Cross-sectional variations of illiquidity on stock returns, idiosyncratic volatility biases in the Chinese stock market

Chen Yang*

Graduate School of Economics, Ritsumeikan Unversity,
1-1-1 Nojihigashi, Kusatsu, Shiga 525-8577, Japan
* Corresponding author. Tel.: +81-80-3832-7461;
E-mail: yangchenlucky@gmail.com

Abstract

Under the NTS Reform (Non-tradable Share Reform), this paper explores the cross-sectional relations between illiquidity and stock returns by considering the idiosyncratic volatility biases in the Chinese stock market. To this end, we propose a new illiquidity index that measures the liquidity of the Chinese stock market more precisely than indexes used in previous studies. Differing from prior studies, stock returns are decreasing in a stock's illiquidity both before and after the NTS Reform. Regarding the negative relation between illiquidity and stock returns, we find that stock returns show no clear relation with illiquidity after controlling for idiosyncratic volatility biases. Furthermore, we use residual approach to eliminate the effect of idiosyncratic volatility, and find there exists a positive relation between illiquidity and stock returns, especially after the NTS Reform.

***JEL* codes**: G11, G12, G15

Keywords: Liquidity; Idiosyncratic volatility; Stock return; Non-tradable Share Reform

1. Introduction

Market microstructure models have shown that liquidity is one of the most important market fractions that influence asset prices (e.g., Easley and O'Hara, 1987). In a seminal paper, Amihud and

Mendelson (1986) show a positive relation between illiquidity and stock returns by using the bid-ask spread for illiquidity proxy. Brennan and Subrahmanyam (1996), Brennan et al. (1998), Datar et al. (1998), and Amihud (2002) all show that stocks with low liquidity acquire higher expected returns as compared to stocks with high liquidity. Pastor and Stambaugh (2003), Acharya and Pederson (2005), Liu (2006), Chordia et al. (2009) have shown that illiquidity is important for explaining asset returns and should be priced by the market.

However, fewer studies attempt to simultaneously consider the effect of liquidity and idiosyncratic volatility on expected stock returns into account[1]. Stoll (1978) and Ho and Stoll (1981) propose an inventory model that dealer provides immediacy by investor trading to market who is faced with risks on his inventory, which is partly due to the de-diversification caused by dealing in few stocks (idiosyncratic volatility risk). Dealers are unwillingness to provide immediacy (liquidity) when they are faced with higher return uncertainty on their inventory. With information asymmetry, an increase in volatility of underlying security returns implies higher uncertainty about the expected value of the security, which leading a higher adverse selection cost faced by liquidity provider, due to the increased possibility of trading with informed traders. This in turn leads to lower liquidity due to higher transaction costs and higher volatility because of higher bid-ask bounce (see for Easley et al., 1996; O'Hara, 2003). Other studies like Easley and O'Hara (2010) develop a model in which illiquidity arises from uncertainty during financial crisis; Brunnermeier and Pedersen (2009) link the asset's market liquidity and traders' funding liquidity, and imply that market liquidity is related to volatility[2].

Among empirical studies, Spielg and Wang (2005) investigate the interaction relation between the

[1] O'Hara (2003) develops an asymmetric information asset pricing model that incorporates the transactions costs of liquidity as well as the risks of price discovery.

[2] Vayanos and Wang (2012) show that the positive relationship between expected returns and idiosyncratic volatility might be partly due to illiquidity.

two factors - idiosyncratic volatility and liquidity and find that the explanatory power of idiosyncratic volatility is strong and even could eliminates the liquidity effect on US stock market. Bao et al. (2011), Kalimipalli et al. (2012, 2013) examine the jointly effect of the two factors on bond market and find that both idiosyncratic volatility and liquidity remain their significant influence on bond yields. Han and Lesmond (2011) show that controlling for liquidity bias in the estimated idiosyncratic volatility eliminates the pricing ability of idiosyncratic volatility[3]. Motivated by these studies, we examine the cross-sectional correlations between illiquidity and stock returns by considering the idiosyncratic volatility bias in the Chinese stock market. As for our knowledge, there has no article to study the effect of liquidity on returns with considering idiosyncratic volatility.

Chinese stock market has developed such remarkably that catches a great deal of attention from the world in recent years. Different from developed markets like US, Europe countries, Japan, we conjecture that Chinese stock market may show some typical features related to Chinese investment and Chinese behavior due to the numerous constraints only in Chinese market[4]. The most represent feature is the Non-tradable Share Reform (April 2005, hence fore NTS Reform), which aimed at overcoming split share structures by converting non-tradable shares into tradable shares. This reform directly improves the market liquidity and influences volatility. Thus it is very necessary as well as important to study whether NTS Reform affects illiquidity, idiosyncratic volatility, or both. Therefore the purpose of this paper is to investigate correlations between illiquidity and stock returns by considering the idiosyncratic volatility bias under the NTS Reform in the Chinese stock market.

The results are as follows. Firstly, differing from prior studies, stock returns are decreasing in a

[3] Ang et al. (2006, 2009) examine the pricing ability of idiosyncratic volatility and find that stocks with high idiosyncratic volatility have earn lower average returns.
[4] Other features such as short-sales constraints are remained now, which also arises the transaction costs and information asymmetry, leading low liquidity and high volatility.

stock's illiquidity both before the NTS Reform and after the NTS Reform. This finding means that investors require higher compensation for liquid stocks than illiquid stocks, which is inconsistent with illiquidity premium (e.g., Amihud and Mendelson, 1986; Amihud, 2002; Pastor and Stambaugh, 2003). Thus we call there exists illiquidity puzzle in the Chinese stock market.

To seek for the negative relation between illiquidity and stock returns, we consider the impact of idiosyncratic volatility on illiquidity as well as stock returns by using bivariate sorts portfolio analysis. To this end, we firstly sort stocks into quintiles by idiosyncratic volatility, and then within each idiosyncratic volatility quintile portfolios, we further sort stocks into quintiles based on illiq_zero, and this produce rebalance every month. After considering the idiosyncratic volatility basis, stock returns show no clearly relations to illiquidity, especially after the NTS Reform. This result is similar with Spiegel and Wang (2005), who also show that idiosyncratic volatility reduces the pricing ability of liquidity.

