Intraday Reversal, Liquidity and Anchored Expectation

Shen Lin and Xiong Xiong

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Abstract

Motivated by the demand of understanding intraday return dynamics for academic debate of price efficiency and the practice of high-frequent trading, we document a robust phenomenon of return reversal in cross-sectionally intraday level. The empirical evidence shows that the previous intraday return, such as the first 30 minutes, negatively predicts the return of rest trading hours after controlling extreme liquidity shocks and bid-ask bounce for both mature (U.S.) and developing (Chinese) market. Several potential driving forces are examined, and we find illiquidity explains the most part of intraday reversal in U.S. but not in China. After discovery of the crucial role of price limitation, we additionally suggest that expectations anchored to the yesterday close is another driving of intraday reversal. Our results provide further insight for understanding intraday return behaviors and anomaly of short-term reversal.

JEL Classification: G12, G14, G41

Keywords: Short-term reversal, psychological anchor, intraday return, liquidity

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1 Introduction

Short-term reversal is a well-known anomaly that stocks with higher (lower) return in last month tend to earn a lower (higher) return over next month (Jegadeesh, 1990). Since the discovery of this simple return prediction, it has been well-documented in different short horizon such as weekly (Lehman, 1990; Avramov, Chordia & Goyal, 2006) or daily (Cox & Peterson, 1994; Bremer & Sweeney, 1991). The high dependency on liquidity (Avramov, Chordia & Goyal, 2006; Nagel, 2012) and bid-ask bounce (Conrad, Gultekin & Kaul, 1997; Ball, Kothari & Wasley, 1995) suggests short-term reversal could be an untradeable phenomenon which deflates its academic value to the topic of long-term asset pricing. However, great attention of both academics and practitioners are attracted on it due to its strong implication on the debate of the efficient market and the timing selection of trading decision of institutional or individual investor. To this day, the growing of high-frequency and intraday traders brings another further research question on this topic: whether or not the price reversal exists in the intraday level and if yes, in what magnitude the reversal impacts the intraday stock price.

In this paper, we provide evidences for the existence of intraday reversal by showing the later intraday return is negatively predicted by previous intraday return in cross-section. We find that, stocks with a higher/lower previous intraday return (*PIR*) earn a lower/higher return in the rest of daily trading in both mature (U.S.) and developing (China) stock market. Specifically, in a representative timing of 10:00 a.m., a portfolio long on the stocks with lowest decile *PIR* and short on the highest counterpart earns about 27 basis-points daily equal-weighted return in U.S. and 44 basis-points one in China after controlling basic possible bid-ask bounce and extremely liquidity shock. By engaging Fama-Macbeth (1997) regression, several famous return predictors are controlled and the predicting ability of our *PIR* survives.

Different timings of *PIR* are tested and intraday reversal is robustness within a large proportion of daily trading time for both stock markets. The result of U.S. stock market shows the significance of first and last 30 minutes of trading hour in reversal pattern which is consistent with the infrequent rebalance of institutional investors (Bogousslavsky, 2016; Gao, Han, Li & Zhou, 2018) in some manner. Inconsistent with their theory and empirical discovery in intraday time-series momentum, the majority of this short-term mispricing is produced in first 30 minutes and adjusted in last 30 minutes

which form a reversal pattern in cross-section. We also investigate the prediction of first 30-minute *PIR* only on the last 30-minute intraday return and result also confirms the existing of reversal on this period with high activation of institutional investors. We argue that uninformed liquidity demand of institutional investors dominates the price movement in the first 30 minutes cross-sectionally and this liquidity shock is gradually corrected by other investors in the rest of trading hours specifically in the last 30 minutes by other institutional investors. Similar pattern is observed in China but the significance of first and last 30 minutes is smaller due to the overall high participation of individual investors.

