained and incompletely-diversified portfolios. On the other hand, Constantinides and Scholes (1980) predict a negative relation because of the tax trading option.

2.2.3 Fundamental Variables

Following Chan, Hamao and Lakonishok (1991), the cross-sectional regression also includes the other three "fundamental" variables---the earnings yield, the cash flow yield[7] and the Book-to-Market (*BM*) ratio--in addition to size, to allow comparison with their findings. According to Chan *et al.* (1991), their choice of the predictor variables is motivated by the existing evidence from the *U.S.* that they are influenced more by the practice of fundamental security analysts than any explicit theoretical model.

The earnings yield EP_y^i is the ratio of earnings per share to the share price for stock *i* in year *y*, and the net income is retrieved from financial statement files. The cash flow

[7] Because Japanese firms are not allowed to use different reporting methods for tax purposes and financial statements, they use accelerated depreciation in financial reporting. Therefore, I include cash flow yield to capture the earnings distortion from firms with large capital investments.

yield CP_y^i is the ratio of earnings plus depreciation per share to the share price for stock *i* in year *y*, and the depreciation is retrieved from financial statement files. The year-end stock *BM* ratio BM_y^i is the ratio of book value to market value of equity for stock *i* at the end of year *y*, and the book value of equity is retrieved from financial statement files.

There are numerous studies that document or disentangle the size and the earnings yield effects; nonetheless, the shortcomings of accounting earnings motivate the exploration of the cash flow yield effect (Bernard and Stober (1989)). Fama and French (1988) suggest that yield surrogates proxy for underlying risks not accounted for by traditional risk measures. Chan, Hamao and Lakonishok (1991) report that the cash flow yield has a reliably positive impact on expected returns, but find no evidence of strong positive earnings yield effect; they also document the positive impact of *BM* ratio on expected returns.

2.2.4 Additional Variables

Additionally, dividend yield and past returns are included in the regression following Brennan *et al.* (1998). Dividend yield DP_y^i is the ratio of dividend per share to the share price for stock *i* in year *y*, and the dividend payout is retrieved from the capital distribution file. Past stock return for the last 100 days and past return for the rest days are included in the regression to study the momentum effects. Specifically, PR_y^{1i} is the past return for the last 100 days for stock *i* in year *y* calculated as the log ratio of the daily closing price on the first trading day to that on the last trading day during this period, and PR_y^{2i} is the past return for the rest days for stock *i* in year *y*, calculated as the log ratio of the daily closing price on the first trading day to that on the last trading day during this period.

Although the dividend yield for Japanese firms is minuscule, I incorporate it to allow for comparison with Amihud (2002). Previous papers also have contradictory predictions of the effects of dividend yield. The positive effect is based on the argument that investors need to be compensated for the higher tax on dividends compared with that on capital gains. However, a negative effect comes from the investor sentiment that stocks with a higher dividend are less risky. In a study of the relation between firm size and dividend payouts, Redding's (1997) suggests that large investors may prefer stocks with high liquidity and high dividend payout. He claims that firm size and liquidity jointly explain the payout decision well, while informational contents explain the level of dividends well.

Although the past return variables are included in Amihud (2002), they are not necessarily relevant for the Japanese data. Therefore, I include the lag monthly return R^i_{m-1} instead to test if there is a return reversal for the sample stocks retrieved from the monthly stock return file, since Bremer and Hiraki (1999) find that the *TSE* stocks with losses in week *t*-1 experience price reversals in week *t*.

2.2.5 Model Specifications

The cross-sectional effect of illiquidity on stock return is tested for stocks traded in the *TSE* during the period 1976~1999. The 25-year sample period is chosen as a source of out of sample confirmation for asset pricing tests in this thesis, since the cross-section of these stocks is large enough to form diversified portfolios with cross-sectional variation on both factor loadings and characteristics.

All the market and accounting data are collected from the Japan database of *PACAP* (the Pacific-Basin Capital Markets). Following Lehmann and Modest (1994)[8], I only include the first section stocks, because the stocks listed in different sections satisfy different listing criteria and the first section is the largest on the *TSE*, while second-section stocks are much less actively traded and are likely to have very different trading and liquidity characteristics. And the analysis of the first section stocks of the *TSE* should be analogous to the study of the *NYSE* in the *U.S.*

According to Chan *et al.* (1991), most of the Japanese listing firms use March 31st as their fiscal year-end, and practically all companies publish their financial statements within three months after the fiscal year end. Therefore, I calculate the annual average for those stock characteristics used as independent variables in the regression from July 1st in the current year till June 30th in the following year. I also form the portfolios used for the calculation of beta on the basis of size or *BM*-ratio known to investors as of the end of June for firms both with March 31st and with non-March 31st fiscal year ends to ensure the predictability of the tests. For example, the annual stock illiquidity in 1975 is averaged from July 1st, 1975, to June 30th, 1976, so on and so forth; therefore, the sample period for regression is from 1976 to 1999 and the explanatory variables are computed from 1975 to 1998[9].

The Fama-MacBeth-type cross-sectional regression is estimated for each month (a total of 288 months for 24 years) during the sample period, as in Fama and MacBeth (1973), where monthly stock returns are a function of stock characteristics including illiquidity, beta and prior returns:

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[8] They examine the efficacy of the *TSE*'s trading mechanisms at providing liquidity based on transactions, best-bid and best-offer quotes for first section stocks over 26 months. They study the size of the bid-ask spread and its cross-sectional and intertemporal stability; intertemporal patterns in return, volatility, volume, trade size, and the frequency of trades; and market depth based on the response of quotes to trades and the frequency of trading halts and warning quotes.

[9] The data availability of the Japanese market from the *PACAP* database ends in 2000.

$$R_m^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} \beta_{y-1}^{1i} + k_{3y} PR_{y-1}^{1i} + k_{4y} PR_{y-1}^{2i}, \quad (2.5)$$

where R_m^i is the monthly stock return in year y retrieved from the monthly stock return file, and the independent variables are calculated from data in year y-1.

The regression is further extended to incorporate additional variables such as size, volatility and dividend yield when beta is calculated for *SZ*-based portfolios:

$$R_m^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} \ln CAP_{y-1}^i + k_{3y} \beta_{y-1}^{1i} + k_{4y} STD_{y-1}^i + k_{5y} DP_{y-1}^i$$

$$+ k_{6y} PR_{y-1}^{1i} + k_{7y} PR_{y-1}^{2i}. \quad (2.6a)$$

The above two regressions follow the tests in Amihud (2002). When beta is calculated for *BM*-based portfolios, I substitute *BM* ratio for size and earnings yield for dividend yield, following Chan *et al.* (1991) because they report a reliably positive impact of *BM*-ratio on expected returns and because dividends yield in Japan is minuscule:

$$R_m^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} BM_{y-1}^i + k_{3y} \beta_{y-1}^{1i} + k_{4y} STD_{y-1}^i + k_{5y} EP_{y-1}^i$$

$$+ k_{6y} PR_{y-1}^{1i} + k_{7y} PR_{y-1}^{2i}. \quad (2.6b)$$

I also test the model with fundamentals employed by Chan, Hamao and Lakonishiok (1991):

$$R_m^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} EP_{y-1}^i + k_{3y} CP_{y-1}^i + k_{4y} \ln CAP_{y-1}^i + k_{5y} BM_{y-1}^i. \quad (2.7)$$

For the 288 sets of monthly estimates, the coefficient averages and *t*-statistics are calculated for the whole sample period including and excluding January[10], as well as the sub-periods from 1976 to 1989 and 1990 to 1999. I use 1989/90 as the split of the sub-periods because the time-series of the annual market illiquidity shows a V-shape pattern that is decreasing from 1976 to 1989 and increasing from 1990 to 1999;

[10] Several papers have document that the effects of market beta, size and liquidity become insignificant when excluding January from the sample period.

moreover, the Japan Securities Research Institute[11] separated the development of the Japanese securities market from 1976 to 1999 into several stages, with a split at 1989/90 as well, in their publication *Securities Market in Japan 2001*.

Using stock return data in Japan from 1956 to 1995, Hodoshima, *et al.* (2000) find that regression of return on beta without differentiating positive and negative market excess returns produces a flat relationship between beta and return. However, significant conditional positive or negative relationships between beta and return are found once the observations are separated into up and down market groups, where the up (or down) market refers to observations associated with positive (or negative) market premium, $R_m - R_f > 0$ ($R_m - R_f < 0$).[12] They explain that the expected market excess return should never be negative, but actual observations used in the regression are often negative. Similarly, one may argue that the expected illiquidity premium should never be negative but the realized premium may well be so. If the realized illiquidity premium is positively correlated with excess market return, then the estimated relationship between the Amihud ratio and stock returns may also be distorted. Therefore, I further separate our sample into up and down markets and repeat the cross-sectional regressions to see if illiquidity is priced differently in those markets.

Chiao and Hueng (2004) shows that the firm size and the book-to-market ratio cannot fully explain stock returns on prior-return-based portfolios in Japan. The overreaction effect after controlling for *SZ* and *BM* effects is significant and plays an important role

[11] See Appendix A and Figure 1 for the time-series pattern of the annual market illiquidity and the separation of development stages of the Japanese securities market.
[12] Chan and Lakonishok (1993), Grundy and Malkiel (1996), and Pettengill *et al.* (1995) investigate the relationship between return and beta by taking into account whether the market excess return is positive or negative in the *U.S.* market and find that the beta and stock returns are significantly related.

in explaining the zero-investment returns on the loser-to-winner strategy.[13] Recent finance literature has shown that asset price behavior can differ under different market states, which can be attributable to different investor behavior in bull and bear markets. In the Japanese stock market, the overreaction behavior of the investors may lead to opposite relations between stock characteristics and stock return under bull or bear markets.

Although the past return variables are included in Amihud (2002), they are not necessarily relevant for the Japanese data. Since Bremer and Hiraki (1999) find that the *TSE* stocks with losses in week *t*-1 experience price reversals in week *t*, I include the lag monthly return instead to test if there is a return reversal for (2.5), (2.6a) and (2.6b) in the following specifications:

$$R_m^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} \beta_{y-1}^{1i} + k_{3y} R_{m-1}^i ; \qquad (2.8)$$

$$R_m^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} \ln CAP_{y-1}^i + k_{3y} \beta_{y-1}^{1i} + k_{4y} STD_{y-1}^i + k_{5y} DP_{y-1}^i + k_{6y} R_{m-1}^i ; \qquad (2.9a)$$

$$R_m^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} BM_{y-1}^i + k_{3y} \beta_{y-1}^{1i} + k_{4y} STD_{y-1}^i + k_{5y} EP_{y-1}^i + k_{6y} R_{m-1}^i . \qquad (2.9b)$$

For a robustness check, I substitute annual stock return for monthly stock returns as a dependent variable in the above cross-sectional regressions (2.5 ~ 2.7) as follows:

$$R_y^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} \beta_{y-1}^{1i} + k_{3y} PR_{y-1}^{1i} + k_{4y} PR_{y-1}^{2i} ; \qquad (2.10)$$

$$R_y^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} \ln CAP_{y-1}^i + k_{3y} \beta_{y-1}^{1i} + k_{4y} STD_{y-1}^i + k_{5y} DP_{y-1}^i$$

$$+ k_{6y} PR_{y-1}^{1i} + k_{7y} PR_{y-1}^{2i} . \qquad (2.11a)$$

I substitute cash flow yield for earnings yield following Chan *et al.* (1991) since they also find a reliably positive impact of cash flow yield on expected returns, but they

[13] Motivated by this observation, they construct a portfolio whose return serves as a new factor that mimics overreaction. This new factor improves the performances of the Fama-French (1993) three-factor model in several prior-return-based and characteristics-based portfolios.

find no evidence of strong positive earnings yield effect after controlling for other fundamental variables:

$$R_y^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} BM_{y-1}^i + k_{3y} \beta_{y-1}^{1i} + k_{4y} STD_{y-1}^i + k_{5y} CP_{y-1}^i$$

$$+ k_{6y} PR_{y-1}^{1i} + k_{7y} PR_{y-1}^{2i} . \qquad (2.11b)$$

Because the market value is highly correlated with illiquidity and earnings yield is highly correlated with cash flow yield[14], (2.7) is transformed into the following versions to consider the multicollinearity problems:

$$R_y^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} BM_{y-1}^i + k_{3y} EP_{y-1}^i ; \qquad (2.12a)$$

$$R_y^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} BM_{y-1}^i + k_{3y} CP_{y-1}^i ; \qquad (2.12b)$$

$$R_y^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} BM_{y-1}^i + k_{3y} CP_{y-1}^i + k_{4y} STD_{y-1}^i + k_{5y} PR1_{y-1}^i . \qquad (2.12c)$$

Finally, I substitute the lag monthly data of illiquidity and size for the annual data in the following specifications:

$$R_m^i = k_{0y} + k_{1y} ILL_{m-1}^i + k_{2y} \beta_{y-1}^{1i} + k_{3y} R_{m-1}^i ; \qquad (2.13)$$

$$R_m^i = k_{0y} + k_{1y} ILL_{m-1}^i + k_{2y} \ln CAP_{m-1}^i + k_{3y} \beta_{y-1}^{1i} + k_{4y} STD_{y-1}^i + k_{5y} CP_{y-1}^i + k_{6y} R_{m-1}^i ; \qquad (2.14a)$$

$$R_m^i = k_{0y} + k_{1y} ILL_{m-1}^i + k_{2y} BM_{y-1}^i + k_{3y} \beta_{y-1}^{1i} + k_{4y} STD_{y-1}^i + k_{5y} CP_{y-1}^i + k_{6y} R_{m-1}^i ; \qquad (2.14b)$$

$$R_m^i = k_{0y} + k_{1y} ILL_{m-1}^i + k_{2y} EP_{y-1}^i + k_{3y} CP_{y-1}^i + k_{4y} \ln CAP_{m-1}^i + k_{5y} BM_{y-1}^i . \qquad (2.15)$$

Table 5 reports the summary statistics for all the independent variables included in the cross-sectional regression. The annual mean, standard deviation and skewness are calculated across the sample stocks in each year; the time-series means are then calculated for these statistics across years, as well as the minimum, maximum and median of the annual mean. Because the trading value and the market value are denominated in yen, which is a smaller currency unit compared to dollar, the

[14] See the correlation matrix reported in Table 6.

illiquidity measure is smaller (0.093 compared to 0.337) and the size is larger than those values reported in Amihud (2002). The dividend yield is much lower than that of the *NYSE* stocks (1.19% compared to 4.14%) because of the different payout polices of the firms listed on the two exchanges. Finally, the stock volatility is similar to that reported by Amihud (2002) (2.31 vs. 2.08).

Table 6 presents the correlation matrix between the independent variables with *SZ*-portfolio beta in Panel A and *BM*-portfolio beta in Panel B. Correlations that are greater than 0.500 are in bold types. The correlation between illiquidity and size is -0.502[15], and earnings yield and cash flow yield is highly correlated as well (0.685).

2.3 Empirical Results

In this section, I will discuss the empirical results for the cross-sectional tests of illiquidity effects from tables 7~11 in the model specifications (2.5) ~ (2.15) listed above for the sample stocks.

2.3.1 Cross-sectional Tests with *SZ*-Portfolio Beta

Table 7 presents the regression results for the cross-sectional tests of the specifications in (2.5), (2.8), (2.10) and (2.13) where the market beta is estimated from *SZ*-portfolios. Panel A shows the results for the original regression, as in Amihud (2002), as well as the annual regression where the dependent variable is changed to annual stock return. In the annual regression, the illiquidity variable has a positive and significant coefficient of 0.0177 and the past return for the last 100 days has a negative and significant coefficient of -0.0870. In contrast to the regression

[15] Amihud (2002) reported the correlation for the *NYSE* stocks as -0.614.

results from Amihud (2002) for the *NYSE* stocks for the regressions with monthly return, only the illiquidity measure is significantly priced with a coefficient of 0.0014 for the whole sample period, and the effect is stronger when excluding January. The first sub-period also has a highly significant coefficient of 0.0022, but there is no evident effect in the second sub-period.

A further examination of the monthly market excess return shows that, for 168 months in the first sub-sample period, 111 months are associated with the positive market excess return and 57 with negative ones. For 120 months in the second sub-sample period, only 54 months are associated with the positive market excess return and 66 with negative ones. Therefore, the ratio of negative excess market return months over positive ones is much higher in the second sub-sample period (66/54) than in the first (57/111).

Panel B shows the test result for the up market when the market return is greater than the risk-free rate. The coefficient of illiquidity becomes insignificant for the whole period and negative (-0.0035) in the second sub-period. The coefficient for beta becomes positive and significant, while the coefficient for past return for the last 100 days is highly significant except in the first sub-period.

Panel C shows the test for the down market when the market return is less than the risk-free rate. The coefficient for illiquidity is 0.0019 for the whole period and 0.0034 for the second sub-period. The coefficient of beta becomes negative and highly significant.

Panel D shows the regression where past return variables have been changed to lag monthly return. The coefficient of illiquidity is positive and highly significant except in the second sub-period. The coefficient for lag return is negative and highly significant in all periods.

Panel E shows the regression where lag annual illiquidity has been changed to lag monthly illiquidity. Illiquidity has a positive and significant coefficient of 0.0182 and lag monthly return has negative and highly significant coefficients in all periods.

Likewise, Panel F shows the test of significance in the up market for the regression in Panel E. The coefficient of illiquidity is 0.0234, and the coefficient of beta becomes positive and significant.

Panel G shows the test of significance in the down market for the regression in Panel E. The coefficient of illiquidity has lost significance, and the coefficient of beta has changed sign.

Table 8 presents the regression results for the cross-sectional tests of the specifications in (2.6a), (2.9a), (2.11a) and (2.14a). In Panel A, the coefficient for illiquidity is 0.0174 and that for volatility is -0.0332 for annual regression. Adding size, volatility and dividend yield does not affect the results too much in the original monthly regression. The coefficient for size is positive (0.0047) and contradictory to the prediction. The market beta has a negative coefficient (-0.0161), unlike that for the *NYSE* stocks, but is consistent with previous studies of the Japanese market[16]. For regression with monthly return, the result of the standard deviation is consistent with the tax argument from Constantinides and Scholes (1980), and the effect without January is fairly significant. The past return for the last 100 days has a negative effect on the stock return, while that for rest days has a positive effect. The dividend yield effect is not obvious.

When the tests are done separately for the up and down markets, the effects from most of the above variables become significantly stronger. In Panel B, the coefficient of

[16] Hodoshima, Garza–Gomez and Kunimura (2000) argue that regression of return on beta without differentiating positive and negative market excess returns produces a flat relationship between return and beta for the Japanese data; taking into account the difference, however, yields significant conditional relationships.

illiquidity has reduced to 0.0003. The coefficients for size and past return for the last 100 days are negative and significant, and the coefficient for volatility is positive (0.0059) and significant. In Panel C, the coefficient of illiquidity is positive (0.0028) and highly significant, and the sign for the coefficients of other variables has reversed. The effect of the dividend yield is much stronger.

In Panel D, significant effects come from illiquidity and lag return.

Panel E shows the regression where lag annual illiquidity and size have been changed to lag monthly illiquidity and size. The coefficient of illiquidity has lost significance since size is highly correlated with illiquidity. Lag monthly return has negative and highly significant coefficients in all periods.

Likewise, Panel F shows the test of significance in the up market for the regression in Panel E. The coefficient of illiquidity becomes negative and insignificant, but the coefficient of size becomes negative and significant (-0.0069), consistent with the prediction. The volatility also has a positive and significant effect on stock return (0.0056).

Panel G shows the test of significance in the down market for the regression in Panel E. The coefficient of illiquidity is still insignificant, but cash flow yield has a positive and significant effect on stock return, consistent with the result of Chan *et al.* (1991). The coefficients of beta, size and volatility have all changed signs.

2.3.2 Cross-sectional Tests with *BM*-Portfolio Beta

Table 9 presents the regression results for the cross-sectional tests of the specifications in (2.5), (2.8), (2.10) and (2.13) where the market beta is estimated from *BM*-portfolios. Panel A shows the results for the original regression as in

Amihud (2002), as well as for the annual regression where the dependent variable is changed to annual stock return. In the annual regression, the illiquidity variable has a positive and slightly significant coefficient of 0.0140 and the past return for the last 100 days has a negative and significant coefficient of -0.0800. In contrast to the regression results from Amihud (2002) for the *NYSE* stocks, but similar to the results from Table 7, only the illiquidity measure is significantly priced with a coefficient of 0.0014 for the whole sample period, but the effect becomes weaker when excluding January. The first sub-period also has a highly significant coefficient of 0.0024, but there is no evident effect in the second sub-period.

Panel B shows the test result for the up market when the market return is greater than the risk-free rate. The coefficient of illiquidity becomes highly significant for the whole period (0.0038). The coefficient for beta becomes positive (0.0106) and significant, while the coefficient for past return for the last 100 days is highly significant, except in the first sub-period.

Panel C shows the test for the down market when the market return is less than the risk-free rate. The coefficient for illiquidity becomes negative (-0.0016) for the whole period and the coefficient of beta becomes negative (-0.0226) and highly significant.

Panel D shows the regression where past return variables have been changed to lag monthly return. The coefficient of illiquidity is positive (0.0016) and highly significant, except in the second sub-period. The coefficient for lag return is negative and highly significant in all periods.

Panel E shows the regression where lag annual illiquidity has been changed to lag monthly illiquidity. Illiquidity has a positive and significant coefficient of 0.0246 and lag monthly return has negative and highly significant coefficients in all periods. Beta has a slightly moderate and negative coefficient (-0.0076).

Likewise, Panel F shows the test of significance in the up market for the regression in Panel E. The coefficient of illiquidity becomes 0.0515, and the coefficient of beta becomes positive and moderately significant.

Panel G shows the test of significance in the down market for the regression in Panel E. The coefficient of illiquidity has lost significance and become negative, but the coefficient of beta becomes highly significant.

Table 10 presents the regression results for the cross-sectional tests of the specifications in (2.6b), (2.9b), (2.11b) and (2.14b). In this table, I replace the size variable with *BM* ratio and the dividend yield with earnings yield. In Panel A, the coefficient for illiquidity is 0.0173 and that for volatility is -0.0252 for the annual regression. For the monthly regression, the coefficient of illiquidity is highly significant again, and the *BM* ratio also has significantly positive coefficients from 0.0061 (t=2.590) to 0.0091 (t=2.611). The market beta has a negative coefficient (-0.0009). The past return for the last 100 days has a negative effect on the stock return, while that for the rest days has a positive effect. The effects of earnings yield and cash flow yield are not obvious.

When the tests are done separately for the up and down markets, the results become intriguing. In Panel B, the coefficients of illiquidity and *BM* ratio are still positive and highly significant. The coefficient for past return for the last 100 days is negative (-0.0147) and becomes highly significant, and the coefficient for volatility becomes positive (0.0093) and highly significant. In Panel C, the effect of volatility is so strong that it subsumes the illiquidity effect and *BM* effect.

In Panel D, significant effects come from illiquidity, *BM* ratio and lag return.

Panel E shows the regression where lag annual illiquidity has been changed to lag monthly illiquidity. The coefficient of illiquidity is positive and significant (0.0249) and the coefficient of *BM*-ratio is also positive and significant (0.0069). Lag monthly return has negative and highly significant coefficients in all periods.

Likewise, Panel F shows the test of significance in the up market for the regression in Panel E. The coefficient of illiquidity is still positive and significant (0.0433), and the coefficient of *BM*-ratio is positive and significant (0.0099) as well. The volatility has a positive and significant effect on stock return (0.0102), and the lag return has a negative and significant effect on stock return (-0.0836).

Panel G shows the test of significance in the down market for the regression in Panel E. The coefficient of illiquidity has lost its significance, but beta has a negative and slightly significant effect on stock return. The coefficient of volatility has changed sign.

2.3.3 Cross-sectional Tests with Fundamental Variables

Finally, Table 11 reports the regression results for the cross-sectional test in (2.7), (2.12a), (2.12b), (2.12c) and (2.15), incorporating the four fundamental variables as in Chan, Hamao and Lakonishok (1991). Panel A shows the annual regression that incorporates *BM*-ratio, earnings yield, cash flow yield and two variables that have effects on stock return in the previous tests from Table 2.4 and Table 2.5. The effect of *BM* ratio has subsumed the effects from all other variables in the three specifications.

Panel B shows the regression results with illiquidity and the four fundamental variables. The coefficients for illiquidity and *BM* ratio remain significant. In contrast to their result from Model (8) in Panel A of Table VI, the other three variables (earnings yield, cash flow yield and size) do not show strong influence on the stock returns, partially due to the multicollinearity problem between size and cash flow yield, although the signs of these coefficients are generally consistent with the expectation.

Panel C shows the regression results with monthly illiquidity and size and the three accounting variables. Illiquidity has a positive and weakly significant coefficient of 0.0113, cash flow yield has a positive and moderately significant coefficient of 0.0143, and *BM*-ratio has a positive and significant coefficient of 0.0061, as predicted.

2.4 Conclusion

In this chapter, I study the cross-section of the *TSE* stocks from 1976~1999 as a function of the Amihud ratio, size, beta, volatility, *BM* ratio, prior returns and three yield variables in various specifications and sub-periods. The results from the cross-sectional tests of liquidity effects on stock returns show that the Amihud ratio is indeed a good measure for liquidity in the Japanese market, especially during the first sub-period when controlling other variables. During the period 1976~1999, expected stock return is an increasing function of expected illiquidity. The mean-adjusted Amihud ratio has a significantly positive effect on expected return when controlling other liquidity, risk and some additional variables, either in a four-variable specification or a seven-variable one. Among the other variables, both dividend yield[17] and *BM* ratio have positive coefficients with moderate significance, while the rest have no visible effects. Basically, the results are not influenced when excluding the January data from the sample period. However, the coefficient for illiquidity is not

[17] I also do robustness check for the tests using a reduced sample where the observations with zero dividend yield have been excluded. The coefficients for dividend yield have become significantly positive but the results for other variables do not change.

significant at all in the second half (1990~1999) of the sample period as compared with the first half.

When the tests are done separately for the up and down markets to account for the conditional relation between beta and return, the result of market beta confirms the study by Hodoshima, Garza–Gomez and Kunimura (2000), who claim that differentiating positive and negative market excess returns in the regression of return on beta yields significant conditional relationships for Japanese data. Moreover, I also document a strong effect of volatility that subsumes the effect from beta in the conditional tests.

Yonezawa (1992) states that unsystematic risk was a significant factor in the pricing of stocks in Japan, and that lack of diversification was the main cause of the invalidity of the *CAPM* in the Japanese stock market.

Several popular reasons have been put forward by Yonezawa and Maru (1984) to explain this phenomenon.

(1) Japanese stocks have been traded in lots that require a large fund to set up a well-diversified portfolio, which very few personal investors could afford.

(2) Japanese companies often held the stocks of those companies with which they have business relations, which does not comply with the assumptions of *CAPM* that investors make decisions based solely on the rational expectations theorem.

(3) Trust funds and mutual funds were more interested in the 'scenarios' recommended by the biggest 4 Japanese securities companies than to bother about diversification.

Finally, the extremely significant and negative effect of lag monthly return in all specifications confirms the findings of Bremer and Hiraki (1999) that Japanese stocks show strong short-term return reversal.

The cross-sectional tests are also done in a larger sample where stock price is not confined to being greater than 100 yen, and a different sample formation method is used where the annual samples are formed based on calendar year-end value (for Table 7, Table 8 and Table 9). Basically, there are no distinctive changes for the coefficients and test-statistics, and the Amihud ratio has positive and significant effect on stock return. Moreover, because the summary statistics in Table 5 has shown that there may be some outliers in the explanatory variables for the tests of cross-sectional effects, I identify the outliers and redo the tests, the results seem not to be affected by the outliers and remain the same using the adjusted sample.

Moreover, I test the cross-sectional liquidity effects on annual stock returns where the portfolio beta is estimated from the market model in *BM*-by-*SZ* portfolios sorted first into five *BM* quintiles and then into five *SZ* quintiles within the *BM* groups. The results are not of much difference compared to those with *SZ*- or *BM*-portfolios, so I do not report them here.

In summary, the most enlightening part of this test is that both the Amihud ratio and the *BM* ratio have positive and significant effects on the stock returns, confirming the studies by Amihud (2002) and Chan, Hamao and Lakonishok (1991). Thus, this paves the way for further study of time-series tests and asset pricing with liquidity risk, using these variables.