To eliminate the influence of idiosyncratic volatility on illiquidity, we use residual illiq_zero by orthogonalizing the idiosyncratic volatility from the illiq_zero measure, based on Fama and French (2008). And then we sort stocks into quintiles by the residual illiq_zero and find that a positive relation between illiq_zero and stock returns both before and after the NTS Reform. Additionally, this result is remarkably significant after the NTS Reform.

Prior studies on Chinese stock market are all about the influence of liquidity on stock returns or idiosyncratic volatility on stock returns[5]. For example, Su and Mai (2004), Wu and Song (2007), Nayan and Zheng (2010), i.e., examine the relation between liquidity and stock returns by using turnover ratio as liquidity measure, and find a positive relation between illiquidity and stock returns.

[5] Yang and Han (2009) document a negative relation between idiosyncratic volatility on stock returns, Chen, et al. (2007) also obtain the similar results with Yang and Han (2009), while Deng and Zheng (2011) find that idiosyncratic volatility is positively related to stock returns.

With the illiquidity measure of Amihud (2002), Li and Wu (2003) provide evidence that supports a negative relations between illiquidity and stock returns; whereas Narayan and Zheng (2011) show aggregate illiquidity is a priced risk factor, which is positively related to stock returns. Other related studies like Jin and Yang (2002) explore the effects of stock price, trading volume and volatility on market liquidity, and find that factors such as trading volume, stock price and volatility of return can give significant explanation to different liquidity level.

Comparing with prior studies on Chinese stock market, this paper makes three efforts. It is the first attempt to study the jointly effect of liquidity and idiosyncratic volatility on stock returns with using a new illiquidity measure to capture the liquidity of Chinese stock market. Second, we consider the influences of the NTS Reform to examine whether the NTS Reform affects the relations between liquidity and idiosyncratic volatility or liquidity and returns. Third, we propose a residual approach to eliminate the impact of idiosyncratic volatility on liquidity.

The rest of this paper is organized as follows. Section 2 provides the data description, liquidity and idiosyncratic volatility measures used in this study. Section 3 presents the portfolio analyses for univariate sorts analysis and bivariate sorts analysis with considering the impact of idiosyncratic volatility. Section 4 presents illiq_zero residual approach to further explore the correlation between illiq_zero and stock returns. Section 5 provides concluding comments.

2. Data and Descriptive Statistics

We obtain daily and monthly stock returns, market returns and trading volumes from CSMAR

(China Stock Market & Accounting Research) database over the period December 2000 through January 2012, which includes all common stocks traded on the Shanghai A' Share Stock Exchange. As discussed earlier, we focus on the A' Share market since the size and the trading value of the A' Share market accounts for 80 percent of the whole stock market. We also use annual accounting data for calculating the book-to-market ratio (B/M) and market value (MV) from the balance sheet of each firm. In addition, monthly risk-free rate is converted from the annual risk free rate based on compound interest calculation from CSMAR database. Here we exclude stocks whose trading days in a month is less than 10 days.

Following Fama and French (1992,1993), we form size portfolios and book-to-market portfolios to calculate SMB and HML factor. In the end of each year t from 2001 to 2011, all common stocks are ranked based on market value and then split them into two groups, small and big (S and B). We also break all these common stocks into three book-to-market equity groups based on the breakpoints for the bottom 30% (Low), middle 40% (Medium), and top 30% (High) of the ranked values of B/M.

Then we construct six portfolios (S/L, S/M, S/H, B/L, B/M, B/H) from the intersections of the two MV and three B/M groups. For example, the S/L portfolio contains the stocks in the small MV group that are also in the low B/M group, and the B/H portfolio contains the big MV group that are also have high B/M. Monthly value-weighted returns on the six portfolios are calculated each year. SMB is the difference between the returns on the small- (S/L, S/M, S/H) and big- (B/L, B/M, B/H) stock portfolios with about the same weighted average book-to-market equity. As the same way, HML means the difference between the returns on the low- (S/L, B/L) and high- (S/H, B/H) stock portfolios with about the same weighted average MV.

2.1 Estimation of Illiquidity and Idiosyncratic Volatility

Consider that there has a large percentage of non-trading days due to high trading costs in Chinese stock market, we propose a new liquidity measure, Illiq_zero - the revised version of Amihud (2002) for our illiquidity measure, which can be calculated as follows：

$$\text{Illiq\_}Zero_{i,t} = \alpha\left(\frac{1}{N_{i,t}}\sum_{t=1}^{N_{i,t}}\left|R_{i,d}\right| / VOLD_{i,d}\right) + \beta NT\%_{i,t}, \qquad \alpha = \beta = 0.5 \tag{1}$$

where α and β are anonymous factors, $N_{i,t}$ is the number of days on which stock i is traded in month t, $\left|R_{i,d}\right|$ is the absolute value of returns on stock i on day d, and $VOLD_{i,d}$ is the Chinese yuan trading volume of stock i on day d, which is divided by 10^8. $NT\%_{i,t}$ is the percentage of zero-return days within a month. If the stock return on day d is not zero, the new illiquidity measure is same with the Amihud illiquidity measure, whereas if the stock return on day d is zero, the new illiquidity measure will be the same as that of Lesmond et al. (1999)[6]. Therefore, the monthly illiquidity of a stock is a combination of the illiquidity on trading days and the illiquidity on non-trading days given by the same weight. This new illiquidity measure captures the price reaction to trading volume as well as the trading cost. Higher the new illiquidity measure, lower the stock liquidity.

Following Ang, et al. (2006, 2009), we define idiosyncratic volatility as the standard deviation of the residuals from the Fama and French (1993) model. In each month, daily excess returns of individual stocks are regressed on the daily Fama-French three factors: the excess return on a broad market portfolio ($R_m - r_f$), SMB and HML factors,

[6] Lesmond et al. (1999) propose an illiquidity measure, by using the numbers of zero return days to numbers of trading days over some intervals, to capture the trading costs dimension of liquidity.

$$R_{id} - r_{fd} = \alpha_{it} + \beta_{it}\left(R_{md} - r_{fd}\right) + s_{it}SMB_d + h_{it}HML_d + \varepsilon_{id} \quad (2)$$

where d is the subscript for the day and t is the subscript for the month, $d \in t$, and β_i, s_i, h_i are factor sensitivities or loadings. We run a time-series regression for each stock in each month. The idiosyncratic volatility of a stock is computed as the standard deviation of the regression residuals.