Next, we follow the prior studies and study the liquidity dependency of intraday reversal. With three measurements of liquidity, including market capitalization, share turnover and illiquidity of Amihud (2002), we find that reversal disappears in the most liquidity quintile of U.S. stocks. The difference of equal-weighted intraday reversal return between most liquid portfolios and most illiquid counterparts is about 40 basis-points with significant statistics. Liquidity also plays a role on intraday reversal of Chinese stock market with smaller impact. The difference between stocks with different liquidity state is only about 10 to 15 basis-points even insignificant with share turnover. Furthermore, reversal strategy still earns about 30 basis-points daily return with the most liquid stocks in China. An intuitionistic idea is the general condition of liquidity of Chinese market is poor. However, because of high participation of individual investors, the yearly share turnover of most stocks in China are higher than 100% caused by their feature of overtrading (Odean, 1999). Combining with different characteristic shown by the different *PIR* timing, we argue that liquidity is not only driving force of intraday reversal in the developing market.

The major distinction, which could explain the difference pattern of intraday reversal, between mature and developing market is a variety of trading friction especially the daily price limitation adopted in Chinese stock market. As regard to price limitation, other two possible channels, which would give rise to intraday reversal, are considered in this paper namely Overreaction caused by Trading Halt (OTH) and Underreaction to the news driven by the Anchored Expectation (UAE). Before testing these two hypotheses, we first check the role of price limitation, which would aggravate the impacts of both channels, on the intraday reversal. Using the data of firms simultaneously listed and traded on stock exchanges of mainland (with price limitation)

and Hong Kong (without price limitation), we test the intraday pattern of both markets after controlling fundamental value of sample. The result shows that, although the underlying values of stocks traded in these two markets are identical, the return spread of *PIR*-based portfolios is -26.7 basis-points in mainland market meanwhile the one in Hongkong is only -3.8 with insignificant t-statistics. By showing entirely different patterns, we prove that price limitation plays a crucial role in Chinese intraday reversal.

Finally, we identify which one of the channels mentioned above is valid. The intuition of OTH, which is so called magnet effect, is that the existence of price limitation brings an additional risk to the investors when the stock price is near to the limit. The investors fear about losing opportunity to trade after the trigger is hit. Therefore, they would be desperate to facilitate trades when the price is close to the daily limitation. This phenomenon is well-described by Chen, Petukhov & Wang (2018) in theory and well-tested in several developing market, such as Spanish (Abad & Pascual, 2007) and Taiwan (Cho, Russell, Tiao & Tsay, 2003; Hsieh, Kim & Yang, 2009). With price limitation, the irrational price movement caused by OTH would be corrected in the following intraday forming an intraday reversal pattern. In the other hand, UAE predicts that investors' expectation is affected by the past representative price such as 52-week high (George & Hwang, 2004; Li & Yu, 2012). In this case, we argue that the yesterday close price could be an anchor for the investors whose expectations of stock's fundamental value is based on it and reluctant to digest the new information contained in the intraday price movement. UAE induces investors to trade against to the previous price movement, which also forms a pattern of intraday reversal, until their anchor is reset by a new close price after daily trade end.

Since both channels build similar pattern in intraday, the price movement over the following days are investigated for the identification of valid channel. As mentioned above, intraday reversal of OTH is a process of price correction which should be followed by a flat or same side movement during the next several days. Meanwhile, the one of UAE is irrational and need to be corrected which implies that the price movement during the following day would be opposite to the reversal part. By studying the daily returns over ten following days, we find the UAE is strongly supported by empirical evidence. Even without price limitation in U.S., the equal-weighted return of reversal shrinks from -27.4 to -19.7 basis-points with significant positive daily return in $t+1$ if we extend the holding period. After $t+1$, spread returns are flat with insignificant t-

statistics up to *t+10*. The shrink of reversal return in Chinese market is stronger from -43.9 to -16.6 basis-points after one more day holding. Moreover, if we extent the holding up to 10 days, the spread portfolio earns a significant positive return of 14 basis-points instead of reversal. Results of both markets are the powerful evidence that, besides of illiquidity, UAE is the valid channel which plays an important role in the intraday reversal pattern for not only developing but also mature stock markets.