CHAPTER III THE TIME-SERIES EFFECTS OF ILLIQUIDITY ON JAPANESE STOCK RETURNS

3.1 Introduction

In the previous chapter, the Amihud ratio has been shown to be a good proxy for liquidity in explaining the cross-section of stock returns in the Japanese market controlling size, risk, yield and prior returns. Hence, it is encouraging to investigate the time-series relationship between the Amihud ratio and the stock return to see whether it is consistent with the positive cross-sectional relation, as previous empirical papers focused mainly on the cross-sectional tests or time-series tests in a very short span because of the availability of the microstructure data.

From previous studies of the stock and bond markets, we know that the illiquidity costs such as the bid-ask spread and brokerage fees are higher, while the transaction size is lower for stocks than bonds; this observation implies that stocks are not only riskier but more illiquid than bonds and the expected stock returns in excess of the Treasury yield should be the compensation for illiquidity in addition to risk.

Amihud, Mendelson and Wood (1990)[18] suggest that there is another illiquidity effect in an illiquid market called "flight to liquidity." When expected market illiquidity rises, there are two effects on expected stock returns: on the one hand, stock price declines and expected return rises for all stocks; on the other hand, capital flies from less liquid to more liquid stocks (the so-called "flight to liquidity"). The two effects are complementary for illiquid stocks but are a substitute for liquid stocks. Increasing market illiquidity not only negatively affects prices for liquid stocks, but also

[18] Amihud *et al.* (1990) study the relationship between market liquidity and market return for the 1987 crash by estimating the effects of changes in the bid-ask spread, the initial spread, and the change in quote size on the change in stock prices in three periods around the crash. They reason that "the price decline reflects, in part, a reassessment of market liquidity", while the price recovery resulted from liquidity improvement to some degree.

increases the relative demand for them that mitigates the price decline. However, the same condition decreases the relative demand for illiquid stocks that attenuates the price decline.

Moreover, there are also two effects of unexpected market illiquidity, either in the same or opposite directions on contemporaneous stock return. Therefore, it is necessary to investigate the variation of the liquidity effects on stocks with different liquidity, *i.e.*, the second-order effect that illiquid stocks require higher expected return. The proposition suggests that the illiquidity effect is stronger for small illiquid stocks and weaker for large liquid stocks.

Hence, the two hypotheses tested in the time-series regression are that expected return increases on expected illiquidity and contemporaneous return decreases on unexpected illiquidity. The methodology follows that of French, Schwert and Stambaugh (1987) who test the effect of risk on excess stock return.[19]

A time-series test is implemented using annual and monthly illiquidity data for the whole market, as well as *SZ*-based and *BM*-based portfolios to study the "size effect" and "*BM* effect." Chiao and Hueng (2004) investigate the overreaction effects independent of the risk and characteristics of the Japanese stock market. They show that the firm size and the book-to-market ratio cannot fully explain stock returns on prior-return-based portfolios in Japan. The overreaction effect after controlling for SZ and *BM* effects is significant and plays an important role in explaining the zero-investment returns on the loser-to-winner strategy.

The January effect is examined in the monthly regression with a January dummy, which may offer insights into controversies surrounding *U.S.* markets. Hamori (2001) examines the seasonal properties of Japanese stock prices, using time-series data of

[19] French *et al.* (1987) find that the expected market risk premium is positively related to the volatility, whereas the unexpected market returns are negatively related to the unexpected change of volatility, which provides indirect evidence of the positive relation.

TOPIX and indices that represent companies with large, medium and small numbers of listed shares from 1971 through 1997. The monthly effects are confirmed for the whole sample period, but are not found for the latter half of the sample period; moreover, Hamori claims that the seasonality of Japanese stock prices indices is deterministic but not stochastic from seasonal unit roots.

The rest of this chapter is structured as follows: the next section describes the data and methodology used in the time-series test, while the following section discusses the empirical results for the tests using either annual or monthly data and controlling for term yield premium, and the last section concludes the second part of the dissertation.

3.2 Data and Methodology

The time-series test in this chapter applies for the same sample of the first section stocks on the *TSE* as in the previous chapter, where the stocks have more than 200 valid trading days in a year, year-end price higher than 100 yen, and annual illiquidity in the middle 98% of the distribution.

The time-series effect is tested by regressing expected and unexpected market illiquidities on market or portfolio return sorted by year-end *SZ* or *BM* values using either annual or monthly data, where the January and term structure effects are also considered[20]. The market illiquidities are estimated from an autoregression model where the expected illiquidity is based on the lag value, and the unexpected illiquidity is the residual from the model. The market illiquidity is calculated as the average of all the illiquidity values of the sample stocks during a certain period; and the portfolio return is also an average of the stock return for each portfolio.

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[20] Please refer to section 2.2.2 on page 31 for the details of the calculation of illiquidity.

The annual market illiquidity used in the time-series test is the logarithmic form of the average annual illiquidity across stocks. Altogether, there are 24 values for the annual market illiquidity from 1976~1999. The expected and unexpected market illiquidity are estimated through an *AR(I)* model:

$$\ln ILL_y^M = c_0 + c_1 \ln ILL_{y-1}^M + v_y , \tag{3.1}$$

where $\ln ILL_{y-1}^M$ is the market illiquidity in the previous year and v_y represents the unexpected market illiquidity $\ln ILLU_y^M$, and c_1 is expected to be positive. Investors determine the expected illiquidity $\ln ILLE_y^M$ at year-beginning based on the information in the previous year:

$$\ln ILLE_y^M = c_0 + c_1 \ln ILL_{y-1}^M . \tag{3.2}$$

The market price is then set at year-beginning to generate the expected return through the next model:

$$R_y^M - R_y^f = f_0 + f_1 \ln ILLE_y^M + u_y = g_0 + g_1 \ln ILL_{y-1}^M + u_y , \tag{3.3}$$

where $g_0 = f_0 + f_1 c_0$ and $g_1 = f_1 c_1$, R_y^M is the average return across stocks in market portfolio *M* in year *y*[21], R_y^f is the annual rate of the call money rate or one-month Gensaki rate in year *y* as in Chan *et al.* (1991) retrieved from the monthly key economic file and u_y is the unexpected excess return. The time-series regression of the excess market return on the market illiquidity is as follows:

$$R_y^M - R_y^f = g_0 + g_1 \ln ILL_{y-1}^M + g_2 \ln ILLU_y^M + w_y , \tag{3.4a}$$

[21] The annual market return calculated from the return R_y^i for stock *i* in year *y* as the log ratio of year-end daily closing price to year-beginning daily closing price.

where the two predictions are that higher expected market illiquidity leads to higher expected market excess return ($g_1 > 0$) and higher unexpected market illiquidity leads to lower current market excess return ($g_2 < 0$), respectively.

The above predictions are further tested on size-based and *BM*-based portfolios,

$$R_y^p - R_y^f = g_0{}^p + g_1{}^p \ln ILL_{y-1}^M + g_2{}^p \ln ILLU_y^M + w_y^p , \tag{3.4b}$$

where R_y^p is the annual return on *SZ*-based or *BM*-based portfolios, *i.e.* the average return across stocks in portfolio *p* in year *y*. The coefficients $g_1{}^p$ are expected to be positive and decrease in size ($g_1{}^5 > g_1{}^{10} > g_1{}^{15} > g_1{}^{20} > g_1{}^{25} > 0$); while the coefficients $g_2{}^p$ are expected to be negative and increase in size ($g_2{}^5 < g_2{}^{10} < g_2{}^{15} < g_2{}^{20} < g_2{}^{25} < 0$).

The methodology used in the annual regression is also replicated using monthly illiquidity data to enhance the statistical validity. The monthly market return is regressed against monthly illiquidity measures as follows:

$$R_m^M - R_m^f = g_0 + g_1 \ln ILL_{m-1}^M + g_2 \ln ILLU_m^M + g_3 JAN_m + w_m , \tag{3.5a}$$

where JAN_m is a January dummy that is added to account for the January effect, R_m^M is the average return across stocks in market portfolio *M* in month *m* retrieved from the monthly market return file, and R_m^f is the monthly rate of the call money rate or one-month Gensaki rate in month *m*. Monthly expected market illiquidity ILL_m^M is the average illiquidity[22] across stocks in market portfolio *M* in month *m*.

The differences in the illiquidity effects are again tested on *SZ*-based and *BM*-based portfolios:

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[22] Monthly stock illiquidity ILL_m^i is the average illiquidity for stock *i* across days in month *m*.

$$R_m^p - R_m^f = g_0^p + g_1^p \ln ILL_{m-1}^M + g_2^p \ln ILLU_m^M + g_3^p JAN_m + w_m^p, \quad (3.5b)$$

where monthly portfolio return R_m^p is the average return across stocks in portfolio *p* in month *m*.

Finally, since empirical papers have seldom studied the effects of term yield premium in asset pricing for the Japanese market, I test the illiquidity effects controlling for the term yield premium in the following model:

$$R_m^M - R_m^f = g_0 + g_1 \ln ILL_{m-1}^M + g_2 \ln ILLU_m^M + g_3 JAN_m + aTM_{m-1} + u_m, \quad (3.6a)$$

and the additional hypothesis about the premium is $a > 0$. The term yield premium $TM_m = YL_m - R_m^{G3}$ is computed as the difference between the yield to maturity of 10-year government bond YL_m and the three-month Gensaki rate R_m^{G3} in month *m* retrieved from the monthly key economic file.

Tests are also implemented on portfolios:

$$R_m^p - R_m^f = g_0^p + g_1^p \ln ILL_{m-1}^M + g_2^p \ln ILLU_m^M + g_3^p JAN_m + a^p TM_{m-1} + u_m^p. \quad (3.6b)$$

As in the cross-sectional tests in the last chapter, I also test the time-series effects in the two sub-periods for the monthly regressions.

3.3 Empirical Results

3.3.1 Time-series Tests with Annual Illiquidity

Table 12 presents the estimation results of the time-series regression of expected and unexpected market illiquidity on market return as well as *SZ*-based portfolio return in (3.4a) and (3.4b). The estimation of model (3.1) provides the following results for the time-series test with annual illiquidity: $\ln ILL_y^M = -0.695 + 0.726 \ln ILL_{y-1}^M + v_y$.

Kendall (1954) points out that the estimated coefficient $\hat{c}_1$ is biased downward when estimating an *AR(I)* model like that in (3.1) from finite samples. He proposes a simple but accurate bias correction approximation procedure: the estimated coefficient $\hat{c}_1$ is augmented by the term $(1+3\hat{c}_1)/T$, where T is the sample size (in this case, it is 23); whereas the intercept $\hat{c}_0$ is deduced by the term $(1+3\hat{c}_1)/T$ multiplied by the average value of the independent variable. By applying Kendall's (1954) method, the bias-corrected slope coefficient $\hat{c}_1$ is 0.865, and the intercept becomes -0.347 accordingly.

In the regression on market return, the expected market illiquidity has a positive and weakly significant coefficient of 0.145, while the unexpected market illiquidity has a negative and highly significant coefficient of -0.232, both of which are consistent with the findings of Amihud *et al.* (1990). Inconsistent with Amihud (2002), the positive coefficients of expected illiquidity on portfolio return do not show a distinctive monotonically declining trend in size. However, the negative coefficients of unexpected illiquidity increase monotonically in size, with strong significance as expected. Table 13 reports the results for *BM*-based portfolios in (3.4b) that are similar to those of size-based portfolios. In particular, although the unexpected market illiquidity has a negative and highly significant effect on portfolio return and decreases with *BM* ratio, the expected market illiquidity does not show a strong effect on portfolio return.

The above results with annual illiquidity data imply that the excess market or portfolio return is an increasing function of the expected market illiquidity and a decreasing function of the unexpected market illiquidity; however, the "size effect" and "*BM* effect" are only reflected by the unexpected market illiquidity for the time variation of the excess portfolio return.

3.3.2 Time-series Tests with Monthly Illiquidity

As there are only 24 observations for the time-series regression with annual illiquidity data, it is necessary to repeat the methodology of the previous section here, using monthly data for a robustness check with many more observations.

Table 14 presents slightly stronger results for the time-series regression of expected and unexpected market illiquidity on market return as well as portfolio return with monthly liquidity data in (3.5a) and (3.5b). A similar autoregressive model is estimated for the monthly data of 288 observations during the period 1976~1999 as follows: $\ln ILL_m^M = -0.213 + 0.918 \ln ILL_{m-1}^M + v_m$. Applying Kendall's (1954) bias correction method with a sample size of 287, the adjusted slope coefficient is 0.931, and the intercept is -0.179. The monthly unexpected illiquidity is calculated as the residual from the above autoregressive model, using the adjusted coefficients.

Panel A to C report the regression results for the whole sample period (1976~1999), the first sub-period (1976~1989) and second sub-period (1990~1999), where the sample sizes are 179 and 108 for the two subperiods, respectively. In Panel A, the expected market illiquidity has a positive but insignificant coefficient of 0.005, while the unexpected market illiquidity has a negative and strongly significant coefficient of -0.127 in the regression on market return. The negative coefficients of unexpected illiquidity increase monotonically in size with strong significance; although the coefficients are lower (-0.138 to -0.080 compared with -0.458 to -0.201 for annual data), the *t*-stat is higher (-10.21 to -6.36 compared with -3.75 to -1.86 for annual data). The January dummy has positive and significant coefficients for most of the portfolios. For the first sub-period in Panel B, the coefficients for the expected and unexpected illiquidities are higher than the coefficients in the whole-period tests. For the second sub-period in Panel C, the coefficients for the expected and unexpected illiquidities are lower.

In Panel A of Table 15, the results for the *BM*-portfolios in (3.5b) are similar, and the January effect is obvious as well for those portfolios with larger *BM* ratio. Unlike the results of *SZ* portfolios, for the first sub-period in Panel B, the coefficient for expected illiquidity is higher, but that for the unexpected illiquidity is lower than the coefficients in the whole period tests. For the second sub-period in Panel C, the coefficient for expected illiquidity is lower, while that for the unexpected illiquidity is higher.

3.3.3 Time-series Tests with Term Yield Premium

Previous papers have studied the time-series effect of bond yield premiums on stock returns. Fama and French (1989) and Fama (1990) find that both the default yield premium and the term yield premium have positive effects on excess stock return. Keim and Stambaugh (1986) combine the above measures together and report similar results[23].

The results presented in Table 16 and Table 17 show that the effect of expected and unexpected market illiquidity on ex ante stock excess return retains after controlling for the term yield premium in (3.6a) and (3.6b). In contrast with Fama and French (1989), the term yield premium has a negative and insignificant effect; therefore, does not affect the effects of market illiquidity. The results for the sub-period tests are similar to those tests without term yield premium. One thing noteworthy is that the

[23] The default yield premium is the excess yield on risky corporate bonds, while the term yield premium is the difference between long-term and short-term yield. The combined measure is the difference between the yield on corporate bonds with rating below BAA and on short-term treasury bills.

coefficients of term yield premium all become positive for the second sub-period, which is consistent with Fama and French (1989), although the effect is insignificant.

3.4 Conclusion

In this chapter, I test the relation between expected and unexpected market illiquidity on market and portfolio returns for the *TSE* stocks from 1976~1999, and the unexpected market illiquidity is estimated from autoregression of expected market illiquidity. For the time-series tests using either annual or monthly illiquidity data, although the expected illiquidity has a significantly positive effect on expected excess return on the market portfolio, it does not show "size effect" across the *SZ*-based portfolios; in other words, the coefficient does not decrease when the portfolio size becomes larger. However, the unexpected illiquidity has a very strong negative effect on return and also shows a decreasing trend with the increasing portfolio size. Moreover, I document a "*BM* effect" that has not been explicitly studied in previous research that stocks with higher *BM* ratio tend to experience stronger effects of unexpected market illiquidity. One possible explanation is that these stocks are treated as more illiquid ones, like those stocks with smaller size; thus, the rise of unexpected market illiquidity, which negatively affects stock prices, also decreases the relative demand for stocks with higher *BM* ratio and exacerbates their price decline. This finding confirms the suggestion made by Fama and French (1992) that the characteristics such as *BM* or *SZ* must proxy for a risk (or ‘‘distress") factor in returns because distressed firms are likely to have high *BM* and small *SZ*.

When controlling for the term yield premium in the monthly regression, the results do not change too much and the term yield premium has a surprisingly negative effect on the stock return. However, the test using monthly illiquidity data has a strong January-size effect similar to the findings in *U.S.* studies with the "tax loss selling hypothesis" as a possible explanation[24]. Although there is no tax on capital gains for individual investors nor is there a tax benefit for losses in Japan, the potential integration between the *U.S.* and Japanese markets precludes the total rejection of the tax-loss-selling hypothesis according to Kato and Schallheim (1985).

A robust check for the tests in tables 14 and 15 is done using value-weighted market returns instead of equally-weighted market returns. Although the coefficient for the expected market illiquidity has become significant, that for the January dummy becomes insignificant, and that for the unexpected market illiquidity is still strongly significant but is less than the result using equally-weighted market return. Since the test results of the two return-calculation methods are of slight difference, I do not report here to save space.

In summary, the results from the time-series regression confirm the prediction that the stock return in excess of the treasury yield compensates not only its market risk but market illiquidity with a stronger effect for firms with smaller size or higher *BM* ratio. This finding motivates me to further study of liquidity risk in asset pricing since the greater sensitivity of the stock returns for smaller firms and firms with higher *BM* ratio to market illiquidity suggests that they have greater illiquidity risk; if illiquidity risk is priced in the market, stocks should also be compensated for higher liquidity risk with higher liquidity premiums.

[24] Previous studies have explored roughly four reasons to explain the January effect: 1) An increase in January cash flows due to holiday bonuses and pensions; 2) The sale of nonprofitable stocks for tax reasons at the end of the year and subsequent reinvestment in January; 3) Financial managers' attempts to show better year-end portfolio structures; 4) Governments, firms and individual investors forming budgets for future investments.

CHAPTER IV ASSET PRICING WITH LIQUIDITY RISK FOR *TSE* STOCKS BY LIQUIDITY-ADJUSTED *CAPM*

4.1 Introduction

The results for the stock return behavior from existing empirical tests for *CAPM* are not so exciting, as researchers found that the model may be misspecified and that beta might not be a complete measure for risk. On the other hand, liquidity has been rendered with determinacy in previous theoretical studies on asset pricing; however, its different empirical measures seem to vary over time, *i.e.*, transaction costs are stochastic. Therefore, it is crucial to investigate the influence of the liquidity risk involved with this uncertainty other than beta risk on asset prices in equilibrium. Fortunately, Acharya and Pedersen (2005) offer us a liquidity-adjusted *CAPM* that relates stock returns to the risks arising from the illiquidity of individual stocks as well as marketwise illiquidity.

In this sophisticated model, the expected illiquidity of a stock and its so-called "net beta" (the covariance of its net return with that of the market) positively affect its expected return. The net beta can be decomposed into three types of liquidity risks that represent the interaction of the illiquidity or return of individual stocks with those of the whole market. The model implies that investors either require a return premium for an illiquid security in the illiquid market, or would like to pay a premium for a security with high return in the illiquid market or a liquid stock during the down market.

Therefore, my third task in the dissertation is to see if the liquidity risk is actually priced in Japan, *i.e.*, whether an illiquid security has commonality in liquidity, return sensitivity to market liquidity, and liquidity sensitivity to market returns.

Since I have used the Amihud ratio as a proxy for illiquidity in the aforementioned tests of liquidity effects, and it has been proved as a fine proxy for illiquidity for the Japanese market in cross-sectional and time-series tests with long periods of time, it is practicable to apply it in the empirical tests for the liquidity-adjusted *CAPM*. Because the model is specified in terms of "yen cost per yen invested," I need to normalize the above measure by considering inflation and the level of transaction costs.

At first, the normalized monthly Amihud ratio is computed for each stock in the sample. Then, the monthly portfolio return and illiquidity are calculated for a market portfolio and for the 25 test portfolios that have been sorted by stock illiquidity, size or *BM* ratio. After that, the liquidity risks are estimated from portfolio illiquidity innovations and returns. Finally, a Fama-MacBeth type regression is run monthly across all portfolios and the robustness is checked through alternative specifications.

Previous theoretical literature on asset pricing, such as Amihud and Mendelson (1986) and Constantinides (1986), have endowed liquidity with stationarity. Vayanos (1998) studies the effects of transaction costs on asset prices and turnover using a dynamic equilibrium model that assumes an overlapping-generations economy with a riskless bond and risky stocks. He finds that stock price may increase in transaction costs and a frequently traded stock may be less affected by increasing transaction costs. For realistic parameter values, transaction costs have very small effects on stock prices but large effects on turnover. In line with this paper, Vayanos and Vila (1999) assume two riskless assets in the economy, where one is liquid for short-term investment and the other carries proportional transaction costs for long-term investment. When transaction costs increase, the price of the liquid one increases, while that of the illiquid one decreases if in small supply, but increases if in large supply.

Garleanu and Pedersen (2000) study the impact of present and future adverse selection costs on asset prices. They find that adverse selection may lead to allocational inefficiencies that reduce current prices through the present value of all future allocation costs, and that adverse selection affects assets of different maturity differently. Huang (2002) suggests that illiquidity can have large effects on asset returns when agents face liquidity shocks and borrowing constraints, which can help illustrate the reason that some securities have high liquidity premia despite low turnover.

On the contrary, empirical papers on liquidity allow it to vary over time, both for individual stocks and for the market, and two implications from the liquidity-adjusted *CAPM* have seen broad empirical support from previous studies. Several papers document the well-known phenomenon of "commonality in liquidity", meaning that investors require a premium for an illiquid security in an illiquid market. Using daily data for the *NYSE* stocks in 1992, Chordia, Roll and Subrahmanyam (2000) find that quoted spreads, quoted depth and effective spreads significantly co-move with market- and industry-wide liquidity after controlling for individual liquidity determinants such as volatility, trading volume and price. The existence of commonality suggests that both inventory risks and asymmetric information affect intertemporal changes in liquidity.

Hasbrouck and Seppi (2001) investigate common factors in prices, order flows, and liquidity for 30 Dow stocks over 15-minute intervals during 1994. Using principal components and canonical correlation analyses, they find that commonality in the order flows explains roughly two-thirds of the commonality in returns. They also report that liquidity proxies help explain time variation in trade impacts, but the variation and common covariation are relatively small. Huberman and Halka (2001) document the presence of a systematic, time-varying component of liquidity for the *NYSE* stocks in 1996 that neither the inventory-based nor the asymmetric information-based approach to liquidity could explain. The above three papers find that most stocks' illiquidities are positively related to market illiquidity, so the required return should be raised by the commonality-in-liquidity effect.

The pricing implication that the required excess return decreases on the covariance between the stock return and the market illiquidity results from the situation that investors would like to pay a premium for an asset with high return in an illiquid market. Theoretical studies of this effect arise in the models of Holmstrom and Tirole (2000) who examine implications of corporate demand for liquidity, and propose a liquidity-based asset pricing model (*LAPM*) that generates the above-mentioned effect. Another theoretical paper by Lustig (2004) studies the equilibrium implications of solvency constraints in the investigation of the market price of aggregate risk and the wealth distribution that educes the same effect. Using monthly data over 34 years with a measure based on the return reversals-induced order flow, Pastor and Stambaugh (2003) find that expected stock returns are related to the return sensitivities to the market liquidity. Adjusted for exposures to the market return as well as size, value and momentum factors, the average return on stocks with high liquidity risk exceeds that for stocks with low liquidity risk by 7.5% annually. Sadka (2003) and Wang (2003) also present consistent evidence for this effect, using alternative measures of liquidity. Sadka (2003) demonstrates the importance of liquidity for asset pricing and especially for the momentum anomaly. He shows that systematic liquidity risk is important in explaining the cross-sectional variation of expected returns, and its compensation partially contributes to the momentum returns. Another finding from this paper is that profitable momentum strategies that earn superior risk-adjusted returns are associated with low levels of liquidity. Because a positive correlation exists between active participation from institutional investors and the market liquidity, Wang (2003) adopts aggregate institutional equity acquisitions as a proxy for market liquidity and finds that stocks whose returns are more sensitive to the liquidity shocks have higher returns to compensate for exposure to liquidity risk.

In the study of liquidity persistence that predicts future returns and co-moves with contemporaneous returns, Amihud (2002) finds a positive relation between expected illiquidity and expected return and a negative relation between unexpected illiquidity and contemporaneous return for size portfolios in the time-series tests. Amihud, Mendelson and Wood (1990) find that stocks whose liquidity worsened more during the 1987 crash had more negative returns, and that the crash was in part due to an increase in market illiquidity. Chordia, Roll and Subrahmanyam (2001), Chordia, Roll and Subrahmanyam (2000), Hasbrouck and Seppi (2001), Huberman and Halka (2001), Jones (2001), and Pastor and Stambaugh (2003) find a negative relation between market return and market illiquidity. In particular, Jones (2001) assembles an annual time series of bid-ask spreads on Dow Jones stocks from 1898 to 1998 that gradually decline over the century except for some sharp rises during market turmoil. He presents evidence that high spreads and low turnover predict high stock return, up to one year ahead. Chordia, Roll and Subrahmanyam (2001) find that daily changes in market liquidity and trading activity are highly volatile and negatively serially dependent; liquidity plummets significantly in down markets and market volatility induces a decrease in trading activity and spreads. They also find strong day-of-the-week effects, with trading activity and liquidity significantly decreasing on Fridays but increasing on Tuesdays. More recently, Bekaert, Harvey and Lundblad (2003) studied liquidity and expected returns from emerging markets. Using the average proportion of zero daily returns as a measure of liquidity, they find that it significantly predicts future returns, and that unexpected liquidity shocks are positively correlated with return shocks and negatively correlated with shocks to the dividend yield.

Since there are no related papers on the pricing of liquidity risk in Japan, and the *CAPM* has been shown not to hold well in the Japanese market, I expect the model implied relation (that investors either require a return premium for an illiquid security in the illiquid market, or would like to pay a premium for a security with high return in the illiquid market or a liquid stock during the down market) might be hold in the up and down markets according to the empirical results presented in the second chapter about the cross-sectional tests of illiquidity effects.

In the following sections, I will introduce the liquidity-adjusted *CAPM* and its implications, describe the estimation of normalized illiquidity and liquidity risks, and discuss the empirical results of the cross-sectional tests of the constrained and unconstrained models for the liquidity-adjusted *CAPM*.

4.2 Liquidity-adjusted *CAPM* and Liquidity Persistence

To derive the liquidity-adjusted *CAPM*[25], it is essential to probe into the relationship among the expected gross return of an asset $R_t^i = \frac{d_t^i + p_t^i}{p_{t-1}^i}$, its relative illiquidity cost $C_t^i = \frac{c_t^i}{p_{t-1}^i}$, the market return $R_t^M = \frac{\sum_i s^i (d_t^i + p_t^i)}{\sum_i s^i p_{t-1}^i}$ and the relative market illiquidity $C_t^M = \frac{\sum_i s^i c_t^i}{\sum_i s^i p_{t-1}^i}$. In a competitive equilibrium, agents choose consumption and

[25] See Appendix B for assumptions and propositions of the model.

portfolios to maximize their expected utility, and prices are determined in a clearing market.

Acharya and Pedersen (2005) claim that the equilibrium prices in the original economy with illiquidity cost are the same as those of the imagined economy without illiquidity cost where the *CAPM* holds. Therefore, the equilibrium return in the imagined economy is feasible and optimal in the original economy, given the more limited investment opportunities due to the short-selling constraints. Accordingly, the standard *CAPM* transforms into the liquidity-adjusted *CAPM* in returns net of illiquidity cost as follows:

$$E_t(R_{t+1}^i - C_{t+1}^i) = R^f + \lambda_t \frac{\operatorname{cov}_t(R_{t+1}^i - C_{t+1}^i, R_{t+1}^M - C_{t+1}^M)}{\operatorname{var}_t(R_{t+1}^M - C_{t+1}^M)}. \quad (4.1)$$

The liquidity-adjusted *CAPM* for gross returns can be derived by rewriting the one-beta *CAPM* in net returns:

$$E_t(R_{t+1}^i) = R^f + E_t(C_{t+1}^i) + \lambda_t \frac{\operatorname{cov}_t(R_{t+1}^i, R_{t+1}^M)}{\operatorname{var}_t(R_{t+1}^M - C_{t+1}^M)} + \lambda_t \frac{\operatorname{cov}_t(C_{t+1}^i, C_{t+1}^M)}{\operatorname{var}_t(R_{t+1}^M - C_{t+1}^M)}$$

$$-\lambda_t \frac{\operatorname{cov}_t(R_{t+1}^i, C_{t+1}^M)}{\operatorname{var}_t(R_{t+1}^M - C_{t+1}^M)} - \lambda_t \frac{\operatorname{cov}_t(C_{t+1}^i, R_{t+1}^M)}{\operatorname{var}_t(R_{t+1}^M - C_{t+1}^M)}. \quad (4.2)$$

We can notice the sources of liquidity risks represented by the last three terms, for which thorough explanations are offered as follows:

(1) $\operatorname{cov}_{t-1}(C_t^i, C_t^M)$: the first liquidity effect is that the return increases with the covariance between the asset's illiquidity and the market illiquidity, because investors need to be compensated for the risk that their assets may become illiquid when the market as a whole is illiquid. From the theoretical perspective, the illiquidity cost is an autoregressive process of order one--- $c_t = \bar{c} + \rho^C(c_{t-1} - \bar{c}) + \eta_t$ ---- in the assumptions for the liquidity-adjusted *CAPM*, in which there is a time-varying component ρ^C.