<Insert Figure 1>

Figure 1 plots the average monthly illiq_zero measure and idiosyncratic volatility of all common stocks during the period January 2001 to December 2011. On one hand, illiq_zero measure has a high value before the year of 2006, and sharply decreases during the period 2006 through 2011 due to the NTS Reform. It seems that the NTS Reform has increased the liquidity of Chinese stock market. On the other hand, idiosyncratic volatility varies dramatically during the period 2006 to 2011 compared with the period 2001 to 2005. As non-tradable share holders are exposed to idiosyncratic risk due to their excess holdings of that stock, leading the level of idiosyncratic volatility on tradable share market is lower than non-tradable share market. As a result of the NTS Reform, the tradable share market comes to be more de-diversified since those non-tradable shares convert to be tradable shares, increasing the level of idiosyncratic volatility on tradable share market after the NTS Reform (See for Li et al., 2011)

2.2 Summary Statistics

Table 1 shows summary statistics for main variables examined here before the NTS Reform (Panel A) and after the NTS Reform (Panel B), respectively. First, the mean value of the three illiquidity proxies - illiq_zero, amihud, zeront – are 0.3653, 0.4597, 0.0714 before the NTS Reform, which are all larger than those after the NTS Reform (illiq_zero=0.0523, amihud=0.0507, zeront=0.0651). Furthermore, the illiq_zero measure varies from 0.0022 to 15.4000, with a standard deviation of 0.4479 before the NTS Reform, while ranging from 0.0004 to 7.6400, with a standard deviation of 0.0995 after the NTS Reform. From the observations of zeront, we find that the number of zero return days after the NTS Reform declines to 8344 compared with 12182 before the NTS Reform. Second, the mean value of market capitalization and book value come to be larger, especially the market capitalization as a result of the reform. Third, idiosyncratic volatility varies from 0.0022 to 0.0893 and receives a mean of 0.0206 before the reform. As a result of the reform, the mean value increased to 0.0282, varying from 0.0049 to 0.0940, which is consistent with Li et al. (2011).

<Insert Table 1 and Table 2>

Correlations for these variables are provided in Table 2. Firstly, the relation between individual stock returns and the three illiquidity proxies – illiq_zero, amihud, zeront – are all negative. For example, the correlation between illiq_zero and stock returns is -0.1623, which is contrast with prior studies. Studies such as Amihud and Mendelson (1986), Amihud (2002) document that stocks with lower liquidity should be compensated by higher returns. Moreover, as a contribution of zeront on idiosyncratic volatility, illiq_zero and idiosyncratic volatility is negatively correlated with a value of -0.1023, compared to the correlation between amihud and idiosyncratic volatility (-0.0882). In addition,

illiq_zero is negatively correlated to market capitalization as well as book value. This is reasonable since larger a firm, higher the liquidity of that firm.

<Insert Table 3>

We sort stocks into quintiles by illiq_zero, form equally weighted illiq_zero quintile portfolios. The summary statistics of these illiq_zero quintile portfolios are shown in Table 3. Compared with the result before the NTS Reform (Panel A), the three illiquidity proxies - illiq_zero, amihud and zeront show lower values, market capitalization and book value turn to be larger for each illiq_zero quintile portfolio after the reform (Panel B). The Amihud measure, which is defined by the price impact to trading volume, increased monotonically across all illiq_zero quintiles, indicating our new measure, illiq_zero is highly correlated to the illiquidity measure of Amihud (2002). The idiosyncratic volatility increases from 0.0203 (illiq_zero quintile portfolio 1) to 0.0207 (illiq_zero quintile portfolio 5) before the reform, while shows a decreasing trend from 0.0289 to 0.0273 after the reform, though it is not obvious. As for this result, we will do more precise analysis between illiq_zero and idiosyncratic volatility later. Consistent with Table 2, with the increasing of illiq_zero, market capitalization and book value for illiq_zero quintile portfolios have reduced monotonically.

3 Univariate and bivariate portfolio analysis

In this section, we form portfolios based on one-way and two-way sorts to explore the cross-sectional relations between illiquidity and stock returns using the new illiquidity measure – illiq_zero both before and after the NTS Reform. As numerous studies have document that illiquidity is highly related to idiosyncratic volatility (e.g. Ho and Stoll, 1981), we consider the impact of

idiosyncratic volatility in two-way sorts portfolio analysis.

3.1 Univariate sorted portfolio returns

We sort stocks into quintiles based on their monthly estimates of illiq_zero, form equally weighted quintile-sorted portfolios, and then difference the lowest and highest illiq_zero quintiles. Specifically, each month, stocks are sorted into five quintiles based on the illiq_zero and then rebalanced. We then regress the quintile portfolio returns against either the CAPM model or the three-factor (Fama-French) model to estimate the CAPM or the Fama-French alpha, respectively. We finally compare the performance between the portfolio with the lowest illiq_zero (1 Low) and the portfolio with highest illiq_zero (5 High). The difference is the abnormal return one would earn on a zero-cost (arbitrage) portfolio formed by taking a long position in the lowest-quintile portfolio and taking a short position in the highest-quintile portfolio (P1-P5).

The results are presented in Table 4, with Panel A focusing on the results before the NTS Reform and Panel B focusing on results after the NTS Reform. As shown in Panel A of Table 4, the raw return on quintile 1 (lowest illiq_zero) is 0.625% on quantile 5 (highest illiq_zero) is -2.756% per month. This results a difference of 3.381% in the arbitrage portfolio, with a t-statistic of 19.06. And the decreasing trend performs monotonic, which is supportive of Table 2, meaning higher the liquidity, larger the stock returns. After controlling for CAPM or the Fama-French model, the adjusted returns remain decreasing with illiq_zero. For example, the Fama-French alpha of the arbitrage portfolio (P1-P5) has earned a significantly positive return of 1.650% (t=7.07). These results suggest that including the market return, size and value factor does not sufficiently control for the effect of illiq_zero on stock

returns.

<Insert Table 4>

In Panel B of Table 4 (After the NTS Reform), which the raw return as well as the CAPM and Fama-French alpha show similar trend with Panel A. The raw return on illiq_zero quintile 1 is 2.360%, illiq_zero quintile 2 is 2.306%, illiq_zero quintile 3 is 1.697%, illiq_zero quintile 4 is 1.509, and illiq_zero quintile 5 is 1.153%, which decreasing monotonically with illiq_zero. Similarly, the Fama-French alpha declines from 0.635% to -0.164% with the increasing of illiq_zero, which yields a positive alpha of 0.799% per month.