In the rest of this section, we relate our paper to the previous studies. Our paper contributes to the studies about stock price reversal since first discovery by Jegadeesh (1990) and Lehman (1990). As shown in Jegadeesh's study, a zero-position strategy long on the lowest decile and short on the highest decile of last month return can earn a 2.49% monthly return during the period from 1934 to 1987. Similar pattern was found in shorter horizon such as weekly by Lehman (1990), 10-day by Bremer & Sweeney (1991) and daily by Cox & Peterson (1994). Most of existing literatures assign the phenomenon as a liquidity driven one which is well-tested by Avramov, Chordia & Goyal (2006) in cross-section and Nagel (2012) in time-series. And finally, Da, Liu & Schaumburg (2014) identified the profit sources of long- and short-leg of short-term reversal. Specifically, the reversal profit is attributable to liquidity shocks on the long side because fire sales more likely demand liquidity, and it is attributable to investor sentiment on the short side because short-sale constraints prevent the immediate elimination of overvaluation.

This paper contributes to the above studies by showing a similar pattern in the intraday horizon which is increasingly important lately due to the growth of high-frequent trading. Besides of the horizon, we also look deeply into the underlying driven forces of this typical reversal pattern and find two different forces in which one of them is never documented by previous literatures. The crucial role of price limitation as a reinforcement to the impact of UAE on the intraday reversal is revealed in this paper as an addition to liquidity. By investigating both U.S. and Chinese market, we find UAE impacts the intraday reversal and price correction during the following days in not only the developing market with price limitation but also in the mature one without price limitation.

Our paper is also related to the studies about psychological anchor which is considered as a main element taking responsibility for the effect of underreaction to news. In the stock market, George & Hwang (2004) found the 52-week high is a strong

price anchor for investors who will underreact to the good news when the stock price is near to it. They found the nearness to the 52-week high dominates and improves upon the forecasting power of past returns in cross-section. Li & Yu (2012) arrived on same conclusion based with the aggregate market data of U.S. in time-series by finding a positive predicting power of the distance to the 52-week high on future market return. The anchor is also available on the mergers and acquisitions price of firms (Baker, Pan & Wurgler, 2012) and the credit spreads of corporative bond (Dougal, Engelberg, Parsons & Wesep, 2015). By showing the process of intraday reversal and the following daily momentum, we provide empirical support for the impact of anchored expectation on the trading behaviors of investors.

This paper also contributes to the literatures about price behaviors in intraday level which attracts increasing attention by the practitioners due to the growing demand of high-frequent trading. Heston, Korajczyk & Sadka (2010) examine the intraday return and find return continuation at half-hour intervals that are exact multiples of a trading day which lasts for at least 40 trading days. Another related study is Gao, Han, Li & Zhou (2018) who found that the first 30-minute return positively predicts the last 30-minute return. Similar time-serial momentum is discovered by Zhang, Lin & Zhang (2016). Both of them argue that infrequent rebalance of institutional investors form the momentum effect, one type of return seasonality (Bogousslavsky, 2016), in intraday level. Our study contributes to these literatures by showing a reversal pattern in a different interval of measurement which is hardly explained by Bogousslavsky's theory. And then, we offer detail empirical tests for fully understanding the underlying driving of this robust intraday pattern.

The rest of the paper is organized as follows. Section 2 describes the data sources, summary statistics and our main result about intraday reversal. Section 3 discusses several possible driving elements of intraday reversal and the role of UAE is also deeply discussed in this section. Section 4 concludes.

2 Data and intraday reversal

Our data sources, definitions of key variables and the main results about intraday reversal are given in this section. We first give the description about how we obtained intraday data from several different sources and how we build our main return predictor. And then, we provide detailed and certain evidences for the existing pattern of intraday

reversal in both U.S. and Chinese stock market.

2.1 Data and summery statistics

Our analysis is based on the data of two largest stock market in the world, U.S. and Chinese stock market. Data are obtained from several sources. For U.S. stock market, low-frequent stock data are from monthly and daily The Center for Research in Security Prices (CRSP) database, intraday stock data are from Trade and Quote (TAQ) database and accounting data are from Compustat Annually and Quarterly (Compustat) database. Our sample includes all common stocks whose sharecodes are '10' or '11' traded in NYSE, AMEX and NASDAQ from January 2000 to December 2012 due to the availability of data. Intraday price data are merged based on TAQ data. For a given time, we consider the price as the price of last trade before that. We merged all TAQ data into 15-minute interval which gives us series with 26 observations for every stock every day of all U.S. stocks.