Although previously academicians have not studied the effect of notable commonality-in-liquidity on asset prices, three empirical papers (Chordia, Roll and Subrahmanyam (2000), Hasbrouck and Seppi (2001), and Huberman and Halka (2001)) have documented the phenomenon that most stocks' illiquidities are positively related to market illiquidity, which could contribute to the required return. In addition, the risk premium with commonality in liquidity potentially applies in the economy where investors can choose which securities to sell. Particularly speaking, an investor holding an illiquid security may choose to trade other securities instead at lower costs if their liquidity does not co-move with the market liquidity. This implies that investors require a return premium for assets with positive covariance between individual and market illiquidity, *i.e.*, securities whose liquidity co-moves with the market's.

(2) $\mathrm{cov}_{t-1}(R_t^i, C_t^M)$: the second liquidity effect is that the return decreases with the covariance between the asset's return and the market illiquidity, because investors need to be compensated for the risk that their assets will have low return when the market as a whole is illiquid. Two theoretical papers (Holmstrom and Tirole (2000) and Lustig (2004)) support such an effect when examining the implications of corporate demand for liquidity or the equilibrium implications of solvency constraints. Consistent with Pastor and Stambaugh (2003), Wang (2003) reports that in the presence of the Fama-French factors and the momentum factor, the Fama-MacBeth two-stage test yields an annual spread above 4% between portfolios with high and low market liquidity risk.

(3) $\mathrm{cov}_{t-1}(C_t^i, R_t^M)$: the third liquidity effect is that the return decreases with the covariance between the asset's illiquidity and the market return, because investors need to be compensated for the risk that their assets become illiquid when the market

return is low. Meanwhile, investors are willing to accept a discounted return on the stocks whose illiquidity costs are low in a down market, because the ability to sell assets easily is especially valuable when the market return declines. Lynch and Tan (2003) support this, as they find that the liquidity premium is large if the transactions costs covary negatively with wealth shocks. Moreover, an indirect evidence for this implication comes from Ljungqvist and Richardson (2003) who analyze the cash flow, return and risk characteristics of private equity. Using a unique dataset of private equity funds over the last two decades, they document that private equity generates excess returns on the order of five-plus percent per annum relative to the aggregate public equity market, which may represent compensation for holding a 10-year illiquid investment.

To derive an unconditional version for the estimation of the liquidity-adjusted *CAPM*, the assumption of independence over time for dividends and illiquidity costs is violated because illiquidity is persistent; therefore, constant conditional covariances of innovations in illiquidity and returns are assumed instead, and the following unconditional relation is achieved:

$$E(R_t^i - R_t^f) = E(C_t^i) + \lambda\beta^{1i} + \lambda\beta^{2i} - \lambda\beta^{3i} - \lambda\beta^{4i}, \quad (4.3)$$ [26]

where

$$\beta^{1i} = \frac{\text{cov}(R_t^i, R_t^M - E_{t-1}(R_t^M))}{\text{var}[R_t^M - E_{t-1}(R_t^M) - (C_t^M - E_{t-1}(C_t^M))]} \quad (4.4)$$

is the market beta,

$$\beta^{2i} = \frac{\text{cov}(C_t^i - E_{t-1}(C_t^i), C_t^M - E_{t-1}(C_t^M))}{\text{var}[R_t^M - E_{t-1}(R_t^i) - (C_t^M - E_{t-1}(C_t^M))]}, \quad (4.5)$$

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[26] The same model can also be derived by assuming a constant risk premium λ and the following property of covariance: $E(\text{cov}_t(X,Y)) = \text{cov}(X - E_t(X), Y) = \text{cov}(X - E_t(X), Y - E_t(Y))$. The time-variation of λ is driven by the constant absolute risk aversion assumed in the model.

$$\beta^{3i} = \frac{\text{cov}(R_t^i, C_t^M - E_{t-1}(C_t^M))}{\text{var}[R_t^M - E_{t-1}(R_t^M) - (C_t^M - E_{t-1}(C_t^M))]}, \tag{4.6}$$

$$\beta^{4i} = \frac{\text{cov}(C_t^i - E_{t-1}(C_t^i), R_t^M - E_{t-1}(R_t^M))}{\text{var}[R_t^M - E_{t-1}(R_t^M) - (C_t^M - E_{t-1}(C_t^M))]} \tag{4.7}$$

are three sources of liquidity betas, and $\lambda = E(R_t^M - C_t^M - R^f)$.

From the theoretical perspective, the computation of the net return is complicated because it depends on the investor's holding period which may be different from the sampling period; besides, a pricing relation for gross returns and illiquidity may hold in richer models in which net returns are not sufficient state variables. In the empirical literature, extant works such as Chordia, Roll and Subrahmanyam (2000), Hasbrouck and Seppi (2001), and Huberman and Halka (2001) document significant interactions between gross return and liquidity; while previous papers such as Amihud and Mendelson (1986), Amihud (2002), and Pastor and Stambaugh (2003) find that these interactions are actually priced. Therefore, although the conditional *CAPM* holds for returns net of illiquidity costs, the empirical analysis in this dissertation employs gross returns that can be decomposed into net returns and illiquidity costs.

In the next few sections, I will estimate and test the liquidity-adjusted *CAPM* in the following procedures: firstly, forming a market portfolio and 25 test portfolios based on illiquidity, size or *BM* ratio; secondly, computing return and normalized illiquidity for each portfolio in every month; thirdly, estimating illiquidity innovations and liquidity betas for each portfolio; lastly, testing the liquidity-adjusted *CAPM* by running cross-sectional regressions and checking the robustness using various specifications.

4.3 Normalized Illiquidity and Liquidity Risks

As the liquidity cost in the liquidity-adjusted *CAPM* proposed by Acharya and Pedersen (2005) is the cost of selling measured in "yen cost per yen invested," the Amihud ratio somehow does not directly measure the transaction cost. Hence, they normalized the adjusted Amihud ratio such that it will be consistent with the distribution characteristics of the effective bid-ask spread reported by Chalmers and Kadlec (1998). The normalized illiquidity in the former for size-decile portfolios has a mean of 1.24% and a standard deviation of 0.37%, while the effective spread in the latter ranges from 0.29% to 3.14%, with a mean of 1.11%. Therefore, Acharya and Pedersen (2005) conclude that the normalized illiquidity measure is directly related to the per-trade cost required by the liquidity-adjusted *CAPM*. Previous empirical papers[27] show that the Amihud ratio may be the most reliable liquidity proxy among price-impact measures using daily data; therefore, assuming it is a valid instrument for the costs of selling, I use the Amihud ratio calculated in the previous chapter as a proxy for liquidity, since its data are available for a time series desirable for asset pricing with liquidity risk. Despite the statistical suitability of the Amihud ratio in the empirical analysis of this chapter, it has two problems that need to be solved before it can be incorporated in the model by Acharya and Pedersen (2005).

First, the Amihud ratio is measured in "percent per yen," since the daily illiquidity is calculated as the ratio of return over trading value ($|R_m^i|/VAL_m^i$), while the relative liquidity cost in the liquidity-adjusted *CAPM* is the ratio of the cost of selling over ex-dividend price (c_t^i / p_{t-1}^i) specified in "yen cost per yen invested." This suggests that the Amihud ratio should be adjusted for inflation to maintain stationarity and to be suitable for the empirical tests of the model.

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[27] Amihud (2002) shows that the Amihud ratio is positively related to price impact measures and fixed trading costs, and Hasbrouck (2002) finds that the Spearman (Pearson) correlation of Kyle's lambda with the Amihud ratio is 0:737 (0:473).

Another problem is that the Amihud ratio does not directly measure the transaction cost, although it indeed is a reliable instrument for the cost of selling. To solve these two problems, I employ the normalized monthly stock illiquidity in the estimation computed as follows:

$$C_m^i = 0.25 + 0.30 ILL_m^i * CAPR_{m-1}^M, \tag{4.8}$$

The illiquidity ILL_m^i for stock *i* in month *m* is multiplied by the market cap ratio of market portfolio *M* in month *m*-1, where $CAPR_{m-1}^M$ is the ratio of the capitalization of the market portfolio at the end of month *m*-1 over that at the end of February 1975. Since the normalized illiquidity is still a noisy measure that causes difficulty in finding its empirical relation with return, I will use portfolios instead of individual stocks in my analysis to alleviate this problem.

The market portfolio is formed every month during the sample period from 1975 to 1999 by the stocks with a beginning-of-month price higher than 100 yen and at least 15 days of return and volume data. Meanwhile, 25 illiquidity (*LQ*) portfolios are formed each year from 1976 to 1999 from the sample by sorting their annual illiquidity in the previous year. Likewise, 25 *SZ* and *BM* portfolios are formed in each year, based on the year-end market capitalization and *BM* ratio in the previous year for the sample stocks, respectively.

Next, I compute the equally-weighted portfolio return R_m^p and normalized portfolio illiquidity C_m^p for each portfolio *p* in month *m*, respectively, as

$$R_m^p = \frac{1}{I^p} \sum_{i=1}^{I^p} R_m^i \tag{4.9}$$

and $C_m^p = \frac{1}{I^p} \sum_{i=1}^{I^p} C_m^i$, *p*=1,2,…, 25. (4.10) where R_m^i and C_m^i are the monthly return and monthly normalized illiquidity for stock *i* in month *m*, respectively; *p* is the rank of the portfolio, and I^p is the number of stocks in portfolio *p*. I use equally-weighted return and illiquidity in line with Amihud (2002) and Chordia, Roll and Subrahmanyam (2000); and besides, the equally-weighted market return and market illiquidity compensate for the over-representation of large liquid stocks.

The normalized illiquidity for *LQ* portfolios ranges from 0.25% to 0.92%, with a mean of 0.41% and standard deviation of 0.18%. Ahn, Cai, Hamao and Ho (2002) divide their sample of 204 Nikkei 225 component stocks into three groups by average prices from Jan. 5 to Mar. 31, 2000. The average spread is 0.56% for Group 1 with average price less than or equal to ¥2000, 0.31% for Group 2 with average price between ¥2001 and ¥3000, 0.34% for Group 3 with average price between ¥3001 and ¥30000. Thus, the average spread for the whole sample is 0.40%, almost identical to my estimation of average normalized illiquidity of 0.41%.

Because illiquidity is persistent and to eliminate seasonal variation, innovations in illiquidity $C_m^p - E_{m-1}(C_m^p)$ are used to compute liquidity betas, which are obtained from the following regression for each portfolio *p* as well as the market portfolio *M*:

$$0.25 + 0.30ILL_m^p * CAPR_{m-1}^M = a_0 + a_1(0.25 + 0.30ILL_{m-1}^p * CAPR_{m-1}^M)$$

$$+ a_2(0.25 + 0.30ILL_{m-2}^p * CAPR_{m-1}^M) + u_m^p, \tag{4.11}$$

where u_m^p is used as the standardized illiquidity innovation $C_m^p - E_{m-1}(C_m^p)$. The three unadjusted portfolio illiquidities ILL_m^p , ILL_{m-1}^p and ILL_{m-2}^p are multiplied by the same capitalization ratio for the market portfolio $CAPR_{m-1}^{M}$ to exclude its effect on the illiquidity innovations. [28]

Meanwhile, the innovations in market portfolio return are also estimated in an *AR(2)* specification that also controls for market characteristics available at the month-beginning in the spirit of Sadka (2003); in particular, the market return and volatility, the average market illiquidity, the log of trading value and turnover for the market are all measured over the past six months, while the log of market capitalization is a one-month lag.

After the innovations for illiquidity and return have been estimated, the four betas $\beta^{1p}, \beta^{2p}, \beta^{3p}$ and β^{4p} can be computed for each portfolio, using all monthly return and illiquidity observations from 1976 to 1999[29] according to (4.4)~(4.7) as follows:

$$\beta^{1p} = \frac{\operatorname{cov}(R_m^p, R_m^M - E_{m-1}(R_m^M))}{\operatorname{var}[R_m^M - E_{m-1}(R_m^M) - (C_m^M - E_{m-1}(C_m^M))]}, \tag{4.12}$$

$$\beta^{2p} = \frac{\operatorname{cov}(C_m^p - E_{m-1}(C_m^p), C_m^M - E_{m-1}(C_m^M))}{\operatorname{var}[R_m^M - E_{m-1}(R_m^M) - (C_m^M - E_{m-1}(C_m^M))]}, \tag{4.13}$$

$$\beta^{3p} = \frac{\operatorname{cov}(R_m^p, C_m^M - E_{m-1}(C_m^M))}{\operatorname{var}[R_m^M - E_{m-1}(R_m^M) - (C_m^M - E_{m-1}(C_m^M))]}, \tag{4.14}$$

$$\beta^{4p} = \frac{\operatorname{cov}(C_m^p - E_{m-1}(C_m^p), R_m^M - E_{m-1}(R_m^M))}{\operatorname{var}[R_m^M - E_{m-1}(R_m^M) - (C_m^M - E_{m-1}(C_m^M))]}. \tag{4.15}$$

The beta is calculated as the ratio of the covariance between portfolio return R_m^p or illiquidity innovations $C_m^p - E_{m-1}(C_m^p)$ with market return innovations $R_m^M - E_{m-1}(R_m^M)$

28 Pastor and Stambaugh (2003) employ a similar *AR(2)* specification to compute the market liquidity innovations.
29 I use the entire time-series to compute the four betas since Black, Jensen and Scholes (1990) and Pastor and Stambaugh (2003) adopt similar approaches.

or illiquidity innovations $C_m^M - E_{m-1}(C_m^M)$ over the variance of market return net of return and illiquidity innovation[30].

The properties of the equally-weighted *LQ*, *SZ* and *BM* odd-numbered portfolios are reported in Table 18, Table 19 and Table 20, respectively. For the illiquidity portfolios in Table 18, stocks with high average illiquidity tend to have high excess portfolio returns and small market capitalizations; β^{1p} is increasing with portfolios, while β^{3p} and β^{4p} are decreasing with portfolios, β^{2p} does not show a monotonic trend. For the size portfolios in Table 19, stocks with high average illiquidity tend to have high excess portfolio returns and small market capitalizations but have high portfolio turnover; β^{1p} is decreasing with portfolios, while β^{4p} is increasing with portfolios, β^{2p} and β^{3p} do not show monotonic trends. In Table 20, stocks with high average illiquidity tend to have high excess portfolio returns, high portfolio turnover and small market capitalizations. And all the betas do not show monotonic trends.

I also calculate the correlation between the normalized illiquidity and size, trading value and turnover across portfolios, respectively. For all three portfolio formation approaches, illiquidity is highly correlated with size and trading value (correlation coefficient between -0.792 and -0.891), but is highly correlated with turnover only for *SZ* portfolios.

Table 21 reports the correlation matrix for the liquidity betas in *LQ*, *SZ* and *BM* portfolios, respectively. In Panel A for *LQ* portfolios, the highest correlation is 0.811 between β^{3p} and β^{4p}; in Panel B for *SZ* portfolios, the highest correlation is 0.670 between β^{2p} and β^{3p}; in Panel C for *BM* portfolios, the highest correlation is -0.798 between β^{1p} and β^{4p}.

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[30] $\text{var}[R_m^M - E_{m-1}(R_m^M) - (C_m^M - E_{m-1}(C_m^M))]$=0.003246 for the sample in my thesis.

4.4 Cross-sectional Tests

The liquidity-adjusted *CAPM* is tested using *LQ*, *SZ* or *BM* portfolios for each month over the period 1976~1999. A cross-sectional regression of the excess returns on the 25 test portfolios is run, with explanatory variables being the portfolio characteristics in a *GMM* framework that accounts for the pre-estimation of liquidity betas (as in Cochrane (2001)). The estimated coefficients are then averaged over all months.

When the risk premia of the different betas is the same, the "net beta" is defined as

$$\beta^{np} = \beta^{1p} + \beta^{2p} - \beta^{3p} - \beta^{4p}; \tag{4.16}$$

and the liquidity-adjusted *CAPM* then becomes similar to the unconditional model in (4.3) as follows:

$$E(R_m^p - R_m^f) = \alpha + \kappa E(C_m^p) + \lambda \beta^{np}. \tag{4.17}$$

The coefficient κ adjusts for the difference between the monthly period used in the estimation and the typical holding period of an investor. Since the average holding period is proxied by the period over which all shares are turned over once, κ is the average monthly turnover across all stocks in the sample[31].

Next, as the above model does not constitute a test of the effect from liquidity risk, I isolate the effect of liquidity betas from the level of liquidity $E(C_m^p)$ and the market beta β^{1p} in the test of the following model:

$$E(R_m^p - R_m^f) = \alpha + \kappa E(C_m^p) + \lambda^1 \beta^{1p} + \lambda \beta^{np}. \tag{4.18}$$

The model is also tested in an unconstrained version that allows different risk premia for different betas as follows,

$$E(R_m^p - R_m^f) = \alpha + \kappa E(C_m^p) + \lambda^1 \beta^{1p} + \lambda^2 \beta^{2p} + \lambda^3 \beta^{3p} + \lambda^4 \beta^{4p}. \tag{4.19}$$

[31] The calibrated value for average portfolio turnover is 0.037 for *LQ* portfolios, 0.053 for *SZ* portfolios and 0.042 for *BM* portfolios.

The monthly portfolio turnover TRN_m^p calibrated for coefficient κ is computed as follows:

$$TRN_m^p = VAL_m^p / CAP_m^p . \qquad (4.20)$$

This is the ratio of trading value to market capitalization for portfolio *p* in month *m*, where monthly portfolio trading value VAL_m^p is the sum of the trading value across stocks in portfolio *p* in month *m*, and the month-end portfolio market cap CAP_m^p is the sum of market capitalization across stocks in portfolio *p* at the end of month *m*.[32]

Finally, robustness checks are done through controlling for the size for the above three versions of the liquidity-adjusted *CAPM*. Specifically, I add the log value of the month-beginning portfolio market cap ratio to the cross-sectional regression:

$$CAPR_m^p = CAP_m^p / CAP_m^M . \qquad (4.21)$$

This is the ratio of market capitalization CAP_m^p for portfolio *p* to that of the market portfolio *M* at the beginning of month *m*, where month-beginning market cap for a portfolio is the sum of market capitalization across all the stocks in the portfolio.

The first step in the cross-sectional regression is to test the constrained model of the liquidity-adjusted *CAPM* with a single risk premium for the net beta in (4.17). The model specifications and assumptions for lines 1~3 are listed as follows:

Line 1: $E(R_m^p - R_m^f) - kE(C_m^p) = \alpha + \lambda\beta^{np} (+\ln CAPR_m^p)$, constrained liquidity-adjusted *CAPM* where $\lambda^1 = \lambda^2 = -\lambda^3 = -\lambda^4$. The net return $E(R_m^p - R_m^f) - kE(C_m^p)$ is treated as the dependent variable, where *k* is fixed as the time-series average of the monthly portfolio turnover calculated from (4.20). The joint hypotheses are α =0 and λ >0.

[32] Monthly stock trading value VAL_m^i is the trading value for stock *i* in month *m*, and month-end stock market cap CAP_m^i is the market capitalization for stock *i* at the end of month *m* retrieved from monthly stock price and return file.

Line 2: $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda\beta^{np}$ ($+\ln CAPR_m^p$), constrained liquidity-adjusted *CAPM* where $\lambda^1 = \lambda^2 = -\lambda^3 = -\lambda^4$. The excess return $E(R_m^p - R_m^f)$ is treated as the dependent variable, and κ is a free parameter. The joint hypotheses are α =0, κ >0 and λ >0.

Line 3: $E(R_m^p - R_m^f) = \alpha + \lambda^1\beta^{1p}$ ($+\ln CAPR_m^p$), the standard *CAPM*. The joint hypotheses are α =0 and λ^1 >0.

The second step in the cross-sectional regression is to test the constrained model of the liquidity-adjusted *CAPM* with the market beta and the net beta to isolate the effect of liquidity risk over market risk as well as liquidity level in (4.18). The model specifications and assumptions for lines 4~6 are listed as follows:

Line 4: $E(R_m^p - R_m^f) - kE(C_m^p) = \alpha + \lambda^1\beta^{1p} + \lambda\beta^{np}(+\ln CAPR_m^p)$, constrained liquidity-adjusted *CAPM* that $\lambda^1 = \lambda^2 = -\lambda^3 = -\lambda^4$. The net return $E(R_m^p - R_m^f) - kE(C_m^p)$ is treated as the dependent variable, where *k* is fixed as the time-series average of the monthly portfolio turnover. The joint hypotheses are α =0 and λ >0.

Line 5: $E(R_m^p - R_m^f) = \alpha + \kappa E(C_m^p) + \lambda^1\beta^{1p} + \lambda\beta^{np}$ ($+\ln CAPR_m^p$), constrained liquidity-adjusted *CAPM* that $\lambda^1 = \lambda^2 = -\lambda^3 = -\lambda^4$. The excess return $E(R_m^p - R_m^f)$ is treated as the dependent variable, and κ is a free parameter. The joint hypotheses are α =0, κ >0 and λ >0.

Line 6: $E(R_m^p - R_m^f) = \alpha + \lambda^1\beta^{1p} + \lambda\beta^{np}(+\ln CAPR_m^p)$, constrained liquidity-adjusted *CAPM* that $\lambda^1 = \lambda^2 = -\lambda^3 = -\lambda^4$. The excess return $E(R_m^p - R_m^f)$ is treated as the dependent variable, and the model is restricted with κ =0. The joint hypotheses are α =0 and λ >0.

The third step in the cross-sectional regression is to test the unconstrained model of the liquidity-adjusted *CAPM* with different premia for different resources of liquidity risk in (4.19). The model specifications and assumptions for lines 7~9 are listed as follows:

Line 7: $E(R_m^p - R_m^f) - kE(C_m^p) = \alpha + \lambda^1\beta^{1p} + \lambda^2\beta^{2p} + \lambda^3\beta^{3p} + \lambda^4\beta^{4p}$ ($+\ln CAPR_m^p$), unconstrained liquidity-adjusted *CAPM* with different risk premium. The net return $E(R_m^p - R_m^f) - kE(C_m^p)$ is treated as the dependent variable, where k is fixed as the time-series average of the monthly portfolio turnover. The joint hypotheses are α =0, λ^1 >0, λ^2 >0, λ^3 <0 and λ^4 <0.

Line 8: $E(R_m^p - R_m^f) = \alpha + \kappa E(C_m^p) + \lambda^1\beta^{1p} + \lambda^2\beta^{2p} + \lambda^3\beta^{3p} + \lambda^4\beta^{4p}$ ($+\ln CAPR_m^p$), unconstrained liquidity-adjusted *CAPM* with different risk premium. The excess return $E(R_m^p - R_m^f)$ is treated as the dependent variable, and κ is a free parameter. The joint hypotheses are α =0, κ >0, λ^1 >0, λ^2 >0, λ^3 <0 and λ^4 <0.

Line 9: $E(R_m^p - R_m^f) = \alpha + \lambda^1\beta^{1p} + \lambda^2\beta^{2p} + \lambda^3\beta^{3p} + \lambda^4\beta^{4p}$ ($+\ln CAPR_m^p$), unconstrained liquidity-adjusted *CAPM* with different risk premium. The excess return $E(R_m^p - R_m^f)$ is treated as the dependent variable, and κ =0. The joint hypotheses are α =0, λ^1 >0, λ^2 >0, λ^3 <0 and λ^4 <0.

The following subsections discuss the empirical results for the tests of the three versions for the liquidity-adjusted *CAPM* in (4.17), (4.18) and (4.19) that incorporate the net beta in lines 1~3, the market beta together with the net beta in lines 4~6 and the liquidity betas together with the market beta in lines 7~9. For each version, I test three specifications where κ is a fixed parameter with calibrated value from the average monthly portfolio turnover in lines 1, 4 and 7; or κ is a free parameter to be estimated in lines 2, 5 and 8; or κ is restricted to be zero in lines 3, 6 and 9.

The cross-sectional regression results for the constrained model in (4.17) are presented in lines 1~3 for *LQ*, *SZ* and *BM* portfolios in Table 22, Table 23 and Table 24, respectively. Lines 4~6 report the results of the constrained model isolating market risk in (4.18) for three portfolio formation approaches. Lines 7~9 in Tables 22~24 report the results for the unconstrained model in (4.19).

As in the first chapter, I also do the tests of significance for up and down markets to allow a conditional relationship between beta and return. Panel A of those tables shows the tests without distinguishing up and down markets. Panels B and C show the tests for the up and down markets, respectively.

4.4.1 Tests on *LQ* Portfolios

In line 1 of Panel A in Table 22, α is insignificant, λ is positive but insignificant with a coefficient of 0.0085 and a *t*-value of 1.075. In line 2, κ is positive and highly significant with a coefficient of 0.0333 (slightly lower than the calibrated value of 0.0368) and a *t*-value of 4.238; this result is consistent with the previous result from the cross-sectional regression on stock returns in Chapter I that the average illiquidity has a positive effect on stock return. λ becomes negative when average illiquidity is included in the specification, suggesting that the effect from the level of illiquidity subsumes that of the liquidity risk. In line 3, the result for λ^1 is similar to that of λ in line 1. Unlike the result from Acharya and Pedersen (2005), the R^2 for the standard *CAPM* is higher than the constrained liquidity-adjusted *CAPM*.

The risk premiums for the market beta and the net liquidity beta have opposite signs (-0.3801 and 0.3772) and are significant (*t*=-3.415 and 3.388) in line 4. In line 5, the result is similar to that in line 4, but the absolute values for the coefficients become smaller (-0.0726 and 0.0714); unlike in Acharya and Pedersen (2005), κ is a positive (0.0144) and insignificant (t=0.990). Line 6 shows the result similar to that in line 4. Because β^{1p} is contained in β^{np}, the negative market risk premium with higher absolute value than that of the positive liquidity risk premium implies that liquidity risk does not matter over and above market risk and the level of liquidity.

Because of the severe multicollinearity problem between the four betas, it is difficult to identify the effects of different liquidity risks statistically. However, an interesting result comes from the liquidity sensitivity to market return, where β^{4p} has a negative coefficient as expected with moderate significance in line 7 and line 9.

In the test results for up market in Panel B, the coefficients for β^{1p} and β^{np} are higher than those in the tests for the whole period and are significant. For the constrained model isolating market risk, the coefficient of β^{np} is higher than β^{1p}, suggesting that the effect from liquidity risk is stronger than that from market risk. In the unconstrained model, the coefficient for market risk becomes positive and highly significant as in Chapter II.

In Panel C, the coefficients for β^{1p} and β^{np} become negative and significant for the constrained and unconstrained models, which is consistent with the previous results. However, the coefficients are insignificant in the isolation model, and the negative effect from market risk is stronger than the positive effect from liquidity risks. Moreover, there is no effect from β^{4p} in the unconstrained model.

4.4.2 Tests on *SZ* Portfolios

In Table 23 that reports the results for *SZ* portfolios, the R^2s are higher. The coefficient for net beta is still 0.0085 in line 1, and that for the average illiquidity is 0.0464 in line 2. The coefficient for average illiquidity is significant (0.0342 with *t*=2.278) in line 5. For the tests of unconstrained model, the regressions on size portfolios show results that are similar to that of the illiquidity portfolios, with slight differences in line 8. The coefficient for average illiquidity is significant with *t*-values of 3.010 suggesting that level of illiquidity contributes more to the cross-section of stock return than liquidity risk.

In Panel B, the coefficients for β^{1p} and β^{np} are higher than those in the tests for whole period and are significant. For the constrained model isolating market risk, the coefficient of β^{np} is higher than β^{1p}, suggesting that the effect from liquidity risk is stronger than that from market risk. In the unconstrained model, the coefficient for market risk becomes positive and highly significant as in Chapter II.