Both before and after the NTS Reform, notable in the results is the monotonically decreasing trend of stock returns from the lowest-ranked illiq_zero quintile to the highest-ranked illiq_zero quintile. This means investors would earn a positive return on arbitrage portfolio formed by taking long positions in lowest illiq_zero quintile and taking short positions in the highest illiq_zero quintile portfolio. Therefore we call there exists an illiquidity puzzle in Chinese stock market.

3.2 Bivariate sorted portfolio returns

We then form two-way sorted portfolios to simultaneously control for the impact of idiosyncratic volatility while examining the cross-sectional effect of illiquidity on stock returns. Each month, we sort stocks into quintiles by idiosyncratic volatility firstly, and then we form portfolios by illiq_zero into quintiles for each idiosyncratic volatility quintile. This formation would yield 25 idiosyncratic

volatility-illiq_zero portfolios. Table 5 reports the Fama-French alpha both before (Panel A) and after (Panel B) the NTS Reform. The column (P1-P5) shows the difference on portfolio formed by taking long positions in lowest illiq_zero quintile and taking short positions in highest illiq_zero quintile. The last row - 'Control for Iv' shows the Fama-French alpha across illiq_zero quintiles for a portfolio that is equally weighted across idiosyncratic volatility quintiles.

Before the NTS Reform, the decreasing trend is also matched in each idiosyncratic volatility quintile (Iv 1 ~ Iv 5). That is lowest illiq_zero quintile 1 have earned largest returns while highest illiq_zero quintile 5 have earned lowest returns. The Fama-French alphas on arbitrage portfolios (P1-P5) are all significantly positive. For instance, holding for idiosyncratic volatility quintile 1, the Fama-French alphas are decreasing from 0.477% to -0.874%, which yields a positive value of 1.351%, with the t-statistic value is 5.06. Furthermore, in the 'control for Iv' row, the Fama-French alpha shows a monotonically decreasing trend and the result on (P1-P5) is positively 1.557%, which is statistically significant under 1%. Thus idiosyncratic volatility seems has no impact on the relation between illiq_zero and stock returns before the NTS Reform.

<Insert Table 5>

We now turn to the results after the NTS Reform. According to each idiosyncratic volatility quintile, not all of the Fama-French alphas on arbitrage portfolios (P1-P5) are positive, as the Fama-French alpha on arbitrage portfolio (P1-P5) is significantly negative, with a value of -0.013% for idiosyncratic volatility quintile 2. Meanwhile the decreasing trend is not all monotonically across each idiosyncratic volatility quintiles. For idiosyncratic volatility quintile 4, the Fama-French alpha on

illiq_zero quintile 2 is lowest, -0.133%, while the result on illiq_zero quintile 5 is 0.413%. After controlling for idiosyncratic volatility (the row 'Control for Iv'), illiq_zero quintile 1 has earned largest value of 0.558%, and illiq_zero quintile 5 has earned lowest value of 0.057%. As a result, the Fama-French alpha on arbitrage portfolio (P1-P5) shows a positive value of 0.501%, while the t-statistic is only 0.37. Considering the impact of idiosyncratic volatility, the negative correlation between illiq_zero and stock returns is eliminated.

In sum, there exists illiquidity puzzle in Chinese stock market both before and after the NTS Reform. However, the puzzle could be partly eliminated by controlling for the impact of idiosyncratic volatility after the NTS Reform. We provide the following approach to further explore the illiquidity puzzle with the effect of idiosyncratic volatility.

4 Illiq_zero regression residual approach

The bivariate sorts portfolio analysis makes it clear that the correlation between illiq_zero and stock returns may not provide a conclusive test without considering the impact of idiosyncratic volatility. As inventory control model implies, sorting on illiq_zero could be in effect sorting on the idiosyncratic volatility. Thus, in effort to purge the idiosyncratic volatility effects from the illiq_zero, we provide a residual illiq_zero as a sorting variable (e.g. Chen et al., 2002; Fama and French, 2008). The residual illiq_zero is estimated by regressing the illiq_zero on idiosyncratic volatility and then obtain the residual of this regression. This approach will orthogonalize the idiosyncratic volatility from the illiq_zero measure by using Fama-MacBeth (1973) setting. Therefore we could isolate the impact of idiosyncratic volatility to examine the correlation between illiq_zero and stock returns.

Each month, we sort stocks into quintiles by the estimated residual illiq_zero, form equally weighted quintile portfolios, and compare the performance of the quintile portfolios and the (P1-P5) arbitrage portfolio. Table 6 reports the cross-sectional raw returns, CAPM alpha, Fama-French alpha on residual illiq_zero quintile portfolios before the NTS Reform (Panel A) and after the NTS Reform (Panel B).

<Insert Table 6>

As shown in Panel A of Table 6 before the NTS Reform, the raw returns on residual illiq_zero quintile portfolios perform no clear trend, since the lowest value of -1.819% is shown by residual illiq_zero quintile 3. However, the arbitrage portfolio (P1-P5) has earned a raw return of -0.380% per month, with a t-statistic of -1.93. Similarly, the CAPM alpha and Fama-French alpha on arbitrage portfolio (P1-P5) are -1.312% and -1.885%, respectively. With using residual illiq_zero, the clearly negative correlation between illiq_zero and stock returns disappeared before the NTS Reform.

After the NTS Reform in Panel B, the results are remarkable. The negative correlation between illiq_zero and stock returns are converted, indicating that stock returns are increasing with illiq_zero. Illiq_zero quintile 1 earns lowest raw return of -0.777%, then illiq_zero quintile 2 is -0.219%, illiq_zero quintile 3 is 0.277%, illiq_zero quintile 4 is 2.038% and illiq_zero quintile 5 earns largest raw return of 7.677%. Also the CAPM or Fama-French alpha of residual illiq_zero quintiles shows a monotonically increasing trend with residual illiq_zero. The raw return of the arbitrage portfolio (P1-P5) is significantly -8.454%, suggesting that taking long positions in the highest illiq_zero quintile and taking short positions in the lowest illiq_zero quintile would earn 8.454% per month. After

adjusted by CAPM model or Fama-French three-factor model, the alpha is reduced to 8.054% (CAPM alpha) or 6.935% (Fama-French alpha), but still significant at the 1% level.