For Chinese stock market, stock data in daily- and monthly-frequency are obtained from CSMAR database (www.gtarsc.com) which is only one database in China offering stock and financial statement data for Wharton Research Data Services (WRDS). Intraday price data are from Wind database from January 2000 to December 2001 and Thomson Reuters Tick History (TRTH) database after January 2002 due to the vast missing of THTR before 2002. Accounting data are also from CSMAR database. We considered all common stocks, whose codes begin with '60', '30' and '00', traded in Shanghai Stock Exchange and Shenzhen Stock Exchange as our sample stocks. The sample period is from January 2000 to December 2017. The interval of intraday data is also 15-minute as U.S data. The trading hours in Chinses stock market is from 9:30 to 15:00 with a 90-minute break from 11:30 to 13:00.

Our main cross-sectional predictor is Previous Intraday Return (*PIR*). At the given timing m in day t, $PIR_{i,t}^{m} = P_{i,t}^{m}/P_{i,t-1}^{c}$, where $P_{i,t}^{m}$ is the price of stock i of time m in day t and $P_{i,t-1}^{c}$ is the close price of yesterday. In a related literature, Zhang, Lin & Zhang (2016) found that the market-wide aggregation of directions of stock-level *PIRs* significantly predicts the following intraday market return, which is holding the market index (or index future) from time m to today market close. In another intraday research, Gao et al. (2018) found that the first 30-minute ETF return, whose definition is same as our *PIR*, predicts last 30-minute ETF return. Following these studies, we use *PIR* as our

main intraday return predictor to investigate its impact on the following intraday return cross-sectionally.

Several well-known return predictors are considered as control variables including market equity (*ME*), book-to-market ratio (*BM*), return volatility (*Vola*), short-term reversal (*Rev*), long-term momentum (*Mom*), share turnover (*TO*) and illiquidity (*Ami*). *ME* is share price times total share outstanding for U.S. and total market value (obtained from CSMAR directly) for China. *BM* is the value of book equity divided by market equity. *Vola* is the volatility of daily returns into last calendar month. *Rev* is the return in last month. *Mom* is the cumulative return over the past year with one-month gap. *TO* is trading volume during the last calendar month divided by the total share number (share outstanding for U.S and total share for China) at the end of last month. *Ami* is the average value of absolute daily return divided by trading dollar times 10^6 over last six calendar months.

Some basis requirements are considered for stocks to enter our portfolios including prices to be equal to or higher than 5 domestic dollars, at least 10 non-missing daily stock return within last month and appeared in corresponding database longer than 6 months. Although our main predictor is daily-level, we filter our sample stocks at the beginning of every month based on latest available data to ensure our analysis is comparable with general empirical studies. In addition, in daily level, we exclude stocks which are in a dividend-paying day, in a share breaking day or previously available data of daily return is less than 120 trading day (appearing on the database longer than six-month but having a long trade suspending). Our result is robust with different filters or different sample updating.

The summary statistics are reported in Table 1. At the representative time m = 10:00 of everyday, we sort stocks into quintiles of their corresponding market based on their *PIRs*. In each quintile, the equal-weight *PIRs* and daily return (*Ret*) are calculated. Other firm characteristics as our control variables are also calculated equal-weightedly and given in the table. All characteristics are based on the value at the end of last calendar month. The difference between highest to lowest *PIR* and their t-statistics are also given. All t-statistics shown in the parentheses are based on the Newey-West (1987) standard errors with a lag of 120 for firm characteristics and daily return. We do not apply the heteroskedasticity-consistent standard errors of White (1980) because the possible existence of periodic auto-correlation of return in daily (Campbell, Grossman

& Wang, 1993) or intraday level (Heston, Korajczyk & Sadka, 2010).