In Panel C, the coefficients for β^{1p} and β^{np} become negative and significant for all the model specifications; however, the negative effect from market risk is stronger than the positive effect from liquidity risks. Moreover, the effect from β^{4p} still exists in the unconstrained model.

4.4.3 Tests on *BM* Portfolios

For the results of *BM* portfolio in Table 24, the R^2s are similar to those for *LQ* portfolios. However, the effects from the average illiquidity, the market beta and the net beta have all become weaker. The effects for the market beta and the net beta are less significant in line 4 and line 6, but become significant in line 5. The results for the unconstrained model are not as good as in previous tables, as the significance of the *t* values has decreased.

In Panel B, the coefficients for β^{1p} and β^{np} are higher than those in the tests for the whole period and are significant in the constrained model. For the constrained model isolating market risk, the coefficient of β^{np} is slightly higher than β^{1p}, suggesting that the effect from liquidity risk is stronger than that from market risk, although it is less significant than the effect in the whole period. In the unconstrained model, the coefficients for three of the four betas have the correct signs, but none of them are significant. Nonetheless, the effect from the level of illiquidity becomes highly significant.

In Panel C, the coefficients for β^{1p} and β^{np} become negative and significant for the constrained and unconstrained models; however, the negative effect from market risk is stronger than the positive effect from liquidity risks in the isolation model. Moreover, the effect from β^{1p} still exists in the unconstrained model and the effect from the level of illiquidity becomes negative and highly significant.

4.4.4 Tests Controlling for Size

Table 25, Table 26 and Table 27 show the results of the cross-sectional regression that controls for size for *LQ*, *SZ* and *BM* portfolios, respectively. For the tests of constrained model, there is a significant size effect for *LQ* portfolios that subsumes the effect of the net beta and market beta. For *SZ* portfolios, the coefficient for cap ratio has the wrong sign, but those for the net beta and market beta become positive (0.0267 and 0.0263). The result for *BM* portfolios shows strong size effect in all three lines with coefficients between -0.0047 and -0.0044.

In the test of constrained model isolating market risk, the addition of size variable does not affect the results for *LQ* and *SZ* portfolios, but the effects for market and net beta disappear for *BM* portfolios.

For the tests of unconstrained model, the results remain without dramatic changes for *LQ* and *SZ* portfolios, but the effects become extinct for *BM* portfolios.

4.5 Conclusion

This chapter has tested the liquidity-adjusted *CAPM* with stochastic transaction costs, using Fama-MacBeth-type cross-sectional regression for the *TSE* stocks during the period 1976~1999. Because the Amihud ratio has been proved as a good proxy for illiquidity in the preceding two chapters and has a positive effect on stock returns, I use it in the test of this chapter with a normalization that is correspondent to the average transaction costs. Specifically, I test the constrained and the unconstrained versions of the liquidity-adjusted *CAPM* developed by Acharya and Pedersen (2005) where the excess portfolio return is a function of the average illiquidity, the market beta and three sources of liquidity beta (*i.e.*, the commonality in liquidity, the return sensitivity to market illiquidity, and the illiquidity sensitivity to market return). Generally speaking, the model has better fit for *LQ* and *SZ* portfolios than for *BM* portfolios, with or without controlling for size. And the positive and significant coefficient for the average illiquidity confirms my result of liquidity persistence, showing that illiquidity predicts future returns and commoves with contemporaneous return as demonstrated in the previous two chapters. However, compared with the standard *CAPM*, the liquidity-adjusted *CAPM* does not appear to perform better in the constrained form with a net beta indicated by R^2. When combined with market beta, the net beta explains slightly less of the excess portfolio returns. In the test of the unconstrained version, the source of liquidity risk mainly comes from the illiquidity sensitivity to market return that has not been explicitly investigated before except in Acharya and Pedersen (2005). In contrast with their results, the coefficient for this liquidity risk is in the correct sign and with statistical and economic significance in most of the model specifications, suggesting that illiquidity sensitivity to market return should have been paid more attention, in spite of market risk, average illiquidity, and commonality in liquidity, in the previous literature.

The conclusion for the cross-sectional tests of the liquidity-adjusted *CAPM* is qualitatively the same by using value-weighted *LQ*, *SZ*, or *BM* portfolio returns as that of equally-weighted *LQ*, *SZ*, or *BM* portfolio returns, therefore, I do not report the results to save space.

When the tests are done in the up and down markets, the results are slightly better than those without separation. The coefficients for net beta and market beta become higher and the effects from liquidity risks matter over and above those from the market risk. In the unconstrained model, not only the effect from illiquidity sensitivity to market return, but also the effect from market risk becomes significant.

CHAPTER V SUMMARY AND CONCLUSIONS

5.1 Comparison and Contrasts of Empirical Evidence

The similarities and differences of the tests of illiquidity effects cross-sectionally and in time-series as well as the asset pricing tests of liquidity risks for the *TSE* stocks in this thesis are summarized in the Table 28.

In this thesis, I study the liquidity effects and asset pricing with liquidity risks using Japanese data from 1976 to 1999 to explore the similarities and differences resulted from the market mechanisms and investor behaviors between *U.S.* and Japan.

In the first chapter, I study the cross-section of the *TSE* stocks as a function of the Amihud ratio, size, beta, volatility, *BM* ratio, prior returns and three yield variables in various specifications and sub-periods. The results from the cross-sectional tests of liquidity effects on stock returns show that the Amihud ratio is indeed a good measure for liquidity in the Japanese market, especially during the first sub-period when controlling other variables. During the period 1976~1999, expected stock return is an increasing function of expected illiquidity. The mean-adjusted Amihud ratio has a significantly positive effect on expected return when controlling other liquidity, risk and some additional variables, either in a four-variable specification or a seven-variable one. Among the other variables, both dividend yield and *BM* ratio have positive coefficients with moderate significance, while the rest have no visible effects. Basically, the results are not influenced when excluding the January data from the sample period. However, the coefficient for illiquidity is not significant at all in the second half (1990~1999) of the sample period as compared with the first half.

The extremely significant and negative effect of lag monthly return in all specifications confirms the findings of Bremer and Hiraki (1999) that Japanese stocks show strong short-term return reversal.

When the tests are done separately for the up and down markets to account for the conditional relation between beta and return, the result of market beta confirms the study by Hodoshima, Garza–Gomez and Kunimura (2000), who claim that differentiating positive and negative market excess returns in the regression of return on beta yields significant conditional relationships for Japanese data. Moreover, I also document a strong effect of volatility that subsumes the effect from beta in the conditional tests.

Yonezawa (1992) states that unsystematic risk was a significant factor in the pricing of stocks in Japan, and that lack of diversification was the main cause of the invalidity of the *CAPM* in the Japanese stock market. Several popular reasons have been put forward by Yonezawa and Maru (1984) to explain this phenomenon: Japanese stocks have been traded in lots that require a large fund to set up a well-diversified portfolio, which very few personal investors could afford; Japanese companies often held the stocks of those companies with which they have business relations, which does not comply with the assumptions of *CAPM* that investors make decisions based solely on the rational expectations theorem; Trust funds and mutual funds were more interested in the "scenarios" recommended by the biggest 4 Japanese securities companies than to bother about diversification.

In summary, the most enlightening part of this test is that both the Amihud ratio and the *BM* ratio have positive and significant effects on the stock returns, confirming the studies by Amihud (2002) and Chan, Hamao and Lakonishok (1991).

In the second chapter, I test the relation between expected and unexpected market illiquidity on market and portfolio returns for the *TSE* stocks from 1976~1999, and the unexpected market illiquidity is estimated from autoregression of expected market illiquidity. For the time-series tests using either annual or monthly illiquidity data, although the expected illiquidity has a significantly positive effect on expected excess return on the market portfolio, it does not show "size effect" across the *SZ*-based portfolios; in other words, the coefficient does not decrease when the portfolio size becomes larger. However, the unexpected illiquidity has a very strong negative effect on return and also shows a decreasing trend with the increasing portfolio size. Moreover, I document a "*BM* effect" that has not been explicitly studied in previous research that stocks with higher BM ratio tend to experience stronger effects of unexpected market illiquidity. One possible explanation is that these stocks are treated as more illiquid ones, like those stocks with smaller size; thus, the rise of unexpected market illiquidity, which negatively affects stock prices, also decreases the relative demand for stocks with higher *BM* ratio and exacerbates their price decline. This finding confirms the suggestion made by Fama and French (1992) that the characteristics such as *BM* or *SZ* must proxy for a risk (or ‘‘distress") factor in returns because distressed firms are likely to have high *BM* and small *SZ*.

The test using monthly illiquidity data has a strong January-size effect similar to the findings in *U.S.* studies with the "tax loss selling hypothesis" as a possible explanation. Although there is no tax on capital gains for individual investors nor is there a tax benefit for losses in Japan, the potential integration between the *U.S.* and Japanese markets precludes the total rejection of the tax-loss-selling hypothesis according to Kato and Schallheim (1985).

In summary, the results from the time-series regression confirm the prediction that the stock return in excess of the treasury yield compensates not only its market risk but market illiquidity with a stronger effect for firms with smaller size or higher *BM* ratio. The greater sensitivity of the stock returns for smaller firms and firms with higher *BM* ratio to market illiquidity suggests that they have greater illiquidity risk; if illiquidity risk is priced in the market, stocks should also be compensated for higher liquidity risk with higher liquidity premiums.

The third chapter tests the liquidity-adjusted *CAPM* with stochastic transaction costs, using Fama-MacBeth-type cross-sectional regression for the *TSE* stocks during the period 1976~1999. I test the constrained and the unconstrained versions of the liquidity-adjusted *CAPM* developed by Acharya and Pedersen (2005) where the excess portfolio return is a function of the average illiquidity, the market beta and three sources of liquidity beta (*i.e.*, the commonality in liquidity, the return sensitivity to market illiquidity, and the illiquidity sensitivity to market return). Generally speaking, the model has better fit for *LQ* and *SZ* portfolios than for *BM* portfolios, with or without controlling for size. And the positive and significant coefficient for the average illiquidity confirms my result of liquidity persistence, showing that illiquidity predicts future returns and commoves with contemporaneous return as demonstrated in the previous two chapters. However, compared with the standard *CAPM*, the liquidity-adjusted *CAPM* does not appear to perform better in the constrained form with a net beta indicated by R^2. When combined with market beta, the net beta explains slightly less of the excess portfolio returns. In the test of the unconstrained version, the source of liquidity risk mainly comes from the illiquidity sensitivity to market return that has not been explicitly investigated before except in Acharya and Pedersen (2005). In contrast with their results, the coefficient for this liquidity risk is in the correct sign and with statistical and economic significance in most of the model specifications, suggesting that illiquidity sensitivity to market return should have been paid more attention, in spite of market risk, average illiquidity, and commonality in liquidity, in the previous literature.

When the tests are done in the up and down markets, the results are slightly better than those without separation. The coefficients for net beta and market beta become higher and the effects from liquidity risks matter over and above those from the market risk. In the unconstrained model, not only the effect from illiquidity sensitivity to market return, but also the effect from market risk becomes significant.

5.2 Discussion and Implications

The study in this thesis has incorporated features that are unique to the Japanese market such as stock characteristics that have been documented to have significant effects in asset pricing by previous studies using the *TSE* data.

I find significant "*BM*" effects but not for cash flow yield in the tests of cross-sectional effects unlike Chan, Hamao and Lakonishok (1991), this may due to the availability of the depreciation data that are used to calculate cash flow yield from *PACAP* database. On the other hand, the results of prior returns have shown the necessity for the study of momentum effects that are resulted from liquidity argument as discussed in Sadka (2003).

Moreover, the significant results from the tests when separating up and down markets suggest that Japanese investors have distinguished behaviors in different market states. This discrepancy leads to opposite effects of stock characteristics on stock return; thus, the conditional relation of the standard *CAPM* also applies to other asset pricing models such as the liquidity-adjusted *CAPM*. For investment decisions in Japan, it is also necessary to pay attention to opposite risk and liquidity premium during bull or bear markets when the standard *CAPM* does not hold for the whole market.

In the time-series tests, I could not offer any good explanation for the lack of size or *BM* effects from the expected market illiquidity on portfolio return except that the model that is used to derive unexpected illiquidity maybe mis-specified in Amihud (2002). The insignificant effects from term-yield premium may be due to its calculation method for the *TSE* stocks that is different from that in *U.S.* as well as the fact that the data for default yield premium are not available at hand.

In the liquidity-adjusted *CAPM* developed by Acharya and Pedersen (2005), the values of return and illiquidity have led to the different scales for different covariances and thus the high correlation between market beta and net beta which results in multicollinearity problem in the model specification that isolating market and liquidity risks.

Moreover, the estimation of the innovation for market return may have missed some factors that are unique to Japan. I do not document a strong “commonality-in-liquidity” phenomenon but strong liquidity sensitivity to market return suggesting that investors would like to pay a premium for the liquid stocks in bear markets.

Another problem from the empirical tests of this model is that the Amihud ratio needs to be normalized to be consistent with the distribution of transaction costs in the respective market before employed in the model. If the transaction costs cannot be estimated properly, the level of expected illiquidity may affect the consistency among the results of different model specifications, *i.e.* the true effects from the level of illiquidity, market risk and liquidity risks could not be identified accurately.

Although I could not claim that the liquidity-adjusted *CAPM* is mis-specified without differentiating the market states, an empirical test of it depends on the proper estimation of normalized illiquidity and the innovation of market return based on the data availability, model specifications and the reliability of the liquidity measure. It is interesting to study the effects of liquidity risks using other easily-available measures such as the incidence of zero return observations proposed by Lesmond *et al.* (1999) for the liquidity-adjusted *CAPM*, as it is a good proxy for the delay and search costs which is an important part of the illiquidity costs in an order-driven market like the *TSE*.

In general, my comprehensive studies show that the level and uncertainty of illiquidity have important theoretical and empirical implications for asset pricing theories under different market mechanisms and have practical guidance for investment decisions of different investment behaviors.

Appendix A The Development of the Japanese Stock Market and the Time-series Pattern of Annual Market Illiquidity

The Japan Securities Research Institute separated the development of the Japanese securities market from 1976 to 1999 into several stages in their publication *Securities Market in Japan 2001*, as follows, and Figure 1 shows the time-series pattern of the annual market illiquidity for the sample stocks during this period:

(1) *1976-1984*[33]*: measures taken to cope with the oil crisis*

In order to cope with the recession caused by the oil shocks in the 1970s, the Japanese government issued large amounts of deficit-covering bonds. The bond holdings by city banks and other financial institutions increased to such an extent that the existing liquidity policy became outdated. Therefore, the Ministry of Finance authorized a Gensaki agreement between a securities company and a regional bank, which eased the ban on the banking institutions engaging in the securities business. A new foreign-exchange control law enforced in 1980 paved the way for the liberalization of securities investments. Meanwhile, the stock holdings of business corporations had greatly increased and the banks also invested their funds in stocks. As a result, the structure of securities ownership was increasingly dominated by corporate investors, and cross-shareholding among business corporations increased. In order to maintain an orderly and efficient market, the government launched a system of commingled custody of stock certificates. Thanks to all the above measures that have been taken to cope with the oil crisis in November 1973, the recovery of the market boosted the Nikkei Dow average to a historic high. During this sub-period, the annual market illiquidity peaked at the beginning at 0.17%, declined in the following two years and

[33] An ad valorem brokerage commission system was introduced on Apr. 1, 1977 and Computer-assisted Order Routing & Execution System (CORES) was introduced on Jan. 23, 1982.

oscillated between 0.08% and 0.12% for the rest of the sub-period. The Nikkei 225 increased from 4852.13 to 10377.97 steadily. Therefore, the market liquidity had increased and had been controlled in a stable range due to the liquidity-enhancing measures.

(2) *1985-1989: developments before and after the economic bubble*

Since 1984, the United States had brought strong pressure on Japan to open its securities market, and the number of foreign securities companies that could engage in the securities business in Japan had increased. The Japanese market came to provide all methods of trading, including cash stocks, futures and options, consecutively, during this period. Also, the government started the process of privatizing large state-owned enterprises. In 1986, a law defining the services provided by investment advisers was instituted. Meanwhile, the increased capital held by banks and securities companies stretched the capability of cross-shareholding to the limit. However, the negative impact on the Tokyo securities market of the stock crash in 1987 reminded the market of the disadvantages brought by the liberalization of the money and capital markets with financial market reforms. Because the Japanese market had emerged relatively unscathed from the previous depression in 1929, the stock prices continued to rise at a pace faster than that of other countries. Despite the tight credit stance, the Nikkei Dow average continued to spurt, boosting its secondary market size to the highest in the world. During this period, the annual market illiquidity kept declining from 0.08% to 0.04%, and the Nikkei 225 was increasing sharply from 12882.09 to 32948.69, *i.e.*, the market liquidity rose due to the liberalization of the money and capital markets with financial market reforms, despite the stock market crash in 1987. In sharp contrast, Figure 1 in Acharya and Pedersen (2005) shows the highest market illiquidity innovations at the time of the crash.

3) *1990-1995*[34]*: reform of the financial system after the stock market scandals*

Because of the plummeting stock prices in 1990, the public offering of new issues virtually came to a halt until 1994. As the situation of the Gulf War was worsening, the Ministry of Finance proposed a plan to prop up falling stock prices. However, the scandals involving the nation's leading securities companies came to light, provoking low investor confidence to a greater extent. After a thorough investigation by the National Tax Administration Agency, the big four securities companies were charged with illegal compensation, wrongful transactions and stock manipulation that had caused public outrage. The amended Securities and Exchange Law thereafter banned compensation for trading losses that occurred in discretionary accounts. After these incidents, the regulators realized the shortcomings of the fixed commission-rate system that resulted in a lack of competition among the securities companies, and consequently enacted the Institutional Reform Law in 1992. In addition, the regulators authorized the entry of different categories of financial institutions into one another's markets, and the establishment of wholly-owned subsidiaries in one another's areas of business. Although the enforcement of the Financial System Reform Law has strengthened competition, the trading volume of securities has not recovered. Therefore, the annual market illiquidity climbed up from a historical low of 0.02% to 0.08% again during this sub-period, and the Nikkei 225 dropped from 31940.24 to 14517.4, indicating that the implementation of those reform laws against scandals was not as effective as expected and needed to be ameliorated.

4) *1996-1999*[35]*: debate on, and enforcement of, the Financial System Reform Law*

[34] Floor Order Routing and Execution System (FORES) was introduced on Nov. 26, 1990, Central Depository & Clearing System began its operation on Oct. 9, 1991, and partial (over 1 billion yen) deregulation of brokerage commission was effected on Apr. 1, 1994.

In 1996, the government decided to carry out the so-called "Banking and Securities Market Big-Bang Declaration." In the short run, the policy aimed to rebuild the market that had been exposed to banking and securities scandals; in the medium run, it reflected afterthought about turning the system of licensing securities companies into a registration system; in the long run, it was a decision to reorient the nation's economic and social policies of the previous 50 years. Debate over these issues was conducted by several government agencies, such as the Securities and Exchange Council, and the Financial System Research Council, etc. They came up almost unanimously with a change in policy direction towards a market-based direct financing, and a number of reform measures have been implemented since 1999. In particular, transactions in all financial products have been liberalized, the *OTC* securities trading market was elevated to the same status as the stock exchange, a market for trading in unlisted stocks has been developed, *NASDAQ* has been advanced to the Japanese market, and stock exchanges have been converted to joint stock companies. During this sub-period, the annual market illiquidity was about 0.06% in the first two years, but rose to a historical high of around 0.19% finally, while the Nikkei 225 reduced slightly from 22530.75 to 17529.74 because of the devastating impact of the Asian Financial Crisis, as well as the Russian default and Long-Term Capital Management Crisis. Figure 1 in Acharya and Pedersen (2005) shows high innovations for market illiquidity as well in the late 1990s.

For the whole sample period, the *Tokyo Stock Exchange Fact Book 1999* listed a series of events over 1976 to 1999 that has influenced the changes in the stock indexes and the trading volume on the *TSE*:

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[35] Partial (over 50 million yen) deregulation of brokerage commission was effected on Apr. 1, 1998, ToSTNeT was introduced on June 29,1998, TDnet (Timely Disclosure Network) system was introduced on July 1, 1998, Target (*TSE* wide area network) was introduced on June 1, 1999, and brokerage commission was liberalized on Oct. 1, 1999.

1. The Special Financial Measures Law was enacted on Oct. 15, 1976;

2. The *OPEC* meeting sharply raised crude oil prices on Aug. 15, 1979;

3. An amendment to the Commercial Code introducing a unit share system was enforced on Oct. 1, 1982;

4. Banks started selling government bonds at their windows on Apr. 9, 1983;

5. Trading in government bond futures commenced on Oct. 19, 1985;

6. Shares of *NTT* were listed on Feb. 9, 1987;

7. New York stock prices crashed on Oct. 19, 1987;

8. The Japanese government announced stock price bolstering measures and a fiscal stimulus package on Aug. 15 and 28, 1992, respectively;

9. Shares of JR East Japan and Japan Tobacco were listed on Oct. 26, 1993 and Oct. 27, 1994, respectively;

10. The yen rose above ¥80 to the dollar, an all-time high, on Apr. 19, 1995;

11. The amended Foreign Exchange and Trade Law was enforced on Apr. 1, 1998;

12. The Financial System Reform Law was enforced on Dec. 1, 1998.

Appendix B Assumptions and Propositions of the Liquidity-adjusted *CAPM*

The liquidity-adjusted *CAPM* assumes an overlapping-generations economy where *N* agents indexed by *n* are born at time *t* and live till *t+1* (Samuelson (1958)). Agent *n* has an endowment at time *t*, trades in *t* and *t+1*, and derives utility from consumption x_{t+1} at time *t+1*. His preferences are represented by the expected utility function $-E_t \exp(-A^n x_{t+1})$ with constant absolute risk aversion A^n.

There are *I* securities indexed by *i* with s^i shares each. At time *t*, security *i* pays a dividend of d_t^i, has an ex-dividend price of p_t^i and an illiquidity cost of c_t^i modeled as selling cost per share. The uncertainty about this cost generates the liquidity risk in the model. Short-selling is not allowed. Assuming that d_t^i and c_t^i are *AR(I)* processes:

$$d_t = \bar{d} + \rho^D (d_{t-1} - \bar{d}) + \varepsilon_t \qquad \text{(A.1)}$$

and $c_t = \bar{c} + \rho^C (c_{t-1} - \bar{c}) + \eta_t$. (A.2)

where $\bar{d}$, $\bar{c} \in \Re_+^I$ are positive real vectors, ρ^d, $\rho^c \in [0,1]$, (ε_t, η_t) is an *i.i.d.* normal process with mean $E(\varepsilon_t) = E(\eta_t) = 0$ and variance-covariance matrices $\text{var}(\varepsilon_t) = \Sigma^d$, $\text{var}(\eta_t) = \Sigma^c$, $E(\varepsilon_t \eta_t^{\mathrm{T}}) = \Sigma^{cd}$.

Exogenously, agents can borrow and lend at a risk-free real return of $R^f > 1$.

The following are three propositions related to the liquidity-adjusted *CAPM*.

Proposition 1 states that the required excess return is the expected relative illiquidity cost $E_{t-1}(C_t^i)$ plus the risk premium time four betas, which depend on return and liquidity. In the standard *CAPM*, the required stock return linearly increases with the systematic risk; the adjusted model above yields three more covariances regarded as liquidity risks.

Proposition 1: *In the unique linear equilibrium, the conditional expected net return of security i is*

$$E_t(R_{t+1}^i - C_{t+1}^i) = R^f + \lambda_t \frac{\text{cov}_t(R_{t+1}^i - C_{t+1}^i, R_{t+1}^M - C_{t+1}^M)}{\text{var}_t(R_{t+1}^M - c_{t+1}^M)}, \tag{A.3}$$

where $\lambda_t = E_t(R_{t+1}^M - C_{t+1}^M - R^f)$ *is the risk premium; the conditional expected gross return is*

$$E_t(R_{t+1}^i) = R^f + E_t(C_{t+1}^i) + \lambda_t \frac{\text{cov}_t(R_{t+1}^i, R_{t+1}^M)}{\text{var}_t(R_{t+1}^M - C_{t+1}^M)} + \lambda_t \frac{\text{cov}_t(C_{t+1}^i, C_{t+1}^M)}{\text{var}_t(R_{t+1}^M - C_{t+1}^M)}$$
$$- \lambda_t \frac{\text{cov}_t(R_{t+1}^i, C_{t+1}^M)}{\text{var}_t(R_{t+1}^M - C_{t+1}^M)} - \lambda_t \frac{\text{cov}_t(C_{t+1}^i, R_{t+1}^M)}{\text{var}_t(R_{t+1}^M - C_{t+1}^M)}. \tag{A.4}$$

Because the illiquidity cost is an *AR(I)* process $c_t = \bar{c} + \rho^C(c_{t-1} - \bar{c}) + \eta_t$ and ρ^C>0 implies that liquidity is time-varying and persistent, liquidity predicts future returns and co-moves with contemporaneous returns. Specifically, high current illiquidity predicts high expected illiquidity that leads to high future return but low contemporaneous return. Proposition 2 states that the conditional expected return $E_{t-1}(R_t^q - R^f)$ is positively related to the current illiquidity cost C_{t-1}^q ----an implication of the persistence of liquidity.

Proposition 2 *Suppose that* ρ^c >0, *and that* $q \in \Re^I$ *is a portfolio with* $E_t(p_{t+1}^q + d_{t+1}^q) > \rho^C p_t^q$. *Then, the conditional expected return increases with illiquidity,*

$$\frac{\partial}{\partial C_t^q} E_t(R_{t+1}^q - R^f) > 0. \tag{A.5}$$

Furthermore, so long as the liquidity is persistent and the innovations of dividends and illiquidity are not highly correlated, the predictability of liquidity may imply a negative covariance between contemporaneous illiquidity and return, as in Proposition 3, since high illiquidity predicts high required return that depresses the current price, leading to a low current return.

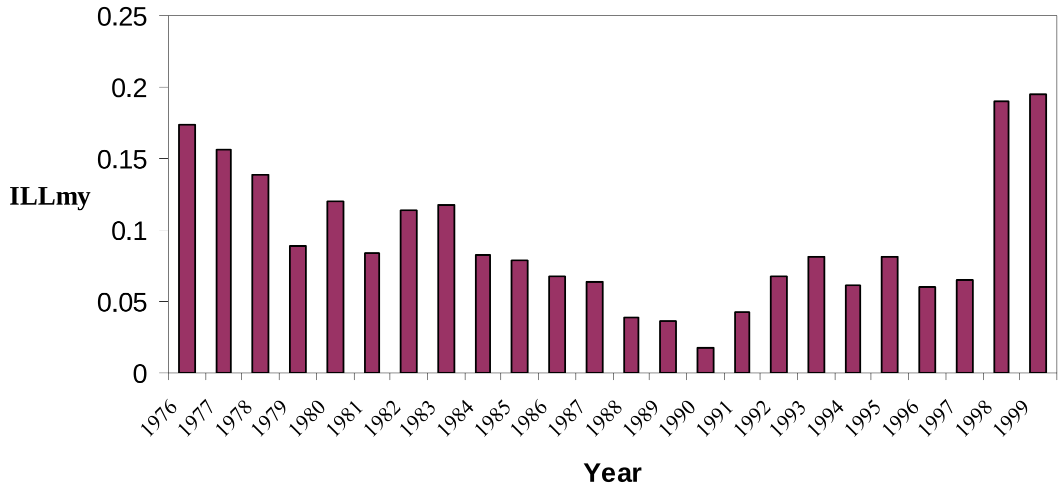
Proposition 3 *Suppose* $q \in \Re^I$ *is a portfolio such that* $\rho^c (R^f q^T \Sigma^{cd} q + (R^f - \rho^d) q^T \Sigma^c q) > (R^f)^2 q^T \Sigma^{cd} q$, *then,*

$$\mathrm{cov}_t (C_{t+1}^q, R_{t+1}^q) < 0. \quad \text{(A.6)}$$

Figure 1 Time-Series Pattern of Annual Market Illiquidity and the Nikkei 225

This figure shows the time-series pattern of the annual market illiquidity ILL_y^M in Panel A and Nikkei 225 in Panel B during the sample period. ILL_y^M is calculated as the cross-sectional average of annual stock illiquidity for all the sample stocks during 1976~1999. The stocks included in the sample must have valid observations of return and trading value data for more than 200 days in a year and have year-end price greater than 100 yen, outliers with annual illiquidity at the highest or lowest 1% tails of the distribution are eliminated. Nikkei 225 is the index value at the end of each fiscal year.