These results are indicative of the “illiquidity puzzle” after removing the impact of idiosyncratic volatility on illiq_zero. In particular, after the NTS Reform, investors require profits when they taking long positions in illiquid stocks. The result also implies that the NTS Reform has improved the liquidity and volatility of tradable share market and further promotes the market efficiency.

5 Conclusions

Using the data of Shanghai A Share stock market over the period January 2001 to December 2011, this paper investigates the cross-sectional correlations between illiquidity and stock returns, with considering the NTS Reform in Chinese stock market. To this end, we propose a new illiquidity measure, illiq_zero, which is a combination of price impact to trading volume and trading cost. Our main findings are shown as follows. First, differing from prior studies, stock returns are decreasing in a stock’s illiquidity (illiq_zero) both before the NTS Reform and after the NTS Reform. This finding means that investors require higher compensation on liquid stocks than illiquid stocks. Thus we call there exists illiquidity puzzle in Chinese stock market. Second, to seek for the negative correlation between illiquidity and stock returns, we consider the impact of idiosyncratic volatility on illiquidity as well as stock returns by using bivariate sorts portfolio analysis. After considering the idiosyncratic volatility basis, stock returns show no clearly relations to illiquidity after the NTS Reform. Third, we use residual approach to minimize the effect of idiosyncratic volatility, and find there exists a positive relation between illiq_zero and stock returns, especially after the NTS Reform.

References

[1] Acharya, V. V. & Pedersen, L. H. (2005). "Asset pricing with liquidity risk." *Journal of Financial Economics* 77, 375-410.

[2] Amihud, Y. (2002). "Illiquidity and stock returns: cross-section and time-series effects." *Journal of financial markets* 5(1), 31-56.

[3] Amihud, Y. & Mendelson, H. (1986). "Liquidity and stock returns." *Financial Analysts Journal* 42, 43-48.

[4] Ang, A., Hodrick, R. J., Xing, Y. & Zhang, X. (2006). "The cross - section of volatility and expected returns." *The Journal of Finance* 61, 259-299.

[5] Ang, A., Hodrick, R. J., Xing, Y. & Zhang, X. (2009). "High idiosyncratic volatility and low returns: International and further US evidence." *Journal of Financial Economics* 91, 1-23.

[6] Bao, J., Pan, J. & Wang, J. (2011). "The illiquidity of corporate bonds." *The Journal of Finance* 66, 911-946.

[7] Brennan, M. J., Chordia, T. & Subrahmanyam, A. (1998). "Alternative factor specifications, security characteristics, and the cross-section of expected stock returns." *Journal of Financial Economics* 49, 345-373.

[8] Brunnermeier, M. K. & Pedersen, L. H. (2009). "Market liquidity and funding liquidity." *Review of Financial studies* 22, 2201-2238.

[9] Chen, G., Tu, H. & Lin, H. (2007). "Idiosyncratic volatility puzzle and explanations based on heterogeneous beliefs: evidence from Chinese stock markets." *working paper, Xiamen University*.

[10] Chen, J., Hong, H. & Stein, J. C. (2002). "Breadth of ownership and stock returns." *Journal of financial Economics* 66(2), 171-205.

[11] Chordia, T., Huh, S.-W. & Subrahmanyam, A. (2009). "Theory-based illiquidity and asset pricing." *Review of Financial Studies* 22(9), 3629-3668.

[12] Datar, V. T., Y Naik, N. & Radcliffe, R. (1998). "Liquidity and stock returns: An alternative test." *Journal of Financial Markets* 1(2), 203-219.

[13] Deng, X. & Zheng, Z. (2011). "Is there an idiosyncratic volatility puzzle exist in China's equity market?" *Journal of Business Economics* 1, 60-67.

[14] Easley, D., Kiefer, N. M., O'Hara, M. & Paperman, J. B. (1996). "Liquidity, information, and infrequently traded stocks." *The Journal of Finance* 51(4), 1405-1436.

[15] Easley, D. & O'Hara, M. (2010). "Microstructure and ambiguity." *The Journal of Finance* 65(5), 1817-1846.

[16] Fama, E. F. & French, K. R. (1992). "The cross - section of expected stock returns." *the Journal of Finance* 47, 427-465.

[17] Fama, E. F. & French, K. R. (1993). "Common risk factors in the returns on stocks and bonds." *Journal of financial economics* 33, 3-56.

[18] Fama, E. F. & French, K. R. (2008). "Dissecting anomalies." *The Journal of Finance* 63(4), 1653-1678.

[19] Fama, E. F. & MacBeth, J. D. (1973). "Risk, return, and equilibrium: Empirical tests." *The*

Journal of Political Economy, 607-636.

[20] Han, Y. & Lesmond, D. (2011). "Liquidity biases and the pricing of cross-sectional idiosyncratic volatility." *Review of Financial Studies* 24(5), 1590-1629.

[21] Ho, T. & Stoll, H. R. (1981). "Optimal dealer pricing under transactions and return uncertainty." *Journal of Financial economics* 9, 47-73.

[22] Jin, Y. & Yang, W. (2002). "An empirical analysis of the factors affecting liquidity in Shanghai stock market." *Journal of Financial Research*(6), 12-21.

[23] Kalimipalli, M. & Nayak, S. (2012). "Idiosyncratic volatility vs. liquidity? Evidence from the US corporate bond market." *Journal of Financial Intermediation* 21(2), 217-242.

[24] Kalimipalli, M., Nayak, S. & Perez, M. F. (2013). "Dynamic effects of idiosyncratic volatility and liquidity on corporate bond spreads." *Journal of Banking & Finance* 37, 2969-2990.

[25] Lesmond, D. A., Ogden, J. P. & Trzcinka, C. A. (1999). "A new estimate of transaction costs." *Review of Financial Studies* 12, 1113-1141.

[26] Li, K., Wang, T., Cheung, Y.-L. & Jiang, P. (2011). "Privatization and risk sharing: Evidence from the split share structure reform in China." *Review of Financial Studies*, hhr025.