[Insert table 1 here]

The results of U.S. and Chinese stock market are given in the upper and bottom panel of table 1 respectively. Statistical result suggests the existence of a U-shaped relationship between *PIR* and firm characteristics. Extreme *PIR* mostly come from high volatile stocks which tent to have smaller firm size, high volatility of past daily return, high turnover and low illiquidity for both U.S. and Chinese stock market. The illiquidity places most important roles for U.S. in which the *Ami* of stocks into highest and lowest *PIR* is about triple higher than the ones in other three quintiles. In the other hand, liquidity is not a crucial factor for the stocks traded in China. The turnover rate of tradable share is maintained above 100% per year for most Chinese stocks due to the high degree of participation of individual investors. It is observable in the table that the average daily turnover of U.S. stocks is only about 0.8% and the one of Chinses stocks is about 1.4%. *PIR* also shows similar reactions to the past return in two stock market. In both markets, extreme past return, both in one-month or one-year, brings a higher absolute *PIR* which means investors often trades actively at the earlier hour when the unrealized profits of their positions are suffering a great gain or loss. This is consistent with the theory of realization utility (An, 2016; Ingersoll & Jin, 2013) that the trading motivation of investors is increasing with the absolute value of their gains or losses. This pattern is stronger in Chinese market which is consistent of two general knowledge about Chinese market as a developing market, which are 1) high participant of individual investors who are always affected by a strong disposition effect and 2) massive trades of price manipulation.

2.2 Intraday reversal

As shown in the table 1, the daily close-to-close return is slightly moving to the zero compared with corresponding *PIR*. This section carefully investigates the relationship between the *PIR* and the following intraday return. At the time m = 10:00 of every day, we sort stocks into ten portfolios based on their *PIRs* and holding them to the today close. The results of U.S. and Chinese stock market are reported in panel A and B respectively. To rule out some concealed data error and untradeable liquidity shock, we considered four type of portfolio construction for both markets.

In addition to the basic filters as section 2.1, firstly, we require the absolute value of stocks' *PIR* is smaller than 50% and the following daily return are from time *m* to close (result [1] in table 2) for the result of U.S. market. Secondly, besides of the filter of [1], the holding price of each portfolio is *m* plus fifteen minutes to rule out the basic bid-ask bounce. Because of delayed holding, we require the absolute value of this fifteen minutes return is smaller than 5% and there is at least an available trade happened between this fifteen-minute ([2]). Thirdly, in addition to portfolio [2], we require stocks' absolute *PIR* are smaller than 5% to enter these portfolios for excluding extreme liquidity shock ([3]). In the end, we only consider the stocks with top 30% of market equity at the end of last month ([4]). Similar portfolios in Chinese market are tested. Because of the -10%/10% limitation of daily price change in the Chinese stock market, we did not set the 50% limitation for type [1] and [2]. Other setting for portfolios [1] to [4] in Chinese market are same as in U.S. market. For each type portfolio, equal-weighted and value-weighted stock return are calculated and reported in basis-points. We also report the difference between highest and lowest *PIR* (H-L) as well as second highest and second lowest (9-2). T-statistics based on Newey-West (1987) standard errors with a lag of 120 are given in the parentheses.

[Insert table 2 here]

The result represented in the table 2 shows a great return reversal in both U.S. and Chinese market. The portfolio [1] of U.S. stock market with fewest constrains shows a significant -1.47% equal-weighted and -0.46% value-weighted return spread between highest to lowest *PIR*. However, by looking carefully into deciles, we find the magnitude of reversal in extremely portfolios (H and L) is the major contribution of overall pattern. The difference between 9-2 is only about -0.29% which is significantly smaller than H-L in equal-weighted return. For value-weighted, return reversal of 9-2 is only 2.1 basis-points which is statistically and economically insignificant. Combining the result with summery statistics, it seems that the most reasonable explanation for intraday reversal is excessive liquidity shock temporarily deviates the stock price from its reasonable value and the price is corrected in following intraday trading. It is obvious that such liquidity shock could be very short-life which leave us no accessible profit for a realistic transaction. However, the result of portfolio [2] claims that it is profitable with consideration of tradability. A 15-minute-lag portfolio with available trading during the period, the H-L equal-weighed spread shrinks from -1.46% to -0.86% but

remained statistically significant. Similar variations happened in value-weighted return and return of 9-2. An additional requirement of limited *PIR* shown in [3] further shrink the result but the magnitude of return spread is still economically significant (equal-weighted H-L is -0.27%). Reversal almost disappears with only top 30% ME firms in U.S. market. The equal-weight spread of H-L and 9-2 are -6.8 and -5.0 basis-points with significant t-statistics meanwhile both value-weighted spreads are insignificant.