Panel A: Annual Market Illiquidity



Panel B: Nikkei 225

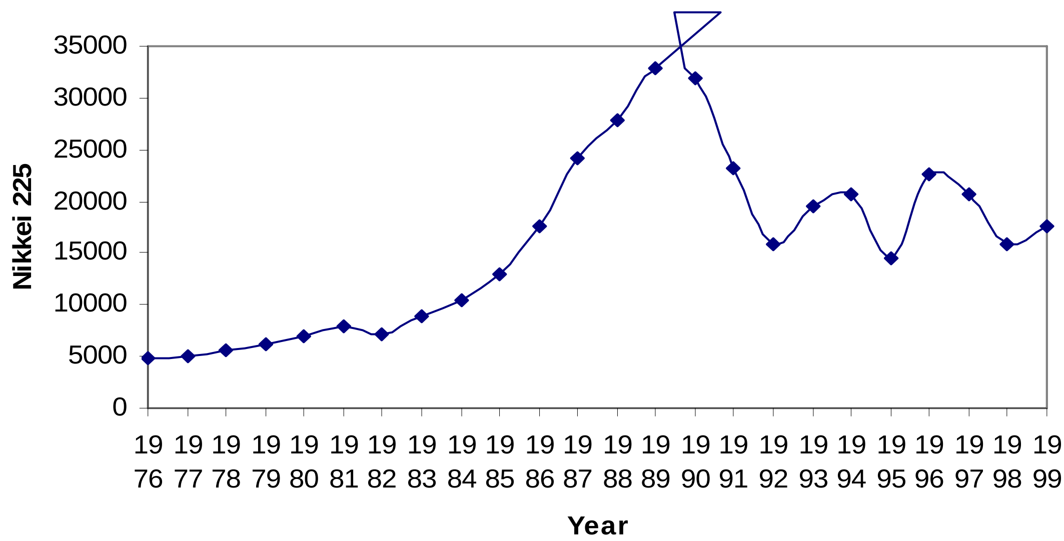


Table 1 Tick Size Classification for the *TSE* Stocks*

This table reports the tick size with respect to the range of stock price per share for the stocks listed on the *TSE*.

Stock price per share (¥)				*Tick size (¥)*
		Up to	2,000	1
More than	2,000	up to	3,000	5
More than	3,000	up to	30,000	10
More than	30,000	up to	50,000	50
More than	50,000	up to	100,000	100
More than	100,000	up to	1,000,000	1,000
More than	1,000,000	up to	20,000,000	10,000
More than	20,000,000	up to	30,000,000	50,000
		More than	30,000,000	100,000

*Excerpted from Fact Book 2004 published by the Tokyo Stock Exchange, Inc.

Table 2 Daily Price Limits Classification for the TSE Stocks*

This table reports the daily price limits classification with respect to previous day's closing price or special quote for the stocks listed on the *TSE*.

Previous Day's Closing Price or Special Quote		*Daily Price Limits (+/-)*
	Less than ¥100	¥30
Equal to or more than ¥100	¥200	¥50
¥200	¥500	¥80
¥500	¥1000	¥100
¥1000	¥1500	¥200
¥1500	¥2000	¥300
¥2000	¥3000	¥400
¥3000	¥5000	¥500
¥5000	¥10,000	¥1,000
¥10,000	¥20,000	¥2,000
¥20,000	¥30,000	¥3,000
¥30,000	¥50,000	¥4,000
¥50,000	¥70,000	¥5,000
¥70,000	¥100,000	¥10,000
¥100,000	¥150,000	¥20,000
¥150,000	¥200,000	¥30,000
¥200,000	¥300,000	¥40,000
¥300,000	¥500,000	¥50,000
¥500,000	¥1,000,000	¥100,000
¥1,000,000	¥1,500,000	¥200,000
¥1,500,000	¥2,000,000	¥300,000
¥2,000,000	¥3,000,000	¥400,000
¥3,000,000	¥5,000,000	¥500,000
¥5,000,000	¥10,000,000	¥1,000,000
¥10,000,000	¥15,000,000	¥2,000,000
¥15,000,000	¥20,000,000	¥3,000,000
¥20,000,000	¥30,000,000	¥4,000,000
¥30,000,000	¥50,000,000	¥5,000,000
	¥50,000,000 or more	¥10,000,000

*Excerpted from Fact Book 2004 published by the Tokyo Stock Exchange, Inc.

Table 3 Special Quote Parameters Classification for the TSE Stocks*

This table reports the special quote parameters classification with respect to the current price for the stocks listed on the *TSE*.

Current Price		*Parameters (+/-)*
	Less than ¥500	¥5
Equal to or more than ¥500	¥1,000	¥10
¥1,000	¥1,500	¥20
¥1,500	¥2,000	¥30
¥2,000	¥3,000	¥40
¥3,000	¥5,000	¥50
¥5,000	¥10,000	¥100
¥10,000	¥20,000	¥200
¥20,000	¥30,000	¥300
¥30,000	¥50,000	¥400
¥50,000	¥70,000	¥500
¥70,000	¥100,000	¥1,000
¥100,000	¥150,000	¥2,000
¥150,000	¥200,000	¥3,000
¥200,000	¥300,000	¥4,000
¥300,000	¥500,000	¥5,000
¥500,000	¥1,000,000	¥10,000
¥1,000,000	¥1,500,000	¥20,000
¥1,500,000	¥2,000,000	¥30,000
¥2,000,000	¥3,000,000	¥40,000
¥3,000,000	¥5,000,000	¥50,000
¥5,000,000	¥10,000,000	¥100,000
¥10,000,000	¥15,000,000	¥200,000
¥15,000,000	¥20,000,000	¥300,000
¥20,000,000	¥30,000,000	¥400,000
¥30,000,000	¥50,000,000	¥500,000
	¥50,000,000 or more	¥1,000,000

*Excerpted from Fact Book 2004 published by the Tokyo Stock Exchange, Inc.

Table 4 Sample Selection Process

This table reports the sample selection process. The sample period covers 1976~1999. The stocks included in the sample must have valid observations of return and trading value data for more than 200 days and have year-end price greater than 100 yen, outliers with annual illiquidity at the highest or lowest 1% tails of the distribution are eliminated.

Year	*Trading days*	*Original stocks*	*Stocks with price>¥100*	*Stocks with trading days>200*	*Final sample*
1976	286	985	915	577	565
1977	286	994	932	656	643
1978	285	1002	939	729	714
1979	286	1011	1009	757	742
1980	285	1022	1021	731	716
1981	285	1030	1027	684	670
1982	285	1041	1037	671	658
1983	286	1058	1047	759	744
1984	287	1077	1074	826	809
1985	285	1086	1084	878	860
1986	279	1109	1109	953	934
1987	274	1129	1129	963	944
1988	273	1152	1152	1027	1006
1989	249	1170	1170	1060	1039
1990	246	1184	1184	1057	1036
1991	246	1192	1192	1020	1000
1992	247	1223	1223	1031	1010
1993	246	1231	1230	1055	1034
1994	247	1236	1236	1115	1093
1995	249	1239	1239	1119	1097
1996	247	1252	1250	1170	1147
1997	245	1296	1293	1135	1112
1998	247	1332	1248	1150	1127
1999	245	1350	1278	1147	1124

Table 5 Summary Statistics for the Stock Characteristics

This table shows the summary statistics for the stock characteristics used in the cross-sectional regression. ILL_y^i is the average illiquidity for stock i across days in year y. CAP_y^i is the market capitalization for stock i at the end of year y. β_y^{1i} is the market beta for stock i in year y estimated from the market model. STD_y^i is the standard deviation of return for stock i across days in year y multiplied by 10^2. EP_y^i is the ratio of earnings per share to share price for stock i in year y. CP_y^i is the ratio of earnings per share plus depreciation to share price for stock i in year y. DP_y^i is the ratio of dividend per share to share price for stock i in year y. BM_y^i is the ratio of book value to market value of equity for stock i at the end of year y. PR_y^{1i} is the past return for the last 100 days for stock i in year y calculated as the log ratio of daily closing price. PR_y^{2i} is the past return for the rest days for stock i in year y calculated as the log ratio of daily closing price. The period covers 1975~1998. The stocks included in the sample must have valid observations of return and trading value data for more than 200 days and have year-end price greater than 100 yen, outliers with annual illiquidity at the highest or lowest 1% tails of the distribution are eliminated.

Variable	*Mean of annual means*	*Mean of annual standard deviation*	*Mean of annual skewness*	*Median of annual means*	*Minimum of annual means*	*Maximum of annual means*
ILL_y^i	0.093	0.110	1.853	0.081	0.018	0.195
CAP_y^i (¥million)	206946.5	428704.0	5.562	213487.3	58419.4	417026.7
β_y^{1i}	1.042	0.185	-0.008	1.048	0.959	1.143
STD_y^i	2.309	0.641	0.642	2.168	1.871	3.354
EP_y^i (%)	2.017	8.098	-4.955	2.099	-3.095	4.938
CP_y^i (%)	7.381	11.439	4.979	6.973	3.978	11.474
DP_y^i (%)	1.189	0.706	0.457	1.108	0.548	2.198
BM_y^i	0.514	0.254	-0.689	0.506	0.265	1.051
PR_y^{1i} (%)	-1.235	20.664	0.160	1.802	-46.750	36.658
PR_y^{2i} (%)	3.612	17.076	0.639	5.198	-27.634	24.335

Table 6 Correlation for the Stock Characteristics

This table shows the correlation matrix for the stock characteristics used in the cross-sectional regression. ILL^i_{m-1} is the illiquidity for stock *i* across days in month *m*-1. $\ln CAP^i_{m-1}$ is the logarithm of the market capitalization for stock *i* at the end of *m*-1. β^{1i}_y is the market beta for stock *i* in year *y* estimated from the market model. STD^i_y is the standard deviation of return for stock *i* across days in year *y*. DP^i_y is the ratio of dividend per share to share price for stock *i* in year *y*. EP^i_y is the ratio of earnings per share to share price for stock *i* in year *y*. CP^i_y is the ratio of earnings per share plus depreciation to share price for stock *i* in year *y*. BM^i_y is the ratio of book value to market value of equity for stock *i* at the end of year *y*. PR^{1i}_y is the past return for the last 100 days for stock *i* in year *y* calculated as the log ratio of daily closing price. PR^{2i}_y is the past return for the rest days for stock *i* in year *y* calculated as the log ratio of daily closing price. And R^i_{m-1} is the monthly return for stock *i* in month *m*-1. The period covers 1975~1998. The stocks included in the sample must have valid observations of return and trading value data for more than 200 days and have year-end price greater than 100 yen, outliers with annual illiquidity at the highest or lowest 1% tails of the distribution are eliminated.

Panel A: *SZ*-Portfolio Beta

Variable	$\ln CAP^i_{m-1}$	β^{1i}_y	STD^i_y	DP^i_y	EP^i_y	CP^i_y	BM^i_y	PR	PR^{2i}_y	R^i_{m-1}
ILL^i_{m-1}	**-0.502**	0.358	0.200	0.071	-0.064	0.004	0.244	-0.185	-0.061	-0.067
$\ln CAP^i_{m-1}$		-0.471	-0.274	-0.131	0.051	-0.002	-0.229	0.084	0.036	0.038
β^{1i}_y			0.232	-0.016	-0.040	-0.027	0.076	-0.092	-0.073	0.005
STD^i_y				-0.306	-0.228	-0.154	0.083	-0.124	0.162	-0.009
DP^i_y					0.213	0.268	0.378	-0.063	-0.020	0.020
EP^i_y						**0.685**	-0.047	0.104	-0.034	0.001
CP^i_y							0.079	0.040	0.001	0.011
BM^i_y								-0.330	0.041	-0.005
PR^{1i}_y									-0.026	0.010
PR^{2i}_y										0.002

Panel B: *BM*-Portfolio Beta

Variable	$\ln CAP^i_{m-1}$	β^{1i}_y	STD^i_y	DP^i_y	EP^i_y	CP^i_y	BM^i_y	PR^{1i}_y	PR^{2i}_y	R^i_{m-1}
ILL^i_{m-1}	**-0.502**	0.037	0.200	0.071	-0.064	0.004	0.244	-0.185	-0.061	-0.067
$\ln CAP^i_{m-1}$		-0.106	-0.274	-0.131	0.051	-0.002	-0.229	0.084	0.036	0.038
β^{1i}_y			0.166	-0.140	-0.070	-0.072	-0.101	0.074	-0.053	0.004
STD^i_y				-0.306	-0.228	-0.154	0.083	-0.124	0.162	-0.009
DP^i_y					0.213	0.268	0.378	-0.063	-0.020	0.020
EP^i_y						**0.685**	-0.047	0.104	-0.034	0.001
CP^i_y							0.079	0.040	0.001	0.011
BM^i_y								-0.330	0.041	-0.005
PR^{1i}_y									-0.026	0.010
PR^{2i}_y										0.002

Table 7 Cross-Sectional Illiquidity Effects on Stock Return---*SZ*-Portfolio Beta

The table presents the means of the coefficients from the monthly cross-sectional regression of stock return on the respective variables:

$$R_m^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y}\beta_{y-1}^{1i} + k_{3y} PR_{y-1}^{1i} + k_{4y} PR_{y-1}^{2i}. \quad (2.5)$$

$$R_m^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y}\beta_{y-1}^{1i} + k_{3y} R_{m-1}^i. \quad (2.8)$$

$$R_y^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y}\beta_{y-1}^{1i} + k_{3y} PR_{y-1}^{1i} + k_{4y} PR_{y-1}^{2i}. \quad (2.10)$$

$$R_m^i = k_{0y} + k_{1y} ILL_{m-1}^i + k_{2y}\beta_{y-1}^{1i} + k_{3y} R_{m-1}^i. \quad (2.13)$$

$ILLM_{y-1}^i$ is the ratio of stock illiquidity to market illiquidity for stock *i* in year *y*-1. ILL_{m-1}^i is the illiquidity for stock *i* in month *m*-1. β_{y-1}^i is the market beta for stock *i* in year *y*-1 estimated from the market model with portfolios sorted by size. PR_{y-1}^{1i} is the past return for the last 100 days for stock *i* in year *y*-1 calculated as the log ratio of daily closing price. PR_{y-1}^{2i} is the past return for the rest days for stock *i* in year *y*-1 calculated as the log ratio of daily closing price. And R_{m-1}^i is the monthly return for stock *i* in month *m*-1. The monthly returns are from 1976 to 1999, and the stock characteristics are from 1975 to 1998. The *t*-statistics are reported in parentheses.

Panel A: Original Regression

Variable	*Constant*	$ILLM_{y-1}^i$	β_{y-1}^i	PR_{y-1}^{1i}	PR_{y-1}^{2i}
Annual regression	0.0450	0.0177	-0.0535	-0.0870	-0.0242
	(0.878)	(2.728)**	(-0.969)	(-2.446)**	(-0.637)
All months	0.0082	0.0014	-0.0015	-0.0060	0.0004
	(1.552)	(2.493)**	(-0.311)	(-1.676)*	(0.085)
Excl. Jan	0.0105	0.0016	-0.0064	-0.0053	0.0003
	(1.973)**	(2.758)***	(-1.331)	(-1.447)	(0.060)
1976~1989	0.0120	0.0022	0.0029	-0.0076	0.0074
	(1.902)*	(3.061)***	(0.520)	(-1.858)*	(1.251)
1990~1999	0.0028	0.0003	-0.0077	-0.0037	-0.0094
	(0.307)	(0.314)	(-0.877)	(-0.578)	(-1.333)

Panel B: Test for Up Market

Variable	*Constant*	$ILLM^{i}_{y-1}$	β^{i}_{y-1}	PR^{1i}_{y-1}	PR^{2i}_{y-1}
All months	0.0197	0.0010	0.0181	-0.0128	-0.0030
	(2.894)***	(1.264)	(3.004)***	(-2.762)***	(-0.485)
Excl. Jan	0.0207	0.0012	0.0148	-0.0125	-0.0057
	(2.955)***	(1.439)	(2.568)**	(-2.685)***	(-0.906)
1976~1989	0.0223	0.0032	0.0093	-0.0020	0.0076
	(3.161)***	(3.775)***	(1.509)	(-0.394)	(1.040)
1990~1999	0.0145	-0.0035	0.0360	-0.0349	-0.0244
	(0.965)	(-2.410)**	(2.763)***	(-3.842)***	(-2.267)**

Panel C: Test for Down Market

Variable	*Constant*	$ILLM^{i}_{y-1}$	β^{i}_{y-1}	PR^{1i}_{y-1}	PR^{2i}_{y-1}
All months	-0.0071	0.0019	-0.0275	0.0030	0.0048
	(-0.881)	(2.460)**	(-3.668)***	(0.542)	(0.715)
Excl. Jan	-0.0021	0.0021	-0.0326	0.0036	0.0077
	(-0.255)	(2.604)**	(-4.384)***	(0.634)	(1.197)
1976~1989	-0.0075	0.0003	-0.0093	-0.0184	0.0070
	(-0.615)	(0.205)	(-0.855)	(-2.604)**	(0.691)
1990~1999	-0.0068	0.0034	-0.0435	0.0218	0.0029
	(-0.626)	(3.665)***	(-4.354)***	(2.848)***	(0.324)

Panel D: Regression with Lag Monthly Return

Variable	*Constant*	$ILLM^{i}_{y-1}$	β^{i}_{y-1}	R^{i}_{m-1}
All months	0.0080	0.0017	-0.0014	-0.0622
	(1.556)	(2.931)***	(-0.272)	(-6.896)***
Excl. Jan	0.0096	0.0018	-0.0058	-0.0560
	(1.879)*	(2.940)***	(-1.101)	(-6.201)***
1976~1989	0.0137	0.0027	0.0019	-0.0379
	(2.054)**	(3.461)***	(0.320)	(-3.438)***
1990~1999	0.0001	0.0003	-0.0060	-0.0959
	(0.007)	(0.382)	(-0.623)	(-6.549)***

Panel E: Regression with Lag Monthly Illiquidity

Variable	*Constant*	ILL^{i}_{m-1}	β^{i}_{y-1}	R^{i}_{m-1}
All months	0.0080	0.0182	-0.0007	-0.0625
	(1.534)	(2.884)***	(-0.140)	(-6.893)***
Excl. Jan	0.0083	0.0165	-0.0036	-0.0555
	(1.570)	(2.581)**	(-0.691)	(-6.173)***
1976~1989	0.0140	0.0258	0.0023	-0.0363
	(1.952)*	(2.733)***	(0.380)	(-3.361)***
1990~1999	-0.0004	0.0075	-0.0049	-0.0990
	(-0.054)	(1.030)	(-0.569)	(-6.566)***

Panel F: Test for Up Market

Variable	*Constant*	ILL^i_{m-1}	β^i_{y-1}	R^i_{m-1}
All months	0.0214	0.0234	0.0203	-0.0843
	(3.293)***	(2.819)***	(3.298)***	(-6.395)***
Excl. Jan	0.0197	0.0230	0.0199	-0.0758
	(2.986)***	(2.521)**	(3.254)***	(-5.777)***
1976~1989	0.0291	0.0317	0.0060	-0.0528
	(3.663)***	(2.949)***	(0.881)	(-3.894)***
1990~1999	0.0057	0.0063	0.0496	-0.1485
	(0.515)	(0.517)	(4.220)***	(-5.468)***

Panel G: Test for Down Market

Variable	*Constant*	ILL^i_{m-1}	β^i_{y-1}	R^i_{m-1}
All months	-0.0100	0.0112	-0.0288	-0.0334
	(-1.215)	(1.158)	(-3.692)***	(-2.954)***
Excl. Jan	-0.0060	0.0082	-0.0329	-0.0302
	(-0.723)	(0.951)	(-4.158)***	(-2.627)***
1976~1989	-0.0192	0.0119	-0.0035	-0.0022
	(-1.381)	(0.655)	(-0.288)	(-0.131)
1990~1999	-0.0018	0.0106	-0.0513	-0.0612
	(-0.189	(1.219)	(-5.492)***	(-4.248)***

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 8 Cross-Sectional Illiquidity Effects on Stock Return with Additional Variables---*SZ*-Portfolio Beta

The table presents the means of the coefficients from the monthly cross-sectional regression of stock return on the respective variables.

$$R_m^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} \ln CAP_{y-1}^i + k_{3y} \beta_{y-1}^{1i} + k_{4y} STD_{y-1}^i + k_{5y} DP_{y-1}^i + k_{6y} PR_{y-1}^{1i} + k_{7y} PR_{y-1}^{2i}; \quad (2.6a)$$

$$R_m^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} \ln CAP_{y-1}^i + k_{3y} \beta_{y-1}^{1i} + k_{4y} STD_{y-1}^i + k_{5y} DP_{y-1}^i + k_{6y} R_{m-1}^i; \quad (2.9a)$$

$$R_y^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} \ln CAP_{y-1}^i + k_{3y} \beta_{y-1}^{1i} + k_{4y} STD_{y-1}^i + k_{5y} DP_{y-1}^i + k_{6y} PR_{y-1}^{1i} + k_{7y} PR_{y-1}^{2i}; \quad (2.11a)$$

$$R_m^i = k_{0y} + k_{1y} ILL_{m-1}^i + k_{2y} \ln CAP_{m-1}^i + k_{3y} \beta_{y-1}^{1i} + k_{4y} STD_{y-1}^i + k_{5y} CP_{y-1}^i + k_{6y} R_{m-1}^i; \quad (2.14a)$$

$ILLM_{y-1}^i$ is the ratio of stock illiquidity to market illiquidity for stock *i* in year *y*-1. ILL_{m-1}^i is the illiquidity for stock *i* in month *m*-1. $\ln CAP_{y-1}^i$ is the logarithm of the market capitalization for stock *i* at the end of year *y*-1. $\ln CAP_{m-1}^i$ is the logarithm of the market capitalization for stock *i* at the end of month *m*-1. β_{y-1}^i is the market beta for stock *i* in year *y*-1 estimated from the market model with portfolios sorted by size. STD_{y-1}^i is the standard deviation of return for stock *i* across days in year *y*-1. DP_{y-1}^i is the ratio of dividend per share to share price for stock *i* in year *y*-1. CP_{y-1}^i is the ratio of earnings per share plus depreciation to share price for stock *i* in year *y*-1. PR_{y-1}^{1i} is the past return for the last 100 days for stock *i* in year *y*-1 calculated as the log ratio of daily closing price. PR_{y-1}^{2i} is the past return for the rest days for stock *i* in year *y*-1 calculated as the log ratio of daily closing price. R_{m-1}^i is the monthly return for stock *i* in month *m*-1. The *t*-statistics are reported in parentheses.

Panel A: Original Regression

Variable	*Constant*	$ILLM_{y-1}^i$	$\ln CAP_{y-1}^i$	β_{y-1}^i	STD_{y-1}^i	DP_{y-1}^i	PR_{y-1}^{1i}	PR_{y-1}^{2i}
Annual regression	-0.0505	0.0174	0.0047	-0.0161	-0.0332	1.5240	-0.0492	-0.0026
	(-0.243)	(3.278)***	(0.579)	(-0.560)	(-2.414)**	(1.585)	(-1.504)	(-0.070)
All months	0.0060	0.0014	0.0001	-0.0003	-0.0014	0.0718	-0.0030	0.0017
	(0.254)	(2.526)**	(0.166)	(-0.110)	(-0.053)	(1.051)	(-0.937)	(0.391)
Excl. Jan	-0.0017	0.0017	0.0005	-0.0019	-0.0029	0.0940	-0.0018	0.0030
	(-0.068)	(3.118)***	(0.558)	(-0.610)	(-2.287)**	(1.340)	(-0.540)	(0.669)
1976-1989	0.0401	0.0019	-0.0008	-0.0028	-0.0011	0.0904	-0.0037	0.0073
	(1.329)	(2.923)***	(-0.701)	(-0.838)	(-0.824)	(0.985)	(-0.939)	(0.226)
1990-1999	-0.0418	0.0005	0.0015	0.0031	-0.0017	0.0458	-0.0022	-0.0060
	(-1.133)	(0.607)	(1.089)	(0.543)	(-0.696)	(0.448)	(-0.388)	(-0.901)

Panel B: Test for Up Market

Variable	*Constant*	$ILLM^{i}_{y-1}$	$\ln CAP^{i}_{y-1}$	β^{i}_{y-1}	STD^{i}_{y-1}	DP^{i}_{y-1}	PR^{1i}_{y-1}	PR^{2i}_{y-1}
All months	0.0946	0.0003	-0.0029	0.0080	0.0059	-0.1336	-0.0120	-0.0067
	(3.111)***	(0.340)	(-2.565)**	(1.964)*	(3.490)***	(-1.410)	(-2.904)***	(-1.124)
Excl. Jan	0.0925	0.0006	-0.0028	0.0075	0.0038	-0.0965	-0.0106	-0.0075
	(2.823)***	(0.714)	(-2.248)**	(1.856)*	(2.399)**	(-0.934)	(-2.452)**	(-1.210)
1976-1989	0.0869	0.0021	-0.0022	-0.0011	0.0021	0.0212	-0.0030	0.0047
	(2.376)**	(2.507)**	(-1.606)	(-0.281)	(1.268)	(0.170)	(-0.650)	(0.6418)
1990-1999	0.1103	-0.0035	-0.0044	0.0267	0.0136	-0.4490	-0.0305	-0.0300
	(2.005)*	(-2.433)**	(-2.156)**	(3.021)***	(3.716)***	(-3.568)***	(-3.844)***	(-3.110)***

Panel C: Test for Down Market

Variable	*Constant*	$ILLM^{i}_{y-1}$	$\ln CAP^{i}_{y-1}$	β^{i}_{y-1}	STD^{i}_{y-1}	DP^{i}_{y-1}	PR^{1i}_{y-1}	PR^{2i}_{y-1}
All months	-0.1113	0.0028	0.0042	-0.0114	-0.0109	0.3435	0.0089	0.0130
	(-3.268)***	(4.019)***	(3.422)***	(-2.565)**	(-6.556)***	(3.725)***	(1.779)*	(1.978)*
Excl. Jan	-0.1182	0.0031	0.0046	-0.0134	-0.0111	0.3298	0.0090	0.0160
	(-3.380)***	(4.346)***	(3.636)***	(-2.994)***	(-6.427)***	(3.795)***	(1.759)*	(2.582)**
1976-1989	-0.0488	0.0017	0.0019	-0.0059	-0.0071	0.2216	-0.0050	0.0121
	(-0.948)	(1.495)	(1.002)	(-1.008)	(-3.578)***	(1.839)*	(-0.683)	(1.175)
1990-1999	-0.1663	0.0039	0.0062	-0.0162	-0.0142	0.4506	0.0210	0.0137
	(-3.730)***	(4.233)***	(4.009)***	(-2.476)**	(-5.616)***	(3.298)***	(3.230)***	(1.629)

Panel D: Regression with Lag Monthly Return

Variable	*Constant*	$ILLM^{i}_{y-1}$	$\ln CAP^{i}_{y-1}$	β^{i}_{y-1}	STD^{i}_{y-1}	DP^{i}_{y-1}	R^{i}_{m-1}
All months	-0.0039	0.0014	0.0004	0.0013	-0.0011	0.1313	-0.0643
	(-0.165)	(2.618)***	(0.489)	(0.372)	(-0.832)	(1.838)*	(-7.670)***
Excl. Jan	-0.0128	0.0017	0.0008	-0.0002	-0.0023	0.1437	-0.0592
	(-0.511)	(3.015)***	(0.890)	(-0.054)	(-1.748)*	(1.957)*	(-6.989)***
1976-1989	0.0474	0.0020	-0.0011	-0.0019	-0.0011	0.1618	-0.0401
	(1.536)*	(2.862)***	(-0.975)	(-0.491)	(-0.844)	(1.711)*	(-3.837)***
1990-1999	-0.0753	0.0006	0.0026	0.0057	-0.0011	0.0887	-0.0981
	(-2.054)**	(0.748)	(1.963)*	(0.908)	(-0.424)	(0.813)	(-7.392)***