[27] Li, Y. & Wu, S. (2003). "An Empirical Analyst of liquidity premium on china stock markets." *Management Of finance* 11, 34-43.

[28] Liu, W. (2006). "A liquidity-augmented capital asset pricing model." *Journal of financial Economics* 82, 631-671.

[29] Narayan, P. K. & Zheng, X. (2010). "Market liquidity risk factor and financial market anomalies: Evidence from the Chinese stock market." *Pacific-Basin finance journal* 18(5), 509-520.

[30] Narayan, P. K. & Zheng, X. (2011). "The relationship between liquidity and returns on the Chinese stock market." *Journal of Asian Economics* 22(3), 259-266.

[31] O'Hara, M. (2003). "Presidential address: Liquidity and price discovery." *The Journal of Finance* 58, 1335-1354.

[32] Pastor, L. & Stambaugh, R. F. (2003). "Liquidity Risk and Expected Stock Returns." *Journal of Political Economy* 111(3), 642-685.

[33] Spiegel, M. I. & Wang, X. (2005). "Cross-sectional variation in stock returns: Liquidity and idiosyncratic risk." *working paper, Yale University*.

[34] Stoll, H. R. (1978). "The pricing of security dealer services: An empirical study of NASDAQ stocks." *The Journal of Finance* 33, 1153-1172.

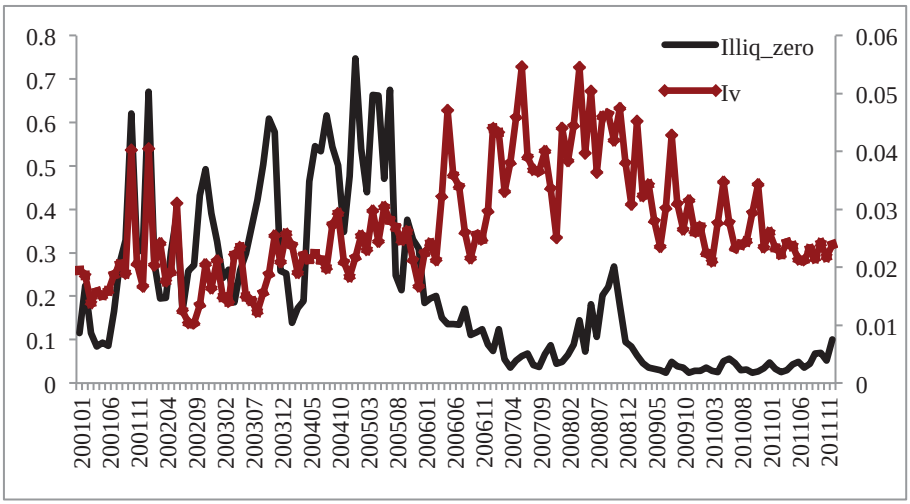
[35] Su, D. & Mai, Y. (2004). "Liquidity and Asset Pricing: An Empirical Exploration of Turnover and Expected Returns on Chinese Stock Markets." *Economic Research Journal* 2(11), 95-105.

[36] Vayanos, D. & Wang, J. (2012). "Liquidity and asset returns under asymmetric information and imperfect competition." *Review of Financial Studies* 25(5), 1339-1365.

[37] Wu, Y. & Song, F. (2007). "Liquidity risk and stock return." *Proceedings of the Operations Research and Management Science* 16(2), 117-122.

[38] Yang, H. & Han, L. (2009). "An empirical study of the relationship between the idiosyncratic volatility and cross-sectional returns." *Journal of Pecking University of Aeronautics and Astronautics* 22, 6-10.

Figure 1 Illiq_zero measure and idiosyncratic volatility



The sample includes stocks from Shanghai A Share market over the period Jan 2001 to Dec 2011. The illiq_zero is calculated as follows. $\text{Illiq\_}Zero_{i,t} = \alpha(\frac{1}{N_{i,t}}\sum_{t=1}^{N_{i,t}}|R_{i,d}|/VOLD_{i,d}) + \beta NT\%_{i,t}$, $\alpha = \beta = 0.5$, where α and β are anonymous factors, $N_{i,m}$ is the number of trading volume days of stock i in month t, $|R_{i,d}|$ is the absolute return on stock i on day d, and $VOLD_{i,d}$ is the Chinese yuan trading volume of stock i on day d, which is divided by 10^8. And $NT\%_{i,t}$ is the percentage of zero-return days within a month. Idiosyncratic volatility is defined as the standard deviation of the residuals from the Fama-French (1993) model.

Table 1 Summary Statistics

Panel A: Before NTS Reform

Variable	Obs	Mean	Std.Dev.	Min	Max
R	26246	-0.0137	0.0919	-0.5430	0.7804
Illiq_zero	26246	0.3653	0.4479	0.0022	15.4000
Amihud	26246	0.4597	0.5566	0.0022	15.4000
Zeront	12182	0.0714	0.0361	0.0435	0.3750
Lnsize	26246	13.6707	0.7942	10.5589	16.9852
Lnbk	26246	15.3538	1.3149	11.2345	21.7493
Iv	26246	0.0206	0.0085	0.0022	0.0893

Panel B: After NTS Reform

Variable	Obs	Mean	Std.Dev.	Min	Max
R	26088	0.0180	0.1421	-0.6730	1.3200
Illiq_zero	26088	0.0523	0.0995	0.0004	7.6400
Amihud	26088	0.0507	0.1095	0.0004	7.6400
Zeront	8344	0.0651	0.0327	0.0435	0.4667
Lnsize	26088	15.4042	1.1591	11.9237	21.3808
Lnbk	26088	15.7557	1.6176	11.7598	23.4641
Iv	26088	0.0282	0.0102	0.0049	0.0940

The sample includes stocks from Shanghai A'Share market over the period Jan 2001 to Apr 2005 in Panel A and Oct 2008 to Dec 2011 in Panel B. Illiq_zero is the illiquidity of all common stocks, which is calculated as follows. $\text{Illiq\_}Zero_{i,t} = \alpha(\frac{1}{N_{i,t}}\sum_{t=1}^{N_{i,t}}|R_{i,d}|/VOLD_{i,d}) + \beta NT\%_{i,t},\ \alpha = \beta = 0.5$, where α and β are anonymous factors, $N_{i,m}$ is the number of trading volume days of stock i in month t, $|R_{i,d}|$ is the absolute return on stock i on day d, and $VOLD_{i,d}$ is the Chinese yuan trading volume of stock i on day d, which is divided by 10^8. And $NT\%_{i,t}$ is the percentage of zero-return days within a month. Amihud is the illiquidity measure of Amihud (2002), which is defined by the price impact to trading volume. Zeront is the non-trading days within a month. Lnsize and Lnbk are the logarithm of market capitalization and book value. IV is the idiosyncratic volatility of all common stocks, which is defined as the standard deviation of the residuals from the Fama-French (1993) model.