Similar shrinking pattern exists in the Chinese stock market but intraday reversal seems more stable than the one in the U.S. market. Due to the limitation of daily price change, the equal-weighted return of H-L (-0.69%) in portfolio [1] is smaller than the one (-1.47%) in U.S. market. However, it is more stable by showing a slightly higher t-statistics (16.2 in China to 15.5 in U.S.) and a higher spread in value-weighted return (-0.54% to -0.46% for H-L and -0.25% to -0.02% for 9-2). Reversal in China is impacted less by 15-minute trading gap (-0.50% for equal-weighted H-L), smaller *PIR* (-0.44% for equal-weighted H-L) and big firm size (-0.40% for equal-weighted H-L). The small-shrank spread in comparison with U.S. market from [1] to [4] in China implies that liquidity shock still plays a role in intraday reversal pattern. But it is undoubtable that some other elements keep this pattern strong among not only the small and illiquid but also all other types stocks.

To investigate the period dependency of intraday reversal, we plot the accumulated wealth change of continuously investing in the stocks with different *PIR* for both U.S. and Chinese stock market in figure 1. The equal-weighted portfolios as type [3] in table 2 are considered as the invested strategy. For easy observation, we only plot the portfolios with highest, forth, seventh and lowest decile of *PIR* along with the long-short portfolio which is longing at lowest and shorting at highest *PIR* (L-H). Panel A and B show the result of U.S. and Chinese market respectively.

[Insert figure 1 here]

The result of U.S. and Chinese market shows that intraday reversal is not a period-dependent phenomenon. The wealth accumulations of reversal strategies are stable and smooth which implies that intraday reversal exists in the most time during our sample period. Although the profit of this strategy seems to be huge but the high trading frequency (daily) would consume a major part of it. However, the general slant of portfolios is upward showing that the main part of profit is coming from the long leg with the low *PIR*. This will remove the concern of practitioners about the difficulty of

short-selling and saving the cost for them. To sum up, it seems that intraday reversal is a long-live phenomenon in both mature and developing markets which is important not only for the discussion about price efficiency in short-term level but also for the practice of high-frequency trading.

2.3 Fama-Macbeth regression

Single-sorting portfolio shows the existence of intraday reversal in both Chinese and U.S. stock market. However, as shown in the summary statistics, the result could be driven by other low frequent return predictors. It is kind of difficult and imprecise to apply Fama-French three factors (Fama & French, 1993) or five factors (Fama & French, 2016) model to investigate the risk-adjusted return due to the occasional missing of intraday data for forming the intraday return of factors. To address this concern, we employ the Fama & Macbeth (1973) cross-sectional regression to control other variables. Every day, we run the cross-sectional regression of following intraday return on the *PIR* of time *m* which is 10:00. The control variables include monthly firms' characteristics and past daily return and turnover. To exclude impact of extremely liquidity shock, our sample is only incorporated by the stocks with basis filters given in the data descriptions and [3] type portfolio which means the regressed following intraday return is from 10:15 to daily close and only the stocks whose absolute *PIR* is smaller than 5% enter our regression sample. The controlled monthly firms' characteristics are nature log of market equity (*log(ME)*), nature log of book to market ratio (*log(BM)*), short-term reversal (*Rev*), long-term momentum (*Mom*), share turnover (*TO*) and return volatility (*Vola*). The details of variable definitions are given in the table 1. In view of the auto-correlation of daily price movement or share turnover, we also control the past one-week trading information including return ($DRet_{-1}$), turnover (DTO_{-1}) in yesterday, cumulative return ($DRet_{-2,-4}$), turnover ($DTO_{-2,-4}$) within last four-day with one-day gap and return ($DRet_{-5}$), turnover (DTO_{-5}) with five-trading-day lag. The time-series average of regressed coefficients and their t-statistics based on Newey-West standard error are reported in table 3.