Panel E: Regression with Lag Monthly Illiquidity and Size

Variable	*Constant*	ILL^{i}_{m-1}	$\ln CAP^{i}_{m-1}$	β^{i}_{y-1}	STD^{i}_{y-1}	DP^{i}_{y-1}	R^{i}_{m-1}
All months	0.0329	0.0055	-0.0019	-0.0011	-0.0014	0.0084	-0.0646
	(2.456)**	(1.025)	(-1.906)*	(-0.336)	(-1.063)	(2.403)**	(-7.739)***
Excl. Jan	0.0231	0.0069	-0.0011	-0.0002	-0.0026	0.0084	-0.0592
	(1.639)	(1.218)	(-1.045)	(-0.072)	(-1.971)**	(2.221)**	(-7.052)***
1976-1989	0.0626	0.0068	-0.0035	-0.0032	-0.0015	0.0083	-0.0382
	(3.766)***	(0.866)	(-2.782)***	(-0.866)	(-1.052)	(1.610)	(-3.665)***
1990-1999	-0.0083	0.0038	0.0004	0.0019	-0.0012	0.0086	-0.1013
	(-0.384)	(0.547)	(0.253)*	(0.327)	(-0.499)	(1.973)*	(-7.775)***

Panel F: Test for Up Market

Variable	*Constant*	ILL^i_{m-1}	$\ln CAP^i_{m-1}$	β^i_{y-1}	STD^i_{y-1}	CP^i_{y-1}	R^i_{m-1}
All months	0.1075	-0.0001	-0.0069	0.0012	0.0056	0.0032	-0.0812
	(6.842)***	(-0.014)	(-5.831)***	(0.286)	(3.319)***	(0.658)	(-6.653)***
Excl. Jan	0.0990	0.0017	-0.0062	0.0040	0.0037	0.0029	-0.0749
	(5.795)***	(0.197)	(-4.818)***	(0.867)	(2.184)**	(0.533)	(-6.059)***
1976-1989	0.1000	0.0004	-0.0057	-0.0019	0.0013	0.0062	-0.0525
	(5.300)***	(0.042)	(-4.049)***	(-0.418)	(0.686)	(0.942)	(-4.016)***
1990-1999	0.1229	-0.0012	-0.0095	0.0076	0.0145	-0.0029	-0.1398
	(4.320)***	(-0.110)	(-4.345)***	(0.786)	(4.508)***	(-0.453)	(-5.802)***

Panel G: Test for Down Market

Variable	*Constant*	ILL^i_{m-1}	$\ln CAP^i_{m-1}$	β^i_{y-1}	STD^i_{y-1}	CP^i_{y-1}	R^i_{m-1}
All months	-0.0665	0.0131	0.0049	-0.0042	-0.0108	0.0154	-0.0424
	(3.315)***	(1.889)*	(3.447)***	(-0.871)	(-6.145)***	(3.115)***	(-4.072)***
Excl. Jan	-0.0716	0.0133	0.0054	-0.0055	-0.0104	0.0153	-0.0396
	(3.513)***	(1.971)*	(3.709)***	(-1.106)	(-5.732)***	(2.958)***	(-3.719)***
1976-1989	-0.0160	0.0171	0.0011	-0.0057	-0.0069	0.0112	-0.0083
	(-0.525)	(1.572)	(0.485)	(-0.860)	(-3.105)***	(1.347)	(-0.496)
1990-1999	-0.1115	0.0095	0.0083	-0.0029	-0.0143	0.0192	-0.0729
	(-4.401)***	(1.072)	(5.152)***	(-0.410)	(-5.469)***	(3.337)***	(-6.212)***

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 9 Cross-Sectional Illiquidity Effects on Stock Return---BM-Portfolio Beta

The table presents the means of the coefficients from the monthly cross-sectional regression of stock return on the respective variables.

$$R_m^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y}\beta_{y-1}^{1i} + k_{3y} PR_{y-1}^{1i} + k_{4y} PR_{y-1}^{2i} . \quad (2.5)$$

$$R_m^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y}\beta_{y-1}^{1i} + k_{3y} R_{m-1}^i . \quad (2.8)$$

$$R_y^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y}\beta_{y-1}^{1i} + k_{3y} PR_{y-1}^{1i} + k_{4y} PR_{y-1}^{2i} . \quad (2.10)$$

$$R_m^i = k_{0y} + k_{1y} ILL_{m-1}^i + k_{2y}\beta_{y-1}^{1i} + k_{3y} R_{m-1}^i . \quad (2.13)$$

$ILLM_{y-1}^i$ is the ratio of stock illiquidity to market illiquidity for stock *i* in year *y*-1. ILL_{m-1}^i is the illiquidity for stock *i* in month *m*-1. β_{y-1}^i is the market beta for stock *i* in year *y*-1 estimated from the market model with portfolios sorted by *BM* ratio. PR_y^{1i} is the past return for the last 100 days for stock *i* in year *y*-1 calculated as the log ratio of daily closing price. PR_{y-1}^{2i} is the past return for the rest days for stock *i* in year *y*-1 calculated as the log ratio of daily closing price. And R_{m-1}^i is the monthly return for stock *i* in month *m*-1. The monthly returns are from 1976 to 1999, and the stock characteristics are from 1975 to 1998. The *t*-statistics are reported in parentheses.

Panel A: Original Regression

Variable	*Constant*	$ILLM_{y-1}^i$	β_{y-1}^i	PR_{y-1}^{1i}	PR_{y-1}^{2i}
Annual regression	0.0679	0.0140	-0.0723	-0.0800	-0.0252
	(1.826)*	(1.855)*	(-2.218)**	(-2.083)**	(-0.622)
All months	0.0101	0.0014	-0.0037	-0.0063	-0.0001
	(3.048)***	(2.463)**	(-1.164)	(-1.569)	(-0.026)
Excl. Jan	0.0108	0.0011	-0.0062	-0.0045	0.0006
	(3.072)***	(1.860)*	(-1.862)*	(-1.143)	(0.129)
1976-1989	0.0169	0.0024	-0.0025	-0.0074	0.0071
	(3.774)***	(2.860)***	(-0.649)	(-1.906)*	(1.188)
1990-1999	0.0006	0.0001	-0.0054	-0.0047	-0.0103
	(0.128)	(0.125)	(-0.995)	(-0.588)	(-1.332)

Panel B: Test for Up Market

Variable	*Constant*	$ILLM_{y-1}^i$	β_{y-1}^i	PR_{y-1}^{1i}	PR_{y-1}^{2i}
All months	0.0232	0.0038	0.0106	-0.0166	-0.0062
	(5.195)***	(4.736)***	(2.575)**	(-3.275)***	(-0.958)
Excl. Jan	0.0245	0.0034	0.0078	-0.0152	-0.0077
	(5.042)***	(3.958)***	(1.763)*	(-3.193)***	(-1.173)
1976~1989	0.0275	0.0044	0.0030	-0.0028	0.0067
	(4.850)***	(4.495)***	(0.622)	(-0.595)	(0.907)
1990~1999	0.0144	0.0024	0.0261	-0.0448	-0.0326
	(2.053)**	(1.802)*	(3.617)***	(-3.980)***	(-2.682)***

Panel C: Test for Down Market

Variable	*Constant*	$ILLM^{i}_{y-1}$	β^{i}_{y-1}	PR^{1i}_{y-1}	PR^{2i}_{y-1}
All months	-0.0072	-0.0016	-0.0226	0.0074	0.0080
	(-1.591)	(-1.992)**	(-5.143)***	(1.184)	(1.142)
Excl. Jan	-0.0062	-0.0016	-0.0235	0.0086	0.0109
	(-1.357)	(-1.963)*	(-5.254)***	(1.328)	(1.616)
1976~1989	-0.0032	-0.0014	-0.0130	-0.0163	0.0080
	(-0.495)	(-0.943)	(-2.179)**	(-2.351)**	(0.765)
1990~1999	-0.0107	-0.0018	-0.0311	0.0282	0.0080
	(-1.699)*	(-2.264)**	(-4.978)***	(3.010)***	(0.842)

Panel D: Regression with Lag Monthly Return

Variable	*Constant*	$ILLM^{i}_{y-1}$	β^{i}_{y-1}	R^{i}_{m-1}
All months	0.0126	0.0016	-0.0060	-0.0593
	(3.487)***	(2.662)***	(-1.612)	(-6.262)***
Excl. Jan	0.0137	0.0012	-0.0092	-0.0529
	(3.656)***	(1.949)*	(-2.434)**	(-5.648)***
1976~1989	0.0211	0.0027	-0.0057	-0.0366
	(4.382)***	(3.205)***	(-1.358)	(-3.300)***
1990~1999	0.0008	0.0001	-0.0064	-0.0909
	(0.146)	(0.088)	(-0.949)	(-5.613)***

Panel E: Regression with Lag Monthly Illiquidity

Variable	*Constant*	ILL^{i}_{m-1}	β^{i}_{y-1}	R^{i}_{m-1}
All months	0.0145	0.0246	-0.0076	-0.0595
	(3.785)***	(2.678)***	(-2.016)**	(-6.388)***
Excl. Jan	0.0153	0.0190	-0.0105	-0.0525
	(3.829)***	(2.111)**	(-2.730)***	(-5.713)***
1976~1989	0.0234	0.0379	-0.0076	-0.0348
	(4.683)***	(3.021)***	(-1.733)*	(-3.245)***
1990~1999	0.0021	0.0061	-0.0075	-0.0939
	(0.364)	(0.461)	(-1.037)	(-5.841)***

Panel F: Test for Up Market

Variable	*Constant*	ILL^i_{m-1}	β^i_{y-1}	R^i_{m-1}
All months	0.0291	0.0515	0.0106	-0.0823
	(5.516)***	(4.644)***	(2.144)**	(-6.176)***
Excl. Jan	0.0311	0.0495	0.0071	-0.0732
	(5.630)***	(4.017)***	(1.407)	(-5.610)***
1976~1989	0.0361	0.0484	-0.0020	-0.0525
	(5.694)***	(3.990)***	(-0.357)	(-3.960)***
1990~1999	0.0149	0.0579	0.0361	-0.1430
	(1.605)	(2.510)**	(4.062)***	(-4.999)***

Panel G: Test for Down Market

Variable	*Constant*	ILL^i_{m-1}	β^i_{y-1}	R^i_{m-1}
All months	-0.0049	-0.0113	-0.0317	-0.0292
	(-0.977)	(-0.753)	(-6.296)***	(-2.420)**
Excl. Jan	-0.0044	-0.0190	-0.0324	-0.0267
	(-0.850)	(-1.541)	(-6.183)***	(-2.160)**
1976~1989	-0.0029	0.0094	-0.0189	0.0004
	(-0.402)	(0.323)	(-2.748)***	(0.026)
1990~1999	-0.0067	-0.0297	-0.0432	-0.0556
	(-0.951)	(-2.647)**	(-6.124)***	(-3.416)***

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 10 Cross-Sectional Illiquidity Effects on Stock Return with Additional Variables---BM-Portfolio Beta

The table presents the means of the coefficients from the monthly cross-sectional regression of stock return on the respective variables.

$$R^i_m = k_{0y} + k_{1y} ILLM^i_{y-1} + k_{2y} BM^i_{y-1} + k_{3y}\beta^{1i}_{y-1} + k_{4y} STD^i_{y-1} + k_{5y} EP^i_{y-1} + k_{6y} PR^{1i}_{y-1} + k_{7y} PR^{2i}_{y-1}. \quad (2.6b)$$

$$R^i_m = k_{0y} + k_{1y} ILLM^i_{y-1} + k_{2y} BM^i_{y-1} + k_{3y}\beta^{1i}_{y-1} + k_{4y} STD^i_{y-1} + k_{5y} EP^i_{y-1} + k_{6y} R^i_{m-1}. \quad (2.9b)$$

$$R^i_y = k_{0y} + k_{1y} ILLM^i_{y-1} + k_{2y} BM^i_{y-1} + k_{3y}\beta^{1i}_{y-1} + k_{4y} STD^i_{y-1} + k_{5y} CP^i_{y-1} + k_{6y} PR^{1i}_{y-1} + k_{7y} PR^{2i}_{y-1}. \quad (2.11b)$$

$$R^i_m = k_{0y} + k_{1y} ILL^i_{m-1} + k_{2y} BM^i_{y-1} + k_{3y}\beta^{1i}_{y-1} + k_{4y} STD^i_{y-1} + k_{5y} CP^i_{y-1} + k_{6y} R^i_{m-1}. \quad (2.14b)$$

$ILLM^i_{y-1}$ is the ratio of stock illiquidity to market illiquidity for stock *i* in year *y*-1. ILL^i_{m-1} is the illiquidity for stock *i* in month *m*-1. BM^i_{y-1} is the book-to-market ratio for stock i at the end of year *y*-1. β^i_{y-1} is the market beta for stock i in year *y*-1 estimated from the market model with portfolios sorted by *BM* ratio. STD^i_{y-1} is the standard deviation of return for stock *i* across days in year *y*-1. EP^i_{y-1} is the ratio of earnings per share to share price for stock *i* in year *y*-1. CP^i_{y-1} is the ratio of earnings per share plus depreciation to share price for stock *i* in year *y*-1. PR^{1i}_y is the past return for the last 100 days for stock *i* in year *y*-1 calculated as the log ratio of daily closing price. PR^{2i}_{y-1} is the past return for the rest days for stock *i* in year *y*-1 calculated as the log ratio of daily closing price. And R^i_{m-1} is the monthly return for stock *i* in month *m*-1. The monthly returns are from 1976 to 1999, and the stock characteristics are from 1975 to 1998. The *t*-statistics are reported in parentheses.

Panel A: Original Regression

Variable	*Constant*	$ILLM^i_{y-1}$	BM^i_{y-1}	β^i_{y-1}	STD^i_{y-1}	CP^i_{y-1}	EP^i_{y-1}	PR^{1i}_{y-1}	PR^{2i}_{y-1}
Annual	0.0639	0.0173	0.0617	-0.0476	-0.0252	0.0211		-0.0508	0.0007
regression	(1.416)	(2.422)**	(2.238)**	(-1.824)*	(-1.489)**	(0.695)		(-1.417)	(0.018)
All months	0.0066	0.0016	0.0061	-0.0009	-0.0008		-0.0093	-0.0034	0.0020
	(1.603)	(2.852)***	(2.590)**	(-0.342)	(-0.508)		(-1.005)	(-0.989)	(0.438)
Excl. Jan	0.0096	0.0015	0.0062	-0.0021	-0.0028		-0.0128	-0.0015	0.0038
	(2.376)**	(2.681)***	(2.637)***	(-0.814)	(-1.840)*		(-1.330)	(-0.428)	(0.826)
1976-1989	0.0096	0.0024	0.0091	0.0026	-0.0003		-0.0195	-0.0051	0.0073
	(1.681)*	(3.181)***	(2.611)***	(0.766)	(-0.204)		(-1.739)*	(-1.311)	(1.199)
1990-1999	0.0026	0.0003	0.0018	-0.0058	-0.0015		0.0049	-0.0010	-0.0054
	(0.429)	(0.431)	(0.654)	(-1.531)	(-0.479)		(0.314)	(-0.162)	(-0.755)

Panel B: Test for Up Market

Variable	*Constant*	$ILLM^{i}_{y-1}$	BM^{i}_{y-1}	β^{i}_{y-1}	STD^{i}_{y-1}	EP^{i}_{y-1}	PR^{1i}_{y-1}	PR^{2i}_{y-1}
All months	0.0093	0.0038	0.0069	0.0031	0.0093	-0.0121	-0.0147	-0.0071
	(1.669)*	(3.599)***	(2.077)**	(0.958)	(4.650)***	(-1.072)	(-3.431)***	(-1.141)
Excl. Jan	0.0131	0.0034	0.0075	0.0017	0.0069	-0.0124	-0.0129	-0.0072
	(2.427)**	(3.348)***	(2.244)**	(0.527)	(3.682)***	(-1.007)	(-2.967)***	(-1.133)
1976-1989	0.0165	0.0044	0.0088	0.0039	0.0040	-0.0184	-0.0048	0.0043
	(2.375)**	(4.098)***	(1.985)**	(0.927)	(2.060)**	(-1.277)	(-1.055)	(0.575)
1990-1999	-0.0053	0.0024	0.0029	0.0015	0.0203	0.0006	-0.0349	-0.0305
	(-0.591)	(0.534)	(0.667)	(0.305)	(4.684)***	(0.035)	(-4.077)***	(-2.907)***

Panel C: Test for Down Market

Variable	*Constant*	$ILLM^{i}_{y-1}$	BM^{i}_{y-1}	β^{i}_{y-1}	STD^{i}_{y-1}	EP^{i}_{y-1}	PR^{1i}_{y-1}	PR^{2i}_{y-1}
All months	0.0031	0.0000	0.0050	-0.0062	-0.0142	-0.0056	0.0116	0.0142
	(0.505)	(0.003)	(1.542)	(-1.532)	(-7.421)***	(-0.360)	(2.214)**	(2.084)**
Excl. Jan	0.0053	0.0000	0.0046	-0.0068	-0.0148	-0.0134	0.0126	0.0174
	(0.865)	(0.062)	(1.411)	(-1.707)*	(-7.586)***	(-0.871)	(2.334)**	(2.709)***
1976-1989	-0.0036	0.0000	0.0079	0.0002	-0.0085	-0.0215	-0.0056	0.0130
	(-0.367)	(0.012)	(1.713)*	(0.028)	(-3.422)***	(-1.220)	(-0.774)	(1.246)
1990-1999	0.0090	0.0000	0.0009	-0.0118	-0.0192	0.0084	0.0268	0.0152
	(1.140)	(-0.012)	(0.247)	(-2.145)**	(-7.041)***	(0.343)	(3.753)***	(1.694)*

Panel D: Regression with Lag Monthly Return

Variable	*Constant*	$ILLM^{i}_{y-1}$	BM^{i}_{y-1}	β^{i}_{y-1}	STD^{i}_{y-1}	CP^{i}_{y-1}	R^{i}_{m-1}
All months	0.0080	0.0017	0.0065	-0.0032	-0.0004	0.0010	-0.0650
	(1.940)*	(2.955)***	(2.830)***	(-1.241)	(-0.281)	(0.613)	(-7.441)***
Excl. Jan	0.0104	0.0016	0.0062	-0.0042	-0.0021	0.0009	-0.0589
	(2.466)**	(2.640)***	(2.628)***	(-1.578)	(-1.431)	(0.518)	(-6.741)***
1976-1989	0.0111	0.0028	0.0095	-0.0003	0.0003	0.0017	-0.0417
	(2.086)**	(3.455)***	(2.868)***	(-0.081)	(0.231)	(0.613)	(-3.985)***
1990-1999	0.0038	0.0002	0.0023	-0.0073	-0.0015	0.0000	-0.0973
	(0.572)	(0.224)	(0.782)	(-1.817)*	(-0.498)	(0.760)	(-6.712)***

Panel E: Regression with Lag Monthly Illiquidity

Variable	*Constant*	ILL^{i}_{m-1}	BM^{i}_{y-1}	β^{i}_{y-1}	STD^{i}_{y-1}	CP^{i}_{y-1}	R^{i}_{m-1}
All months	0.0084	0.0249	0.0069	-0.0040	0.0000	0.0015	-0.0623
	(2.011)**	(2.876)***	(2.821)***	(-1.534)	(0.011)	(0.423)	(-7.158)***
Excl. Jan	0.0107	0.0206	0.0065	-0.0049	-0.0017	0.0017	-0.0563
	(2.528)**	(2.456)**	(2.578)**	(-1.805)*	(-1.172)	(0.451)	(-6.469)***
1976-1989	0.0120	0.0370	0.0104	-0.0016	0.0008	-0.0019	-0.0369
	(2.196)**	(3.082)***	(2.946)***	(-0.457)	(0.546)	(-0.382)	(-3.534)***
1990-1999	0.0033	0.0082	0.0019	-0.0074	-0.0011	0.0062	-0.0977
	(0.519)	(0.670)	(0.619)	(-1.892)*	(-0.370)	(1.362)	(-6.806)***

Panel F: Test for Up Market

Variable	*Constant*	ILL^i_{m-1}	BM^i_{y-1}	β^i_{y-1}	STD^i_{y-1}	CP^i_{y-1}	R^i_{m-1}
All months	0.0129	0.0433	0.0099	-0.0005	0.0102	-0.0045	-0.0836
	(2.3801)**	(4.007)***	(3.087)***	(-0.134)	(5.730)***	(-0.986)	(-6.610)***
Excl. Jan	0.0169	0.0429	0.0099	-0.0014	0.0078	-0.0046	-0.0762
	(3.161)***	(3.580)***	(2.922)**	(-0.385)	(4.493)***	(-0.929)	(-5.995)***
1976-1989	0.0215	0.0439	0.0095	-0.0008	0.0048	-0.0033	-0.0537
	(3.522)***	(3.682)***	(2.241)**	(-0.190)	(2.794)***	(-0.562)	(-4.152)***
1990-1999	-0.0048	0.0419	0.0106	0.0003	0.0211	-0.0069	-0.1444
	(-0.459)	(1.889)*	(2.308)**	(0.044)	(5.708)***	(-1.008)	(-5.505)***

Panel G: Test for Down Market

Variable	*Constant*	ILL^i_{m-1}	BM^i_{y-1}	β^i_{y-1}	STD^i_{y-1}	CP^i_{y-1}	R^i_{m-1}
All months	0.0024	0.0005	0.0028	-0.0088	-0.0135	0.0095	-0.0339
	(0.367)	(0.034)	(0.770)	(-2.141)**	(-6.952)***	(1.761)*	(-3.124)***
Excl. Jan	0.0030	-0.0073	0.0022	-0.0094	-0.0136	0.0096	-0.0316
	(0.440)	(-0.667)	(0.599)	(-2.216)**	(-6.660)***	(1.709)*	(-2.840)***
1976-1989	-0.0079	0.0160	0.0120	-0.0036	-0.0071	-0.0003	-0.0030
	(-0.758)	(0.585)	(1.909)*	(-0.560)	(-2.960)***	(-0.029)	(-0.181)
1990-1999	0.0115	-0.0133	-0.0053	-0.0135	-0.0193	0.0182	-0.0615
	(1.441)	(-1.302)	(-1.353)	(-2.543)**	(-6.812)***	(3.114)***	(-4.595)***

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 11 Cross-Sectional Illiquidity Effects on Stock Return---Fundamentals

The table presents the means of the coefficients from the monthly cross-sectional regression of stock return on the respective variables.

$$R_m^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} EP_{y-1}^i + k_{3y} CP_{y-1}^i + k_{4y} \ln CAP_{y-1}^i + k_{5y} BM_{y-1}^i . \quad (2.7)$$

$$R_y^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} BM_{y-1}^i + k_{3y} EP_{y-1}^i , \quad (2.12a)$$

$$R_y^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} BM_{y-1}^i + k_{3y} CP_{y-1}^i , \quad (2.12b)$$

$$R_y^i = k_{0y} + k_{1y} ILLM_{y-1}^i + k_{2y} BM_{y-1}^i + k_{3y} CP_{y-1}^i + k_{4y} STD_{y-1}^i + k_{5y} PR1_{y-1}^i , \quad (2.12c)$$

$$R_m^i = k_{0y} + k_{1y} ILL_{m-1}^i + k_{2y} EP_{y-1}^i + k_{3y} CP_{y-1}^i + k_{4y} \ln CAP_{m-1}^i + k_{5y} BM_{y-1}^i , \quad (2.15)$$

$ILLM_{y-1}^i$ is the ratio of stock illiquidity to market illiquidity for stock *i* in year *y*-1. ILL_{m-1}^i is the illiquidity for stock *i* in month *m*-1. EP_{y-1}^i is the ratio of earnings per share to share price for stock *i* in year *y*-1. CP_{y-1}^i is the ratio of earnings per share plus depreciation to share price for stock *i* in year *y*-1. $\ln CAP_{y-1}^i$ is the logarithm of the market capitalization for stock *i* at the end of year *y*-1. BM_{y-1}^i is the book-to-market ratio for stock *i* at the end of year *y*-1. STD_{y-1}^i is the standard deviation of return for stock *i* across days in year *y*-1. PR_y^{1i} is the past return for the last 100 days for stock *i* in year *y*-1 calculated as the log ratio of daily closing price. The monthly returns are from 1976 to 1999, and the stock characteristics are from 1975 to 1998. The stocks included in the sample must have valid observations of return and trading value data for more than 200 days and have year-end price greater than 100 yen, outliers with annual illiquidity at the highest or lowest 1% tails of the distribution are eliminated. The *t*-statistics is reported in parentheses.

Panel A: Annual Regression

Constant	$ILLM_{y-1}^i$	BM_{y-1}^i	CP_{y-1}^i	EP_{y-1}^i	STD_{y-1}^i	PR_{y-1}^{1i}
-0.0394	0.0157	0.0884	0.0502			
(-0.863)	(1.847)*	(3.314)***	(1.321)			
-0.0391	0.0148	0.1057		-0.1027		
(-0.850)	(1.871)*	(3.702)***		(-0.705)		
0.0185	0.0184	0.0683	0.0247		-0.0194	-0.0554
(0.506)	(2.499)**	(2.640)**	(0.865)		(-1.138)	(-1.597)

Panel B: Monthly Regression

Variable	*Constant*	$ILLM_{y-1}^i$	EP_{y-1}^i	CP_{y-1}^i	$\ln CAP_{y-1}^i$	BM_{y-1}^i
All months	0.0107	0.0015	-0.0083	0.0053	-0.0002	0.0065
	(0.363)	(2.802)***	(-0.614)	(1.177)	(-0.214)	(2.412)**
Excl. Jan	-0.028	0.0019	-0.0074	0.0023	0.0012	0.0076
	(-0.937)	(3.479)***	(-0.531)	(0.517)	(1.099)	(2.696)***
1976-1989	0.0497	0.0018	-0.0230	0.0090	-0.0015	0.0084
	(1.576)	(2.659)***	(-1.559)	(1.177)	(-1.248)	(2.135)**
1990-1999	-0.0439	0.0010	0.0124	0.0000	0.0016	0.0037
	(-0.797)	(1.194)	(0.497)	(1.032)	(0.827)	(1.128)

Panel C: Regression with Lag Monthly Illiquidity and Size

Variable	*Constant*	ILL^i_{m-1}	EP^i_{y-1}	CP^i_{y-1}	$\ln CAP^i_{m-1}$	BM^i_{y-1}
All months	0.0237	0.0113	-0.0145	0.0143	-0.0016	0.0061
	(1.598)	(1.925)*	(-1.040)	(2.355)**	(-1.476)	(2.282)**
Excl. Jan	0.0050	0.0133	-0.0141	0.0120	-0.0002	0.0074
	(0.341)	(2.139)**	(-0.976)	(1.901)*	(-0.193)	(2.621)***
1976-1989	0.0408	0.0141	-0.0289	0.0165	-0.0025	0.0089
	(2.652)***	(1.694)*	(-1.774)*	(1.670)*	(-2.007)**	(2.236)**
1990-1999	-0.0002	0.0074	0.0055	0.0112	-0.0003	0.0023
	(-0.005)	(0.930)	(0.226)	(2.384)**	(-0.146)	(0.701)

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 12 Time-Series Illiquidity Effects on SZ-Portfolio Return---Annual Data

The excess annual market return is regressed on annual market illiquidity

$$R_y^M - R_y^f = g_0 + g_1 \ln ILL_{y-1}^M + g_2 \ln ILLU_y^M + w_y, \quad (3.4a)$$

where R_y^M is the equally-weighted annual market return, R_y^f is the annual rate of call-money rate or the one-month Gensaki rate, $\ln ILL_{y-1}^M$ is the expected annual market illiquidity, and $\ln ILLU_y^M$ is the unexpected annual market illiquidity.

The test on 25 SZ portfolios is $R_y^p - R_y^f = g_0{}^p + g_1{}^p \ln ILL_{y-1}^M + g_2{}^p \ln ILLU_y^M + w_y^p$, (3.4b)

where R_y^p, p = 5, 10, 15, 20 and 25, are the equally-weighted annual returns on *SZ* portfolio *p*. Period of estimation: 1976-1999. The *t*-statistics and adjusted R^2 are reported in parentheses, respectively. The sample size is 23.