Table 2 Cross-sectional correlations

	R	Illiq_zero	Amihud	Zeront	Iv	Lnsize	Lnbk
R	1.0000						
Illiq_zero	-0.1623	1.0000					
Amihud	-0.1622	0.9971	1.0000				
Zeront	-0.0148	0.1271	0.0516	1.0000			
Iv	0.1513	-0.1023	-0.0882	-0.1935	1.0000		
Lnsize	0.0269	-0.4971	-0.4962	-0.0558	0.0247	1.0000	
Lnbk	0.0096	-0.2077	-0.2156	0.0847	-0.1184	0.6013	1.0000

The sample includes stocks from Shanghai A Share market between Jan 2001 to Dec 2011. Illiq_zero is the illiquidity of all common stocks, which is calculated as follows. $\text{Illiq\_}Zero_{i,t} = \alpha(\frac{1}{N_{i,t}}\sum_{t=1}^{N_{i,t}}|R_{i,d}|/VOLD_{i,d}) + \beta NT\%_{i,t}$, $\alpha = \beta = 0.5$, where α and β are anonymous factors, $N_{i,m}$ is the number of trading volume days of stock i in month t, $|R_{i,d}|$ is the absolute return on stock i on day d, and $VOLD_{i,d}$ is the Chinese yuan trading volume of stock i on day d, which is divided by 10^8. And $NT\%_{i,t}$ is the percentage of zero-return days within a month. Amihud is the illiquidity measure of Amihud (2002), which is defined by the price impact to trading volume. Zeront is the non-trading days within a month. IV is the idiosyncratic volatility of all common stocks, which is defined as the standard deviation of the residuals from the Fama-French (1993) model. Lnsize and Lnbk are the logarithm of market capitalization and book value.

Table 3 Correlations of various variables on portfolios sorted by illiq_zero

Panel A: Before NTS Reform

	Illiq_zero	Amihud	Zeront	Iv	lnsize	lnbk
1 (Low)	0.076	0.086	0.063	0.0203	14.503	16.199
	(0.04)	(0.06)	(0.03)	(0.01)	(0.75)	(1.75)
2	0.162	0.215	0.071	0.0205	13.857	15.435
	(0.07)	(0.12)	(0.04)	(0.01)	(0.58)	(1.21)
3	0.266	0.368	0.074	0.0206	15.188	15.188
	(0.12)	(0.21)	(0.04)	(0.01)	(1.05)	(1.05)
4	0.422	0.574	0.076	0.0206	15.046	15.046
	(0.21)	(0.36)	(0.04)	(0.01)	(1.00)	(1.00)
5 (High)	0.897	1.052	0.076	0.0207	14.907	14.907
	(0.72)	(0.89)	(0.04)	(0.01)	(0.99)	(0.99)
Panel B: After NTS Reform						
1 (Low)	0.012	0.011	0.049	0.0289	16.465	16.924
	(0.01)	(0.01)	(0.01)	(0.01)	(1.10)	(1.78)
2	0.027	0.025	0.051	0.0289	15.577	15.856
	(0.02)	(0.02)	(0.01)	(0.01)	(0.90)	(1.36)
3	0.042	0.04	0.052	0.0282	15.304	15.61
	(0.03)	(0.04)	(0.01)	(0.01)	(0.97)	(1.42)
4	0.062	0.061	0.06	0.0278	14.989	15.308
	(0.05)	(0.08)	(0.02)	(0.01)	(0.88)	(1.26)
5 (High)	0.118	0.116	0.089	0.0273	14.693	15.085
	(0.20)	(0.21)	(0.05)	(0.01)	(1.08)	(1.55)

The sample includes stocks from Shanghai A Share market within two periods - before (Jan 2001 to Apr 2005) and after the NTS Reform (Oct 2008 to Dec 2011). This table presents the means and standard deviation (in parentheses) for quintile sorted portfolios by illiq_zero. The illiq_zero is calculated as follows. $\text{Illiq\_}Zero_{i,t} = \alpha(\frac{1}{N_{i,t}}\sum_{t=1}^{N_{i,t}}|R_{i,d}|/VOLD_{i,d}) + \beta NT\%_{i,t}$, $\alpha = \beta = 0.5$, where α and β are anonymous factors, $N_{i,m}$ is the number of trading volume days of stock i in month t, $|R_{i,d}|$ is the absolute return on stock i on day d, and $VOLD_{i,d}$ is the Chinese yuan trading volume of stock i on day d, which is divided by 10^8. And $NT\%_{i,t}$ is the percentage of zero-return days within a month. Amihud is the illiquidity measure of Amihud (2002), which is defined by the price impact to trading volume. Zeront is the non-trading days within a month. IV is the idiosyncratic volatility of all common stocks, which is defined as the standard deviation of the residuals from the Fama-French (1993) model. Lnsize and lnbk are the logarithm of market capitalization and book value.