Portfolio	*Constant*	$\ln ILL_{y-1}^M$	$\ln ILLU_y^M$	*F-value*	R^2
Market	0.386	0.145	-0.232	6.26	0.385
	(2.13)**	(2.09)**	(-2.41)***		(0.324)
Portfolio 5	0.173	0.074	-0.458	8.29	0.453
	(0.75)	(0.84)	(-3.75)***		(0.399)
Portfolio 10	0.266	0.121	-0.422	10.47	0.512
	(1.31)	(1.55)	(-3.93)***		(0.463)
Portfolio 15	0.281	0.129	-0.343	8.75	0.467
	(1.47)	(1.77)*	(-3.38)***		(0.413)
Portfolio 20	0.279	0.129	-0.295	9.26	0.481
	(1.67)	(2.03)*	(-3.34)***		(0.429)
Portfolio 25	0.304	0.129	-0.201	3.79	0.275
	(1.48)	(1.64)	(-1.86)*		(0.202)

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 13 Time-Series Illiquidity Effects on BM-Portfolio Return---Annual Data

The excess annual BM-portfolio return is regressed on annual market illiquidity

$$R_y^p - R_y^f = g_0{}^p + g_1{}^p \ln ILL_{y-1}^M + g_2{}^p \ln ILLU_y^M + w_y^p, \quad (3.4b)$$

where R_y^p, p = 5, 10, 15, 20 and 25, are the equally-weighted annual returns on *BM* portfolio *p*, R_y^f is the annual rate of call-money rate or the one-month Gensaki rate, $\ln ILL_{y-1}^M$ is the expected annual market illiquidity, and $\ln ILLU_y^M$ is the unexpected annual market illiquidity. The period of estimation is from 1976 to 1999. The *t*-statistics and adjusted R^2 are reported in parentheses, respectively. The sample size is 23.

Portfolio	*Constant*	$\ln ILL_{y-1}^M$	$\ln ILLU_y^M$	*F-value*	R^2
Portfolio 5	0.252	0.119	-0.290	6.23	0.384
	(1.28)	(1.59)	(-2.79)**		(0.322)
Portfolio 10	0.273	0.117	-0.316	9.65	0.491
	(1.64)	(1.83)*	(-3.57)***		(0.440)
Portfolio 15	0.266	0.109	-0.338	9.23	0.480
	(1.51)	(1.61)	(-3.60)***		(0.428)
Portfolio 20	0.247	0.101	-0.400	9.87	0.497
	(1.27)	(1.36)*	(-3.89)***		(0.446)
Portfolio 25	0.294	0.107	-0.491	10.48	0.512
	(1.30)	(1.24)	(-4.09)***		(0.463)

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 14 Time-Series Illiquidity Effects on SZ-Portfolio Return---Monthly Data

The excess monthly market return is regressed on monthly market illiquidity

$$R_m^M - R_m^f = g_0 + g_1 \ln ILL_{m-1}^M + g_2 \ln ILLU_m^M + g_3 JAN_m + w_m , \quad (3.5a)$$

where R_m^M is the monthly equally-weighted market return and R_m^f is the one-month Gensaki monthly rate, $\ln ILL_{m-1}^M$ is the expected monthly market illiquidity, and $\ln ILLU_m^M$ is the unexpected monthly market illiquidity. JAN_m is a January dummy that equals 1 in January and zero otherwise.

The test on 25 SZ portfolios is

$$R_m^p - R_m^f = g_0^p + g_1^p \ln ILL_{m-1}^M + g_2^p \ln ILLU_m^M + g_3^p JAN_m + w_m^p , \quad (3.5b)$$

where R_m^p, p = 5, 10, 15, 20, and 25, are the equally-weighted monthly returns on SZ portfolio *p*. The period of estimation is from 1976 to 1999. The first sub-period is from 1976 to 1989, and the second sub-period is from 1990 to 1999. The *t*-statistics and adjusted R^2 are reported in parentheses, respectively.

Panel A: 1976~1999 (the sample size is 287)

Portfolio	*Constant*	$\ln ILL_{m-1}^M$	$\ln ILLU_m^M$	JAN_m	*F-value*	R^2
Market	0.016	0.005	-0.127	0.034	51.67	0.354
	(1.43)	(1.14)	(-11.81)***	(3.38)***		(0.347)
Portfolio 5	0.012	0.003	-0.138	0.045	39.43	0.303
	(0.82)	(0.61)	(-10.21)***	(3.53)***		(0.295)
Portfolio 10	0.021	0.008	-0.127	0.039	35.18	0.280
	(1.46)	(1.42)	(-9.60)***	(3.11)***		(0.272)
Portfolio 15	0.017	0.006	-0.113	0.026	30.72	0.253
	(1.32)	(1.28)	(-9.18)***	(2.22)**		(0.245)
Portfolio 20	0.019	0.007	-0.101	0.019	25.78	0.221
	(1.50)	(1.41)	(-8.44)***	(1.71)*		(0.213)
Portfolio 25	0.025	0.008	-0.080	0.009	14.80	0.140
	(1.85)*	(1.57)	(-6.36)***	(0.74)		(0.131)

Panel B: 1976~1989 (the sample size is 179)

Portfolio	*Constant*	$\ln ILL_{m-1}^{M}$	$\ln ILLU_{m}^{M}$	JAN_m	*F-value*	R^2
Market	0.009	-0.000	-0.092	0.032	40.44	0.371
	(1.03)	(-0.13)	(-9.84)***	(4.11)***		(0.353)
Portfolio 5	-0.003	-0.005	-0.099	0.040	30.88	0.361
	(-0.28)	(-1.20)	(-8.38)***	(3.94)***		(0.349)
Portfolio 10	0.012	0.002	-0.085	0.026	20.28	0.271
	(1.09)	(0.39)	(-7.20)***	(2.56)**		(0.257)
Portfolio 15	0.010	0.001	-0.075	0.022	14.48	0.209
	(0.83)	(0.26)	(-6.12)***	(2.08)**		(0.195)
Portfolio 20	0.017	0.003	-0.065	0.017	9.84	0.153
	(1.35)	(0.75)	(-5.06)***	(1.58)		(0.137)
Portfolio 25	0.021	0.005	-0.050	0.015	3.93	0.067
	(1.35)	(0.87)	(-3.11)***	(1.08)		(0.050)

Panel C: 1990~1999 (the sample size is 108)

Portfolio	*Constant*	$\ln ILL_{m-1}^{M}$	$\ln ILLU_{m}^{M}$	JAN_m	*F-value*	R^2
Market	0.021	0.010	-0.159	0.042	20.47	0.371
	(0.79)	(1.04)	(-7.39)***	(1.85)*		(0.353)
Portfolio 5	0.029	0.014	-0.172	0.057	16.39	0.321
	(0.91)	(1.13)	(-6.46)***	(2.04)**		(0.302)
Portfolio 10	0.025	0.013	-0.167	0.064	16.85	0.327
	(0.80)	(1.10)	(-6.48)***	(2.37)**		(0.308)
Portfolio 15	0.023	0.012	-0.148	0.037	15.50	0.309
	(0.81)	(1.09)	(-6.39)***	(1.50)		(0.289)
Portfolio 20	0.017	0.009	-0.134	0.027	14.17	0.290
	(0.66)	(0.94)	(-6.18)***	(1.18)		(0.270)
Portfolio 25	0.027	0.011	-0.107	0.003	10.40	0.231
	(1.10)*	(1.14)	(-5.24)***	(0.15)		(0.209)

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 15 Time-Series Illiquidity Effects on BM-Portfolio Return---Monthly Data

The excess monthly BM-portfolio return is regressed on monthly market illiquidity

$$R_m^p - R_m^f = g_0^p + g_1^p \ln ILL_{m-1}^M + g_2^p \ln ILLU_m^M + g_3^p JAN_m + w_m^p, \quad (3.5b)$$

where R_m^p, p = 5, 10, 15, 20, and 25, are the equally-weighted monthly returns on BM portfolio p, R_m^f is the monthly rate of call-money rate or the one-month Gensaki rate, $\ln ILL_{m-1}^M$ is the expected monthly market illiquidity, and $\ln ILLU_m^M$ is the unexpected monthly market illiquidity. JAN_m is a January dummy that equals 1 in January and zero otherwise.

The period of estimation is from 1976 to 1999. The first sub-period is from 1976 to 1989, and the second sub-period is from 1990 to 1999. The *t*-statistics and adjusted R^2 are reported in parentheses, respectively.

Panel A: 1976~1999 (the sample size is 287)

Portfolio	*Constant*	$\ln ILL_{m-1}^M$	$\ln ILLU_m^M$	JAN_m	*F-value*	R^2
Portfolio 5	0.021	0.008	-0.119	0.035	32.11	0.262
	(1.51)	(1.50)	(-9.19)***	(2.84)***		(0.253)
Portfolio 10	0.020	0.007	-0.117	0.028	40.93	0.311
	(1.73)*	(1.50)	(-10.55)***	(2.72)***		(0.303)
Portfolio 15	0.017	0.005	-0.115	0.031	35.18	0.278
	(1.33)	(1.09)	(-9.75)***	(2.81)**		(0.272)
Portfolio 20	0.011	0.003	-0.122	0.031	36.93	0.289
	(0.87)	(0.57)	(-10.10)***	(2.73)***		(0.282)
Portfolio 25	0.016	0.003	-0.139	0.036	32.83	0.266
	(1.03)	(0.59)	(-9.51)***	(2.61)***		(0.258)

Panel B: 1976~1989 (the sample size is 179)

Portfolio	*Constant*	$\ln ILL_{m-1}^{M}$	$\ln ILLU_{m}^{M}$	JAN_m	*F-value*	R^2
Portfolio 5	0.009	0.001	-0.083	0.036	16.36	0.230
	(0.69)	(0.29)	(-6.09)***	(3.09)***		(0.216)
Portfolio 10	0.017	0.003	-0.095	0.022	25.72	0.320
	(1.51)	(0.62)	(-8.34)***	(2.22)**		(0.308)
Portfolio 15	0.012	0.001	-0.081	0.024	18.25	0.250
	(1.05)	(0.26)	(-6.84)***	(2.40)**		(0.237)
Portfolio 20	0.003	-0.003	-0.082	0.021	19.04	0.258
	(0.24)	(-0.75)	(-7.03)***	(2.12)**		(0.245)
Portfolio 25	0.001	-0.006	-0.089	0.025	18.88	0.257
	(0.07)	(-1.20)	(-6.86)***	(2.26)**		(0.243)

Panel C: 1990~1999 (the sample size is 108)

Portfolio	*Constant*	$\ln ILL_{m-1}^{M}$	$\ln ILLU_{m}^{M}$	JAN_m	*F-value*	R^2
Portfolio 5	0.034	0.015	-0.149	0.036	15.48	0.309
	(1.19)	(1.42)	(-6.28)***	(1.43)		(0.289)
Portfolio 10	0.024	0.012	-0.135	0.041	16.81	0.327
	(0.94)	(1.25)	(-6.55)***	(1.89)*		(0.307)
Portfolio 15	0.018	0.009	-0.147	0.047	16.74	0.326
	(0.66)	(0.86)	(-6.64)***	(1.99)**		(0.306)
Portfolio 20	0.017	0.009	-0.159	0.052	18.56	0.349
	(0.62)	(0.83)	(-7.00)***	(2.15)**		(0.330)
Portfolio 25	0.031	0.014	-0.184	0.058	16.43	0.322
	(0.90)	(1.06)	(-6.51)***	(1.96)*		(0.302)

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 16 Time-Series Illiquidity Effects Controlling for Term Yield Premium on SZ-Portfolio Return---Monthly Data

The excess monthly market return is regressed on monthly market illiquidity

$$R_m^M - R_m^f = g_0 + g_1 \ln ILL_{m-1}^M + g_2 \ln ILLU_m^M + g_3 JAN_m + aTM_{m-1} + u_m, \qquad (3.6a)$$

where R_m^M is the monthly equally-weighted market return and R_m^f is the one-month Gensaki monthly rate, $\ln ILL_m^M$ is the expected monthly market illiquidity, $\ln ILLU_m^M$ is the unexpected monthly market illiquidity, $TM_m = YL_m - R_m^{G3}$ is the term yield premium, and JAN_m is a January dummy that equals 1 in January and zero otherwise.
The test on 25 *SZ* portfolios is

$$R_m^p - R_m^f = g_0^p + g_1^p \ln ILL_{m-1}^M + g_2^p \ln ILLU_m^M + g_3^p JAN_m + a^p TM_{m-1} + u_m^p, \qquad (3.6b)$$

where R_m^p, p = 5, 10, 15, 20, and 25, are the equally-weighted monthly returns on SZ portfolio *p*. The period of estimation is from 1976 to 1999. The first sub-period is from 1976 to 1989, and the second sub-period is from 1990 to 1999. The *t*-statistics and adjusted R^2 are reported in parentheses, respectively.

Panel A: 1976~1999 (the sample size is 287)

Portfolio	*Constant*	$\ln ILL_{m-1}^M$	$\ln ILLU_m^M$	JAN_m	TM_{m-1}	*F-value*	R^2
Market	0.015	0.005	-0.127	0.034	0.004	38.62	0.354
	(1.33)	(1.12)	(-11.75)***	(3.38) ***	(0.13)		(0.345)
Portfolio 5	0.012	0.003	-0.138	0.045	-0.000	29.47	0.303
	(0.77)	(0.61)	(-10.13)***	(3.52)***	(-0.01)		(0.293)
Portfolio 10	0.022	0.008	-0.127	0.039	-0.010	26.32	0.280
	(1.46)	(1.44)	(-9.50)***	(3.09)***	(-0.27)		(0.269)
Portfolio 15	0.018	0.006	-0.113	0.026	-0.006	22.97	0.253
	(1.30)	(1.29)	(-9.09)***	(2.21)**	(-0.19)		(0.242)
Portfolio 20	0.019	0.007	-0.101	0.019	-0.001	19.27	0.221
	(1.39)	(1.39)	(-8.38)***	(1.71)*	(-0.04)		(0.210)
Portfolio 25	0.027	0.008	-0.079	0.009	-0.014	11.11	0.141
	(1.88)*	(1.61)	(-6.27)***	(0.73)	(-0.41)		(0.128)

Panel B: 1976~1989 (the sample size is 179)

Portfolio	*Constant*	$\ln ILL^{M}_{m-1}$	$\ln ILLU^{M}_{m}$	JAN_m	TM_{m-1}	*F-value*	R^2
Market	0.009	-0.000	-0.092	0.032	0.002	30.16	0.409
	(0.98)	(-0.13)	(-9.72)***	(4.10) ***	(0.07)		(0.396)
Portfolio 5	-0.004	-0.005	-0.099	0.040	0.005	23.03	0.361
	(-0.32)	(-1.21)	(-8.26)***	(3.93)***	(0.17)		(0.345)
Portfolio 10	0.015	0.002	-0.084	0.026	-0.021	15.26	0.273
	(1.25)	(0.49)	(-6.96)***	(2.53)**	(-0.66)		(0.255)
Portfolio 15	0.011	0.001	-0.074	0.022	-0.012	10.83	0.210
	(0.90)	(0.32)	(-5.95)***	(2.06)**	(-0.37)		(0.191)
Portfolio 20	0.016	0.003	-0.066	0.018	0.006	7.34	0.153
	(1.22)	(0.71)	(-5.01)***	(1.58)	(0.19)		(0.132)
Portfolio 25	0.024	0.006	-0.048	0.014	-0.028	3.05	0.070
	(1.49)	(0.96)	(-2.94)***	(1.05)	(-0.67)		(0.047)

Panel C: 1990~1999 (the sample size is 108)

Portfolio	*Constant*	$\ln ILL^{M}_{m-1}$	$\ln ILLU^{M}_{m}$	JAN_m	TM_{m-1}	*F-value*	R^2
Market	0.012	0.010	-0.159	0.043	0.053	15.45	0.375
	(0.43)	(0.96)	(-7.37)***	(1.87) *	(0.78)		(0.351)
Portfolio 5	0.024	0.013	-0.172	0.058	0.033	12.23	0.322
	(0.68)	(1.09)	(-6.43)***	(2.04)**	(0.39)		(0.296)
Portfolio 10	0.019	0.013	-0.167	0.065	0.035	12.59	0.328
	(0.57)	(1.06)	(-6.45)***	(2.37)**	(0.43)		(0.302)
Portfolio 15	0.018	0.011	-0.148	0.037	0.030	11.57	0.310
	(0.59)	(1.05)	(-6.36)***	(1.51)	(0.41)		(0.283)
Portfolio 20	0.012	0.009	-0.133	0.027	0.031	10.59	0.292
	(0.43)	(0.89)	(-6.16)***	(1.19)	(0.45)		(0.264)
Portfolio 25	0.024	0.010	-0.107	0.003	0.022	7.76	0.232
	(0.88)	(1.10)	(-5.21)***	(0.16)	(0.35)		(0.202)

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 17 Time-Series Illiquidity Effects Controlling for Term Yield Premium on BM-Portfolio Return---Monthly Data

The excess monthly BM-portfolio return is regressed on monthly market illiquidity

$$R_m^p - R_m^f = g_0^p + g_1^p \ln ILL_{m-1}^M + g_2^p \ln ILLU_m^M + g_3^p JAN_m + a^p TM_{m-1} + u_m^p, \quad (3.6b)$$

where R_m^p, p = 5, 10, 15, 20, and 25, are the equally-weighted monthly returns on *BM* portfolio *p*, R_m^f is the monthly rate of call-money rate or the one-month Gensaki rate, $\ln ILL_{m-1}^M$ is the expected monthly market illiquidity, $\ln ILLU_m^M$ is the unexpected monthly market illiquidity, $TM_m = YL_m - R_m^{G3}$ is the term yield premium, and JAN_m is a January dummy that equals 1 in January and zero otherwise.
The period of estimation is from 1976 to 1999. The first sub-period is from 1976 to 1989, and the second sub-period is from 1990 to 1999. The *t*-statistics and adjusted R^2 are reported in parentheses, respectively.

Panel A: 1976~1999 (the sample size is 287)

Portfolio	*Constant*	$\ln ILL_{m-1}^M$	$\ln ILLU_m^M$	JAN_m	TM_{m-1}	*F-value*	R^2
Portfolio 5	0.025	0.008	-0.118	0.034	-0.026	24.18	0.263
	(1.67)	(1.58)	(-9.05)***	(2.81)***	(-0.73)		(0.252)
Portfolio 10	0.021	0.007	-0.116	0.028	-0.005	30.60	0.311
	(1.68)*	(1.51)	(-10.45)***	(2.70)***	(-0.17)		(0.301)
Portfolio 15	0.018	0.005	-0.115	0.031	-0.009	26.31	0.280
	(1.34)	(1.11)	(-9.65)***	(2.80)***	(-0.27)		(0.269)
Portfolio 20	0.013	0.003	-0.122	0.031	-0.013	27.65	0.290
	(0.95)	(0.61)	(-9.99)***	(2.71)***	(-0.39)		(0.279)
Portfolio 25	0.017	0.004	-0.139	0.036	-0.003	24.54	0.266
	(0.99)*	(0.60)	(-9.43)***	(2.60)***	(-0.07)		(0.255)

Panel B: 1976~1989 (the sample size is 179)

Portfolio	*Constant*	$\ln ILL^M_{m-1}$	$\ln ILLU^M_m$	JAN_m	TM_{m-1}	*F-value*	R^2
Portfolio 5	0.014	0.002	-0.080	0.036	-0.044	12.67	0.237
	(1.04)	(0.47)	(-5.80)***	(3.05)***	(-1.21)		(0.218)
Portfolio 10	0.017	0.003	-0.094	0.022	-0.005	19.18	0.320
	(1.48)	(0.64)	(-8.16)***	(2.21)**	(-0.17)		(0.303)
Portfolio 15	0.014	0.001	-0.080	0.024	-0.015	13.68	0.251
	(1.14)	(0.32)	(-6.64)***	(2.38)**	(-0.47)		(0.233)
Portfolio 20	0.006	-0.003	-0.080	0.021	-0.029	14.49	0.262
	(0.53)	(-0.60)	(-6.76)***	(2.08)**	(-0.94)		(0.244)
Portfolio 25	0.000	-0.006	-0.089	0.025	0.005	14.08	0.257
	(0.02)	(-1.21)	(-6.77)***	(2.26)**	(0.16)		(0.239)

Panel C: 1990~1999 (the sample size is 108)

Portfolio	*Constant*	$\ln ILL^M_{m-1}$	$\ln ILLU^M_m$	JAN_m	TM_{m-1}	*F-value*	R^2
Portfolio 5	0.031	0.015	-0.149	0.036	0.020	11.52	0.309
	(1.00)	(1.39)	(-6.25)***	(1.43)	(0.26)		(0.282)
Portfolio 10	0.017	0.011	-0.134	0.041	0.044	12.66	0.330
	(0.61)	(1.18)	(-6.53)***	(1.90)*	(0.68)		(0.304)
Portfolio 15	0.013	0.008	-0.147	0.047	0.028	12.49	0.327
	(0.46)	(0.82)	(-6.61)***	(1.99)**	(0.40)		(0.301)
Portfolio 20	0.010	0.008	-0.159	0.052	0.041	13.91	0.351
	(0.35)	(0.78)	(-6.97)***	(2.15)**	(0.58)		(0.326)
Portfolio 25	0.027	0.013	-0.184	0.059	0.027	12.23	0.322
	(0.71)	(1.03)	(-6.48)***	(1.95)*	(0.30)		(0.296)

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 18 Properties of LQ-Portfolios

This table reports the properties of the odd–numbered portfolios of the equally-weighted *LQ* portfolios formed each year during 1976–1999. The market beta (β^{1p}) and the liquidity betas (β^{2p}, β^{3p} and β^{4p}) are computed using all monthly return and illiquidity observations for each test portfolio and the equally-weighted market portfolio. The average illiquidity $E(C^p)$, the average excess return $E(R^p - R^f)$, the turnover *TRN* and the market capitalization *CAP* are computed for each portfolio as time-series averages of the respective monthly characteristics. The *t*-statistics are reported in parenthesis.

Portfolio	β^{1p} (·100)	β^{2p} (·100)	β^{3p} (·100)	β^{4p} (·100)	$E(C^p)$ (%)	$E(R^p - R^f)$ (%)	*TRN* (%)	*CAP* (B ¥)
1	70.41 (16.80)	0.0000 (0.59)	0.04 (0.15)	-0.01 (-7.89)	0.25	0.50	4.14	52830.59
3	85.97 (28.87)	0.0001 (1.30)	-0.03 (-0.13)	-0.02 (-7.93)	0.26	0.38	3.85	20804.57
5	89.91 (34.28)	0.0001 (0.52)	-0.01 (-0.04)	-0.05 (-9.85)	0.27	0.45	3.83	12642.74
7	95.82 (41.43)	0.0002 (0.60)	-0.09 (-0.35)	-0.08 (-9.58)	0.28	0.39	3.76	8007.29
9	99.54 (46.42)	0.0001 (0.20)	-0.06 (-0.25)	-0.11 (-9.51)	0.29	0.38	3.99	6121.48
11	104.68 (45.22)	0.0007 (0.85)	-0.16 (-0.59)	-0.15 (-7.99)	0.31	0.53	3.82	4876.13
13	108.11 (49.40)	0.0001 (0.10)	-0.08 (-0.28)	-0.23 (-8.44)	0.33	0.52	3.95	4121.10
15	108.54 (47.26)	0.0009 (0.45)	-0.21 (-0.76)	-0.35 (-8.22)	0.37	0.38	3.29	3575.85
17	110.21 (46.74)	0.0005 (0.17)	-0.25 (-0.87)	-0.53 (-8.76)	0.42	0.60	3.91	2707.37
19	107.32 (46.40)	0.0026 (0.68)	-0.34 (-1.23)	-0.59 (-7.00)	0.48	0.49	3.25	2281.27
21	110.87 (41.73)	0.0000 (0.01)	-0.26 (-0.88)	-0.89 (-7.44)	0.56	0.61	3.04	1848.15
23	112.53 (40.99)	-0.0041 (-0.64)	-0.23 (-0.79)	-1.02 (-7.15)	0.66	0.92	3.45	1426.22
25	113.08 (32.35)	-0.0112 (-1.00)	-0.40 (-1.30)	-1.77 (-7.05)	0.92	1.14	4.22	1521.53

Table 19 Properties of SZ-Portfolios

This table reports the properties of the odd–numbered portfolios of the equally-weighted *SZ* portfolios formed each year during 1976–1999. The market beta (β^{1p}) and the liquidity betas (β^{2p}, β^{3p} and β^{4p}) are computed using all monthly return and illiquidity observations for each test portfolio and the equally-weighted market portfolio. The average illiquidity $E(C^p)$, the average excess return $E(R^p - R^f)$, the turnover *TRN* and the market capitalization *CAP* are computed for each portfolio as time-series averages of the respective monthly characteristics. The *t*-statistics are reported in parenthesis.

Portfolio	β^{1p} (·100)	β^{2p} (·100)	β^{3p} (·100)	β^{4p} (·100)	$E(C^p)$ (%)	$E(R^p - R^f)$ (%)	*TRN* (%)	*CAP* (B ¥)
1	131.56 (26.84)	0.0001 (0.01)	-0.04 (-0.32)	-1.69 (-5.62)	0.90	1.34	7.52	3331.11
3	119.00 (34.08)	0.0002 (0.12)	-0.05 (-0.54)	-0.88 (-5.80)	0.61	0.92	6.65	2141.04
5	113.79 (41.44)	-0.0013 (-0.86)	-0.08 (-0.85)	-0.75 (-6.85)	0.53	0.65	6.76	1875.98
7	115.51 (40.98)	0.0004 (0.38)	-0.06 (-0.65)	-0.55 (-6.53)	0.46	0.54	6.52	1742.37
9	112.35 (44.52)	-0.0002 (-0.23)	-0.06 (-0.69)	-0.36 (-5.80)	0.41	0.47	5.74	1924.84
11	107.50 (45.26)	-0.0002 (-0.29)	-0.03 (-0.31)	-0.35 (-7.70)	0.38	0.52	6.48	2319.74
13	103.37 (45.93)	0.0000 (-0.02)	-0.05 (-0.68)	-0.26 (-8.03)	0.35	0.37	5.88	2825.03
15	100.89 (47.05)	0.0000 (-0.08)	-0.02 (-0.25)	-0.20 (-7.48)	0.33	0.34	5.26	3520.12
17	92.18 (41.54)	-0.0002 (-0.56)	-0.03 (-0.39)	-0.17 (-7.77)	0.32	0.40	5.13	4509.31
19	92.41 (39.14)	-0.0004 (-1.19)	-0.05 (-0.66)	-0.16 (-7.22)	0.31	0.44	5.01	6151.34
21	85.58 (32.99)	-0.0001 (-0.38)	-0.01 (-0.07)	-0.16 (-5.46)	0.29	0.37	4.35	8631.96
23	77.58 (25.29)	-0.0001 (-0.13)	-0.04 (-0.59)	-0.12 (-3.63)	0.29	0.44	4.11	14940.36
25	74.23 (18.04)	-0.0002 (-0.39)	-0.03 (-0.40)	-0.15 (-3.03)	0.28	0.58	2.27	77123.77

Table 20 Properties of BM-Portfolios

This table reports the properties of the odd–numbered portfolios of the equally-weighted *BM* portfolios formed each year during 1976–1999. The market beta (β^{1p}) and the liquidity betas (β^{2p}, β^{3p} and β^{4p}) are computed using all monthly return and illiquidity observations for each test portfolio and the equally-weighted market portfolio. The average illiquidity $E(C^p)$, the average excess return $E(R^p - R^f)$, the turnover *TRN* and the market capitalization *CAP* are computed for each portfolio as time-series averages of the respective monthly characteristics. The *t*-statistics are reported in parenthesis.

Portfolio	β^{1p} (·100)	β^{2p} (·100)	β^{3p} (·100)	β^{4p} (·100)	$E(C^p)$ (%)	$E(R^p - R^f)$ (%)	*TRN* (%)	*CAP* (B ¥)
1	114.11 (30.88)	0.0018 (1.79)	-0.02 (-0.20)	-0.62 (-8.68)	0.42	0.44	6.00	11037.25
3	104.35 (37.33)	0.0009 (1.24)	0.01 (0.06)	-0.38 (-6.80)	0.38	0.33	4.07	13012.80
5	104.38 (39.84)	0.0009 (1.61)	-0.02 (-0.23)	-0.32 (-7.21)	0.37	0.37	4.21	10031.63
7	103.47 (42.25)	0.0004 (0.60)	-0.05 (-0.62)	-0.31 (-7.06)	0.36	0.38	3.83	10554.58
9	101.38 (43.00)	-0.0003 (-0.50)	-0.04 (-0.54)	-0.38 (-7.70)	0.38	0.42	4.01	9142.06
11	95.58 (43.90)	0.0007 (1.20)	-0.02 (-0.32)	-0.30 (-7.46)	0.37	0.50	4.26	8074.58
13	101.36 (45.35)	-0.0001 (-0.08)	-0.03 (-0.40)	-0.34 (-6.21)	0.38	0.64	3.98	7302.65
15	99.59 (45.40)	-0.0002 (-0.25)	-0.04 (-0.51)	-0.37 (-6.46)	0.41	0.60	4.04	5698.09
17	94.39 (42.27)	0.0010 (1.00)	-0.07 (-0.95)	-0.41 (-5.39)	0.43	0.65	3.88	6142.44
19	99.70 (45.79)	0.0005 (0.54)	-0.05 (-0.58)	-0.52 (-7.01)	0.43	0.61	4.40	5763.39
21	100.13 (42.37)	0.0005 (0.49)	-0.06 (-0.73)	-0.48 (-6.25)	0.44	0.87	3.77	5098.38
23	104.41 (42.40)	-0.0017 (-1.33)	-0.11 (-1.29)	-0.64 (-6.85)	0.48	0.64	3.73	4296.17
25	114.47 (31.56)	-0.0028 (-1.92)	-0.10 (-1.11)	-0.64 (-5.68)	0.51	0.96	4.80	4448.66

Table 21 Correlations for Portfolio Liquidity Betas

This table reports the correlations of the four betas, β^{1p}, β^{2p}, β^{3p} and β^{4p}, for the 25 equally-weighted test portfolios formed for each year during 1976~1999. The four betas are computed for each portfolio as per (4.12~4.15) using all monthly return and illiquidity observations for the portfolio and the market portfolio. The monthly innovations in portfolio illiquidity and market illiquidity are computed using the *AR(2)* specification in (4.11) for the standardized illiquidity series. The monthly innovations in market portfolio return are computed using an *AR(2)* specification for the market return series that also employs available market characteristics at the beginning of the month.

Panel A: *LQ* portfolios

Variable	β^{1p}	β^{2p}	β^{3p}	β^{4p}
β^{1p}	1.000	-0.154	-0.788	-0.654
β^{2p}		1.000	0.318	0.555
β^{3p}			1.000	0.811
β^{4p}				1.000

Panel B: *SZ* portfolios

Variable	β^{1p}	β^{2p}	β^{3p}	β^{4p}
β^{1p}	1.000	-0.287	-0.264	-0.591
β^{2p}		1.000	0.670	0.464
β^{3p}			1.000	0.604
β^{4p}				1.000

Panel C: *BM* portfolios

Variable	β^{1p}	β^{2p}	β^{3p}	β^{4p}
β^{1p}	1.000	0.341	-0.616	-0.798
β^{2p}		1.000	-0.216	-0.345
β^{3p}			1.000	0.494
β^{4p}				1.000

Table 22 Test of Liquidity-adjusted CAPM on LQ-Portfolio Return

This table reports the estimated coefficients from cross-sectional regressions of the liquidity-adjusted *CAPM* for 25 equally-weighted *LQ* portfolios using monthly data during 1976–1999 with an equally-weighted market portfolio. I test the model that running excess monthly portfolio returns on the monthly normalized portfolio illiquidity, the market beta, the liquidity betas and the net beta in the following special cases: $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda\beta^{np}$ in (4.17), $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda^1\beta^{1p} + \lambda\beta^{np}$ in (4.18) and $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda^1\beta^{1p} + \lambda^2\beta^{2p} + \lambda^3\beta^{3p} + \lambda^4\beta^{4p}$ in (4.19), where $\beta^{np} = \beta^{1p} + \beta^{2p} - \beta^{3p} - \beta^{4p}$. In some specifications, κ is set to be the average monthly turnover; while in others κ is either a free parameter or is set as 0. The *t*-statistic is reported in the parentheses. The R^2 and the *F*-value are obtained in a single cross-sectional regression, and the adjusted R^2 is reported in the parentheses.

Panel A: Original Regression

Line	Constant	$E(C^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	β^{np}	*F-value*	R^2
1	-0.0037	0.0368					0.0085	17.42	0.431
	(-0.502)						(1.075)		(0.406)
2	-0.0025	0.0333					-0.0020	11.25	0.506
	(-0.354)	(4.238)***					(-0.285)		(0.461)
3	-0.0038		0.0087					18.69	0.448
	(-0.499)		(1.078)						(0.424)
4	0.0061	0.0368	-0.3801				0.3772	13.07	0.543
	(0.917)		(-3.415)***				(3.388)***		(0.501)
5	0.0016	0.0144	-0.0726				0.0714	10.20	0.593
	(0.203)	(0.990)	(-0.276)				(0.273)		(0.535)
6	0.0063		-0.3932				0.3903	13.09	0.543
	(0.935)		(-3.508)***				(3.511)***		(0.502)
7	0.0047	0.0368	-0.0011	-39.4708	0.0486	-0.3351		6.92	0.581
	(0.718)		(-0.157)	(-1.231)	(0.044)	(-2.382)**			(0.497)
8	-0.0003	0.0215	-0.0011	-37.8230	0.2274	-0.1234		6.09	0.616
	(-0.032)	(1.381)	(-0.152)	(-1.067)	(0.204)	(-0.379)			(0.515)
9	0.0048		-0.0011	-39.4460	0.0497	-0.3488		4.95	0.581
	(0.733)		(-0.159)	(-1.231)	(0.045)	(-2.482)**			(0.497)

Panel B: Tests for Up Market

Line	Constant	$E(C^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	β^{np}
1	-0.0147 (-1.564)	0.0368					0.0539 (5.807)***
2	-0.0243 (-2.727)***	0.0623 (5.027)***					0.0153 (1.827)*
3	-0.0157 (-1.644)		0.0553 (5.824)***				
4	-0.0003 (-0.040)	0.0368	-0.5539 (-3.413)***				0.5912 (3.648)***
5	-0.0138 (-1.348)	0.0171 (0.818)	-0.4339 (-1.364)				0.4506 (1.421)
6	-0.0002 (-0.027)		-0.5645 (-3.482)***				0.6018 (3.716)***
7	-0.0022 (-0.278)	0.0368	0.0396 (4.813)***	-22.7164 (-0.497)	0.5393 (0.354)	-0.6049 (-2.893)***	
8	-0.0141 (-1.398)	0.0230 (1.004)	0.0152 (1.828)*	-2.3852 (-0.054)	-0.6862 (-0.475)	-0.5581 (-1.403)	
9	-0.0021 (-0.266)		0.0396 (4.813)***	-22.6214 (-0.495)	0.5405 (0.355)	-0.6160 (-2.949)***	

Panel C: Tests for Down Market

Line	Constant	$E(C^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	β^{np}
1	0.0107	0.0368					-0.0512
	(0.893)						(-4.375)***
2	0.0261	-0.0049					-0.0248
	(2.309)**	(-0.722)					(-2.043)**
3	0.0119		-0.0524				
	(0.973)		(-4.368)***				
4	0.0146	0.0368	-0.1516				0.0958
	(1.289)		(-1.064)				(0.676)
5	0.0219	0.0108	0.4023				-0.4270
	(1.737)*	(0.555)	(0.913)				(-0.979)
6	0.0148		-0.1681				0.1123
	(1.300)		(-1.181)				(0.794)
7	0.0138	0.0368	-0.0547	-61.4948	-0.5965	0.0195	
	(1.265)		(-5.032)***	(-1.410)	(-0.382)	(0.115)	
8	0.0179	0.0195	-0.0225	-84.4066	1.4283	0.4480	
	(1.461)	(0.983)	(-1.782)*	(-1.471)	(0.822)	(0.830)	
9	0.0139		-0.0517	-61.5622	-0.5955	0.0024	
	(1.275)		(-5.033)***	(-1.411)	(-0.382)	(0.014)	

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 23 Test of Liquidity-adjusted CAPM on SZ-Portfolio Return

This table reports the estimated coefficients from cross-sectional regressions of the liquidity-adjusted *CAPM* for 25 equally-weighted *SZ* portfolios using monthly data during 1976–1999 with an equally-weighted market portfolio. I test the model that running excess monthly portfolio returns on the monthly normalized portfolio illiquidity, the market beta, the liquidity betas and the net beta in the following special cases: $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda\beta^{np}$ in (4.17), $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda^1\beta^{1p} + \lambda\beta^{np}$ in (4.18) and $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda^1\beta^{1p} + \lambda^2\beta^{2p} + \lambda^3\beta^{3p} + \lambda^4\beta^{4p}$ in (4.19), where $\beta^{np} = \beta^{1p} + \beta^{2p} - \beta^{3p} - \beta^{4p}$. In some specifications, κ is set to be the average monthly turnover; while in others κ is either a free parameter or is set as 0. The *t*-statistic is reported in the parentheses. The R^2 and the *F*-value are obtained in a single cross-sectional regression, and the adjusted R^2 is reported in the parentheses.

Panel A: Original Regression

Line	Constant	$E(C^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	β^{np}	*F-value*	R^2
1	-0.0038 (-0.572)	0.0553					0.0085 (1.174)	56.25	0.710 (0.697)
2	-0.0022 (-0.311)	0.0464 (4.263)***					-0.0068 (-0.884)	32.31	0.746 (0.723)
3	-0.0040 (-0.599)		0.0090 (1.218)					58.87	0.719 (0.707)
4	0.0077 (1.132)	0.0553	-0.6660 (-3.856)***				0.6602 (3.880)***	33.55	0.753 (0.731)
5	0.0018 (0.234)	0.0342 (2.278)**	-0.1525 (-0.602)				0.1449 (0.575)	21.93	0.758 (0.724)
6	0.0077 (1.141)		-0.6841 (-3.961)***				0.6784 (3.987)***	33.92	0.755 (0.733)
7	0.0075 (1.108)	0.0553	-0.0054 (-0.714)	-6.3809 (-0.111)	-0.2994 (-0.251)	-0.6641 (-3.848)***		15.68	0.758 (0.710)
8	-0.0004 (-0.055)	0.0480 (3.010)***	-0.0094 (-1.249)	20.8186 (0.349)	-0.4956 (-0.406)	-0.0930 (-0.358)		12.39	0.765 (0.703)
9	0.0075 (1.115)		-0.0053 (-0.701)	-6.9378 (-0.120)	-0.2951 (-0.248)	-0.6826 (-3.955)***		15.85	0.760 (0.712)

Panel B: Tests for Up Market

Line	Constant	$E(C^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	β^{np}
1	-0.0124	0.0553					0.0517
	(-1.430)						(5.827)***
2	-0.0201	0.0799					0.0058
	(-2.251)**	(4.880)***					(0.603)
3	-0.0134		0.0530				
	(-1.513)		(5.858)***				
4	-0.0011	0.0553	-0.6614				0.6990
	(-0.129)		(-2.706)***				(2.889)***
5	-0.0146	0.0652	-0.1741				0.1783
	(-1.455)	(2.915)***	(-0.558)				(0.573)
6	-0.0010		-0.6761				0.7137
	(-0.123)		(-2.765)***				(2.949)***
7	-0.0011	0.0553	0.0374	-22.3687	-0.9412	-0.7016	
	(-0.131)		(4.198)***	(-0.262)	(-0.582)	(-2.855)***	
8	-0.0186	0.0852	0.0024	-109.5671	-0.5530	-0.0873	
	(-1.833)*	(3.570)***	(0.251)	(-1.294)	(-0.325)	(-0.277)	
9	-0.0011		0.0375	-22.6556	-0.9382	-0.7165	
	(-0.126)		(4.209)***	(-0.265)	(-0.580)	(-2.915)***	

Panel C: Tests for Down Market

Line	Constant	$E(C^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	β^{np}
1	0.0076	0.0553					-0.0483
	(0.765)						(-4.862)***
2	0.0212	0.0023					-0.0234
	(1.847)*	(0.194)					(-1.889)*
3	0.0083		-0.0489				
	(0.820)		(-4.833)***				
4	0.0192	0.0553	-0.6720				0.6093
	(1.743)*		(-2.812)***				(2.610)**
5	0.0234	-0.0065	-0.1242				0.1010
	(2.022)**	(-0.361)	(-0.295)				(0.242)
6	0.0192		-0.6946				0.6320
	(1.750)*		(-2.910)***				(2.711)***
7	0.0187	0.0553	-0.0618	14.6352	0.5442	-0.6148	
	(1.720)*		(-5.469)***	(0.201)	(0.309)	(-2.604)**	
8	0.0235	-0.0008	-0.0249	192.2128	-0.4200	-0.1005	
	(2.017)**	(-0.045)	(-2.100)**	(2.413)**	(-0.242)	(-0.230)	
9	0.0188		-0.0617	13.7234	0.5501	-0.6379	
	(1.725)*		(-5.461)***	(0.189)	(0.312)	(-2.705)***	

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 24 Test of Liquidity-adjusted CAPM on BM-Portfolio Return

This table reports the estimated coefficients from cross-sectional regressions of the liquidity-adjusted *CAPM* for 25 equally-weighted *BM* portfolios using monthly data during 1976–1999 with an equally-weighted market portfolio. I test the model that running excess monthly portfolio returns on the monthly normalized portfolio illiquidity, the market beta, the liquidity betas and the net beta in the following special cases: $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda\beta^{np}$ in (4.17), $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda^1\beta^{1p} + \lambda\beta^{np}$ in (4.18) and $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda^1\beta^{1p} + \lambda^2\beta^{2p} + \lambda^3\beta^{3p} + \lambda^4\beta^{4p}$ in (4.19), where $\beta^{np} = \beta^{1p} + \beta^{2p} - \beta^{3p} - \beta^{4p}$. In some specifications, κ is set to be the average monthly turnover; while in others κ is either a free parameter or is set as 0. The *t*-statistic is reported in the parentheses. The R^2 and the *F*-value are obtained in a single cross-sectional regression, and the adjusted R^2 is reported in the parentheses.

Panel A: Original Regression

Line	Constant	$E(C^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	β^{np}	*F-value*	R^2
1	0.0030 (0.484)	0.0420					0.0020 (0.290)	10.08	0.417 (0.398)
2	-0.0064 (-0.853)	0.0336 (2.298)**					0.0014 (0.217)	10.24	0.482 (0.435)
3	0.0034 (0.558)		0.0017 (0.246)					8.47	0.425 (0.403)
4	0.0133 (1.844)*	0.0420	-1.0147 (-2.120)**				1.0018 (2.120)**	7.84	0.241 (0.172)
5	0.0092 (1.166)	0.0163 (1.322)	-0.9907 (-2.209)**				0.9778 (2.208)**	6.94	0.498 (0.426)
6	0.0135 (1.869)*		-1.0283 (-2.150)**				1.0154 (2.150)**	6.52	0.243 (0.174)
7	0.0133 (1.844)*	0.0420	-0.0115 (-1.355)	-37.8528 (-1.026)	-1.6761 (-1.197)	-0.6579 (-1.853)*		5.01	0.500 (0.400)
8	0.0086 (1.059)	0.0154 (1.264)	-0.0102 (-1.214)	-42.0828 (-1.124)	-1.5988 (-1.165)	-0.4218 (-1.225)		4.39	0.536 (0.414)
9	0.0134 (1.869)*		-0.0116 (-1.362)	-38.1467 (-1.034)	-1.6939 (-1.210)	-0.6690 (-1.885)*		5.04	0.502 (0.403)

Panel B: Tests for Up Market

Line	Constant	$E(C^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	β^{np}
1	0.0075	0.0420					0.0324
	(0.906)						(3.552)***
2	-0.0165	0.0726					0.0036
	(-1.603)	(3.449)***					(0.436)
3	0.0078		0.0325				
	(0.930)		(3.512)***				
4	0.0193	0.0420	-1.1550				1.1705
	(1.898)*		(-1.746)*				(1.794)*
5	-0.0037	0.0646	-0.8003				0.7901
	(-0.346)	(3.745)***	(-1.368)				(1.369)
6	0.0195		-1.1661				1.1815
	(1.914)*		(-1.762)*				(1.810)*
7	0.0181	0.0420	0.0180	-21.3640	-2.7571	-0.7038	
	(1.789)*		(1.511)	(-0.431)	(-1.485)	(-1.447)	
8	-0.0038	0.0639	-0.0079	-56.5805	-2.7261	-0.2186	
	(-0.342)	(3.727)***	(-0.748)	(-1.121)	(-1.483)	(-0.511)	
9	0.0183		0.0179	-21.5997	-2.7711	-0.7129	
	(1.806)*		(1.506)	(-0.435)	(-1.492)	(-1.465)	

Panel C: Tests for Down Market

Line	Constant	$E(C^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	β^{np}
1	-0.0030	0.0420					-0.0380
	(-0.326)						(-4.051)***
2	0.0069	-0.0178					-0.0015
	(0.636)	(-0.963)					(-0.149)
3	-0.0022		-0.0387				
	(-0.243)		(-4.101)***				
4	0.0055	0.0420	-0.8302				0.7801
	(0.545)		(-1.206)				(1.146)
5	0.0261	-0.0473	-1.2410				1.2244
	(2.324)**	(-3.047)***	(-1.775)*				(1.772)*
6	0.0057		-0.8472				0.7970
	(0.564)		(-1.233)				(1.173)
7	0.0069	0.0420	-0.0503	-59.5276	-0.2551	-0.5976	
	(0.687)		(-4.568)***	(-1.077)	(-0.120)	(-1.153)	
8	0.0249	-0.0484	-0.0132	-23.0254	-0.1170	-0.6889	
	(2.141)**	(-3.180)***	(-0.968)	(-0.412)	(-0.057)	(-1.219)	
9	0.0071		-0.0504	-59.8982	-0.2779	-0.6113	
	(0.706)		(-4.578)***	(-1.084)	(-0.130)	(-1.180)	

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 25 Test of Liquidity-adjusted CAPM Controlling for Size on LQ-Portfolio Return

This table reports the estimated coefficients from cross-sectional regressions of the liquidity-adjusted *CAPM* for 25 equally-weighted *LQ* portfolios using monthly data during 1976–1999 with an equally-weighted market portfolio. I test the model that running excess monthly portfolio returns on the monthly normalized portfolio illiquidity, the market beta, the liquidity betas and the net beta in the following special cases: $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda \beta^{np}$ in (4.17), $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda^1 \beta^{1p} + \lambda \beta^{np}$ in (4.18) and $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda^1 \beta^{1p} + \lambda^2 \beta^{2p} + \lambda^3 \beta^{3p} + \lambda^4 \beta^{4p}$ in (4.19), where $\beta^{np} = \beta^{1p} + \beta^{2p} - \beta^{3p} - \beta^{4p}$. $\ln CAP_m^p$ is the time-series average of the log ratio of portfolio market capitalization to the total market capitalization at month-beginning. In some specifications, κ is set to be the average monthly turnover; while in others κ is either a free parameter or is set as 0. The *t*-statistic is reported in the parentheses. The R^2 and the *F*-value are obtained in a single cross-sectional regression, and the adjusted R^2 is reported in the parentheses.

Line	Constant	$E(C^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	β^{np}	$\ln CAP_m^p$	*F-value*	R^2
1	0.0116	0.0368					-0.0207	-0.0037	11.23	0.505
	(1.853)*						(-2.089)**	(-2.554)**		(0.460)
2	-0.0057	0.0361					0.0036	0.0009	7.49	0.517
	(-0.878)	(4.141)***					(0.379)	(0.574)		(0.448)
3	0.0126		-0.0223					-0.0038	11.77	0.517
	(2.033)**		(-2.316)**					(-2.751)***		(0.473)
4	0.0015	0.0368	-0.4824				0.4904	0.0018	8.31	0.543
	(0.266)		(-3.685)***				(3.661)***	(1.129)		(0.478)
5	-0.0038	0.0210	-0.1518				0.1600	0.0016	7.43	0.598
	(-0.538)	(1.473)	(-0.556)				(0.588)	(1.001)		(0.517)
6	0.0017		-0.4951				0.5030	0.0018	8.33	0.543
	(0.291)		(-3.785)***				(3.758)***	(1.124)		(0.478)
7	0.0023	0.0368	0.0048	-25.4822	0.0874	-0.4252		0.0010	5.76	0.603
	(0.387)		(0.469)	(-0.681)	(0.080)	(-2.146)**		(0.545)		(0.498)
8	-0.0043	0.0260	0.0061	-21.1297	0.2806	-0.1739		0.0013	5.37	0.642
	(-0.591)	(1.699)*	(0.585)	(-0.527)	(0.252)	(-0.495)		(0.672)		(0.522)
9	0.0024		0.0047	-25.6208	0.0880	-0.4379		0.0010	5.77	0.603
	(0.409)		(0.461)	(-0.684)	(0.080)	(-2.211)**		(0.538)		(0.498)

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 26 Test of Liquidity-adjusted CAPM Controlling for Size on SZ-Portfolio Return

This table reports the estimated coefficients from cross-sectional regressions of the liquidity-adjusted CAPM for 25 equally-weighted SZ portfolios using monthly data during 1976–1999 with an equally-weighted market portfolio. I test the model that running excess monthly portfolio returns on the monthly normalized portfolio illiquidity, the market beta, the liquidity betas and the net beta in the following special cases: $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda \beta^{np}$ in (4.17), $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda^1 \beta^{1p} + \lambda \beta^{np}$ in (4.18) and $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda^1 \beta^{1p} + \lambda^2 \beta^{2p} + \lambda^3 \beta^{3p} + \lambda^4 \beta^{4p}$ in (4.19), where $\beta^{np} = \beta^{1p} + \beta^{2p} - \beta^{3p} - \beta^{4p}$. $\ln CAP_m^p$ is the time-series average of the log ratio of portfolio market capitalization to the total market capitalization at month-beginning. In some specifications, κ is set to be the average monthly turnover; while in others κ is either a free parameter or is set as 0. The *t*-statistic is reported in the parentheses. The R^2 and the *F*-value are obtained in a single cross-sectional regression, and the adjusted R^2 is reported in the parentheses.

Line	Constant	$E(C^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	β^{np}	$\ln CAP_m^p$	*F-value*	R^2
1	-0.0109	0.0553					0.0267	0.0027	28.24	0.720
	(-1.608)						(2.682)***	(2.229)**		(0.694)
2	-0.0067	0.0454					0.0034	0.0013	20.81	0.748
	(-0.969)	(4.266)***					(0.418)	(1.168)		(0.712)
3	-0.0109		0.0263					0.0025	29.15	0.726
	(-1.596)		(2.618)					(2.099)**		(0.701)
4	0.0051	0.0553	-0.6359				0.6360	0.0008	21.45	0.754
	(0.856)		(-3.884)***				(3.909)***	(0.722)		(0.719)
5	-0.0016	0.0373	-0.1052				0.1056	0.0013	15.71	0.759
	(-0.228)	(2.479)**	(-0.443)				(0.445)	(1.186)		(0.710)
6	0.0052		-0.6543				0.6543	0.0008	21.69	0.756
	(0.869)		(-3.997)***				(4.023)***	(0.717)		(0.721)
7	0.0048	0.0553	0.0007	-14.6207	-0.2635	-0.6404		0.0008	12.02	0.760
	(0.798)		(0.0799)	(-0.249)	(-0.221)	(-3.878)***		(0.743)		(0.697)
8	-0.0037	0.0496	-0.0007	8.9274	-0.4097	-0.0641		0.0014	9.83	0.766
	(-0.521)	(3.146)***	(-0.086)	(0.147)	(-0.336)	(-0.278)		(1.231)		(0.688)
9	0.0048		0.0007	-15.1289	-0.2594	-0.6590		0.0008	12.15	0.762
	(0.809)		(0.087)	(-0.258)	(-0.217)	(-3.992)***		(0.738)		(0.699)

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 27 Test of Liquidity-adjusted CAPM Controlling for Size on BM-Portfolio Return

This table reports the estimated coefficients from cross-sectional regressions of the liquidity-adjusted *CAPM* for 25 equally-weighted *LQ* portfolios using monthly data during 1976–1999 with an equally-weighted market portfolio. I test the model that running excess monthly portfolio returns on the monthly normalized portfolio illiquidity, the market beta, the liquidity betas and the net beta in the following special cases: $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda\beta^{np}$ in (4.17), $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda^1\beta^{1p} + \lambda\beta^{np}$ in (4.18) and $E(R_m^p - R_m^f) = \alpha + \kappa E(c_m^p) + \lambda^1\beta^{1p} + \lambda^2\beta^{2p} + \lambda^3\beta^{3p} + \lambda^4\beta^{4p}$ in (4.19), where $\beta^{np} = \beta^{1p} + \beta^{2p} - \beta^{3p} - \beta^{4p}$. $\ln CAP_m^p$ is the time-series average of the log ratio of portfolio market capitalization to the total market capitalization at month-beginning. In some specifications, κ is set to be the average monthly turnover; while in others κ is either a free parameter or is set as 0. The *t*-statistic is reported in the parentheses. The R^2 and the *F*-value are obtained in a single cross-sectional regression, and the adjusted R^2 is reported in the parentheses.

Line	Constant	$E(C^p)$	β^{1p}	β^{2p}	β^{3p}	β^{4p}	β^{np}	$\ln CAP_m^p$	*F-value*	R^2
1	-0.0104 (-1.133)	0.0420					-0.0015 (-0.211)	-0.0046 (-2.158)**	9.07	0.452 (0.402)
2	-0.0121 (-1.268)	0.0129 (1.059)					-0.0022 (-0.337)	-0.0044 (-2.126)**	7.38	0.513 (0.444)
3	-0.0105 (-1.136)		-0.0014 (-0.198)					-0.0047 (-2.185)**	9.11	0.453 (0.403)
4	-0.0106 (-1.011)	0.0420	0.0105 (0.030)				-0.0118 (-0.034)	-0.0047 (-1.891)*	6.70	0.489 (0.416)
5	-0.0149 (-1.357)	0.0140 (1.157)	0.1207 (0.328)				-0.1215 (-0.333)	-0.0048 (-2.018)**	7.44	0.598 (0.518)
6	-0.0106 (-1.008)		0.0031 (0.009)				-0.0045 (-0.013)	-0.0047 (-1.903)**	6.73	0.490 (0.417)
7	-0.0082 (-0.740)	0.0420	-0.0020 (-0.249)	-6.6187 (-0.185)	-0.4459 (-0.343)	0.0112 (0.030)		-0.0042 (-2.013)**	4.83	0.560 (0.444)
8	-0.0112 (-0.962)	0.0158 (1.311)	-0.0015 (-0.183)	-13.2401 (-0.370)	-0.4342 (-0.337)	0.2267 (0.594)		-0.0038 (-1.856)*	4.65	0.608 (0.477)
9	-0.0082 (-0.734)		-0.0020 (-0.250)	-6.7559 (-0.189)	-0.4575 (-0.352)	0.0035 (0.009)		-0.0042 (-2.023)**	4.86	0.561 (0.446)

Note: ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 28 Comparisons and Contrasts of the Test Results between U.S. and Japan

This table reports the major test results in this thesis as well as those from Amihud (2002) and Acharya and Pedersen (2005).
Lines 1 to 7 are the "All months" results from Panel A in Table 8 in this thesis and Table 2 in Amihud (2002).
Lines 8 to 10 are the "portfolio" results from Panel A in Table 14 in this thesis and Table 4 in Amihud (2002).
Lines 11 to 16 are the results from Panel A in Table 22 in this thesis and Panel A in Table 5 in Acharya and Pedersen (2005).

Line	Effects	*U.S.* data	Japanese data
1	*Mean-adjusted stock illiquidity*	Positive and significant	Positive and significant
2	*Logarithm of firm size*	Negative and significant	Positive and insignificant
3	*Stock market beta*	Positive and insignificant	Negative and insignificant
4	*Return volatility*	Negative and significant	Negative and insignificant
5	*Stock dividend yield*	Negative and significant	Positive and insignificant
6	*Past return for the last 100 days*	Positive and significant	Negative and insignificant
7	*Past return for the rest days*	Positive and significant	Negative and insignificant
8	*Expected market illiquidity*	Positive and decreasing	Positive
9	*Unexpected market illiquidity*	Negative and increasing	Negative and increasing
10	*January dummy*	Positive and decreasing	Positive and decreasing
11	*Normalized portfolio illiquidity*	Positive and significant	Positive and significant
12	*Portfolio market beta*	Positive and insignificant	Negative and insignificant
13	*Commonality-in-liquidity*	Negative and insignificant	Negative and insignificant
14	*Return sensitivity to market illiquidity*	Positive and insignificant	Positive and insignificant
15	*Illiquidity sensitivity to market return*	Negative and insignificant	Negative and significant
16	*Portfolio net beta*	Positive and significant	Negative and insignificant

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