Table 4 Returns on portfolios sorted by illiq_zero

Panel A: Before NTS Reform

	1(Low)	2	3	4	5(High)	P1-P5
Return	0.625	-0.772	-1.667	-2.283	-2.756	3.381
	4.80	-6.02	-13.20	-18.50	-22.88	19.06
CAPM Alpha	1.814	0.591	-0.218	-0.778	-1.298	3.112
	16.31	5.82	-2.31	-8.88	-15.15	15.12
FF-3 Alpha	1.310	0.592	0.355	-0.064	-0.340	1.650
	10.23	5.02	3.29	-0.65	-3.63	7.07

Panel B: After NTS Reform

	1(Low)	2	3	4	5(High)	P1-P5
Return	2.360	2.306	1.697	1.509	1.153	1.207
	11.31	11.43	8.70	7.86	6.24	4.33
CAPM Alpha	1.451	1.447	0.824	0.655	0.270	1.181
	9.23	9.22	5.62	4.51	2.08	4.99
FF-3 Alpha	0.635	0.773	0.264	0.224	-0.164	0.799
	3.71	4.69	1.72	1.51	-1.25	3.68

The sample includes stocks from Shanghai A Share market within two periods - before (Jan 2001 to Apr 2005) and after the NTS Reform (Oct 2008 to Dec 2011). Stocks are ranked into quintiles on the basis of their illiq_zero every month. Panel A and B presents the monthly raw returns, adjusted returns (alpha) relative to CAPM, as well as adjusted returns (FF-3 alpha) relative to Fama-French 3 factor models before and after the NTS Reform, respectively. The column (P1-P5) reports the return differences between low illiq_zero portfolio and high illiq_zero portfolio. The illiq_zero is calculated as follows. $\text{Illiq\_}Zero_{i,t} = \alpha(\frac{1}{N_{i,t}}\sum_{t=1}^{N_{i,t}}|R_{i,d}|/VOLD_{i,d}) + \beta NT\%_{i,t}$, $\alpha = \beta = 0.5$, where α and β are anonymous factors, $N_{i,m}$ is the number of trading volume days of stock i in month t, $|R_{i,d}|$ is the absolute return on stock i on day d, and $VOLD_{i,d}$ is the Chinese yuan trading volume of stock i on day d, which is divided by 10^8. And $NT\%_{i,t}$ is the percentage of zero-return days within a month.

Table 5 Portfolios sorted by illiq_zero after controlling for idiosyncratic volatility, FF 3 factor alphas

Panel A: Before NTS Reform

	Illiq_zero 1 (Low)	2	3	4	5(High)	P1-P5
Iv 1(Low)	0.477	0.207	0.092	-0.402	-0.874	1.351
	2.56	1.09	0.52	−2.36	−5.83	5.06
2	0.694	0.565	−0.138	−0.268	−0.661	1.355
	3.22	2.66	−0.79	−1.52	−4.44	4.20
3	0.839	0.247	-0.091	-0.382	-0.584	1.423
	3.19	1.18	-0.46	-2.12	-3.69	3.89
4	0.742	0.139	0.158	0.024	-0.370	1.112
	2.63	0.56	0.69	0.11	-1.83	3.01
Iv 5(High)	3.385	2.072	1.645	0.967	0.860	2.525
	8.35	5.62	4.68	3.04	2.71	2.01
Control for Iv	1.231	0.646	0.336	-0.012	-0.326	1.557
	9.54	5.50	3.09	-0.12	-3.44	7.00

Panel B: After NTS Reform

	Illiq_zero 1 (Low)	2	3	4	5(High)	P1-P5
Iv 1(Low)	−1.345	−0.992	−1.661	−1.478	−1.632	0.287
	−5.99	−4.09	−7.07	−6.79	−8.80	5.85
2	−1.624	−0.923	−1.539	−1.518	−1.611	−0.013
	−5.69	−3.43	−6.24	−6.68	−7.67	−5.80
3	-0.829	-1.373	-0.867	-1.390	-1.527	0.698
	-2.60	-4.55	-3.10	-5.02	-6.74	5.56
4	0.573	-0.133	0.425	0.034	0.413	0.160
	1.70	-0.39	1.24	0.11	1.42	0.20
Iv 5(High)	5.977	5.692	5.519	5.791	4.605	1.372
	12.10	11.84	12.39	11.84	10.88	12.73
Control for Iv	0.558	0.455	0.379	0.289	0.057	0.501
	3.34	2.78	2.47	1.88	0.42	0.37

The sample includes stocks from Shanghai A Share market within two periods - before (Jan 2001 to Apr 2005) and after the NTS Reform (Oct 2008 to Dec 2011). In each month, stocks are ranked into quintiles on the basis of their idiosyncratic volatility firstly (Iv 1~ Iv 5), and then sorted (into quintiles) by their illiq_zero in each idiosyncratic volatility quintile (Illiq_zero 1~Illiq_zero 5). Panel A and B presents monthly adjusted returns (alpha) relative to Fama-French 3 factor models before and after the NTS Reform, respectively.. The column (P1-P5) reports the return differences between low illiq_zero portfolio and high illiq_zero portfolio. Control for Iv show alphas across illiq_zero quintiles for a portfolio that is equally weighted across idiosyncratic volatility quintiles. The values under the alphas present t statistics.

Table 6 Returns on portfolios sorted by residual illiq_zero

Panel A: Before NTS Reform

	1(Low)	2	3	4	5(High)	P1-P5
Return	-1.070	-1.471	-1.819	-1.817	-0.690	-0.380
	-11.97	-13.91	-15.78	-14.01	-3.94	-1.93
CAPM Alpha	-0.154	-0.207	-0.440	-0.263	1.158	-1.312
	-2.21	-2.76	-5.35	-2.80	8.12	-13.12
FF-3 Alpha	-0.108	0.036	-0.0001	0.135	1.777	-1.885
	-1.33	0.42	0.00	1.25	11.03	-14.14

Panel B: After NTS Reform

	1(Low)	2	3	4	5(High)	P1-P5
Return	-0.777	-0.219	0.277	2.038	7.677	-8.454
	-5.96	-1.36	1.54	10.14	29.38	-28.90
CAPM Alpha	-1.452	-1.028	-0.602	1.098	6.602	-8.054
	-15.53	-9.31	-4.82	7.77	33.12	-45.21
FF-3 Alpha	-1.423	-1.443	-1.199	0.262	5.512	-6.935
	-14.22	-12.90	-9.47	1.81	26.27	-39.48

The sample includes stocks from Shanghai A Share market within two periods - before (Jan 2001 to Apr 2005) and after the NTS Reform (Oct 2008 to Dec 2011). Stocks are ranked into quintiles on the basis of their residual illiq_zero. Residual illiq_zero is estimated by regressing the illiq_zero estimate on idiosyncratic volatility based on Fama-MacBeth (1973). Panel A and B presents the monthly raw returns, adjusted returns (alpha) relative to CAPM, as well as adjusted returns (FF-3 alpha) relative to Fama-French 3 factor models before and after the NTS Reform, respectively. The column (P1-P5) reports the return differences between low illiq_zero portfolio and high illiq_zero portfolio.The values under returns or adjusted returns (alpha) present t statistics.