The result reported in table 3 confirms the result of single-sorting portfolio and the existence of intraday reversal in both markets. The unitary regressions show statistically significant coefficient of -0.114 for U.S. market and -0.106 for Chinese market. This implies that, on average, about 11.4% and 10.6% price movement at the first 30 minutes

trading period of everyday will reverse to the market average for U.S and China respectively. There is no doubt that it is an economically important element for both academic pricing question or industrial timing selection of intraday or daily trading. The intraday reversal is robust even after controlling for monthly and daily return predictors, such as size, book-to-market, past return and turnover. The result implies that intraday reversal cannot be explained by general asset pricing models or famous return predictors.

[Insert table 3 here]

2.4 Different timing of *PIR*

Another possible concern of intraday reversal is the timing dependency of *PIR*. The result could be data-mined which is only existing in a specific timing as 10:00 shown in the previous table. To inspect the robustness of intraday reversal with timing, we try different *PIR* at different *m* with the sorted portfolio as type [3] descripted in table 1. Every day, we sort all filtered stocks into ten portfolios based on deciles of their *PIR* at the end of every half hour and holding the portfolios from 15-minute later to the daily close. Same as type [3], only stocks whose absolute *PIR* is smaller than 5% are into our portfolios. For each time *m*, time-series average differences between highest and lowest (H-L) and second highest and lowest (9-2) are reported. We do not report every single decile for easy observation. Equal-weighted and value-weighted return for both U.S. and Chinese market are reported respectively. T-statistics given in the parentheses are based on Newey-West (1978) standard errors.

[Insert table 4 here]

The result shown in the table 4 deny the possibility of data-mining and prove evidence for the robustness of relationship between *PIR* and following intraday return. Return reversal can be found at the end of every single 30-minute of trading hour except 14:30 for Chinese market and most of them are statistically significant. The equal-weighted return spread between highest and lowest *PIR* in U.S. reach its largest value at the 10:00 as -27.4 basis-points and continue to decrease along with the trading time passes. The time effects play a significant role when it is close to market end. The magnitude of reversal shrinks conspicuously from -12.6 at 14:30 to -10.1 and then -5.0 at the last observation, 15:30. This is consistent with the story that the institutional

investors prefer to infrequently adjust their positions at the begin and the end thirty-minute of every trading days in another manner to Gao, Han, Li & Zhou (2018). Their position adjustments, in which partly of them are not based on information, could be a liquidity shock reducing the price pressure at the begin of trading hours. These price pressure sluggishly corrected by the daytime traders. And then, when the institutional investors enter at the last thirty-minute of trading hours, a strong correcting power is created and moving the price to its fair value. Based on this possible theory, most of intraday reversal should happen at the end of trading hours, which is observed in U.S. market.

Second highest to lowest differences and value-weighted returns are smaller than the equal-weighted H-L portfolio in U.S. market which is consistent with the result of table 2. A noteworthy result is the U-sharp relationship between timing and reversal profit in value-weighted result. We cannot explain this phenomenon with limited existing intraday or microstructure theory. But the reversal is still statistically significant in every single timing which confirms the existence of intraday reversal over again.

Intraday reversal in China is dependent on the timing of *PIR*. For every thirty minutes except the last 30-minute in the morning trading, the equal-weighted H-L spread shrinks about 10 basis-points from -44 at 10:00 to nearly zero at 14:30. All patterns of other three type portfolio spreads are consistent with the one of equal-weighted H-L. Unlike the U.S. market in which the reversal mainly happened in the last half-hour of trading day, the gradual occurrence of intraday reversal implies once again that the underlying mechanism could be different between U.S. and Chinese stock market.

2.5 First thirty-minute *PIR* and last thirty-minute return.

As we discuss in previous section, infrequently position rebalance of institutional investors could create uninformed liquidity shocks at the begin of daily trading and corrected by some other institutional investors who enter the market at the end of trading hours. However, Gao, Han, Li & Zhou (2018) argue that infrequently rebalances of institutional investors are based on similar information signal which lead to a pattern of intraday momentum. With a variety of ETF data, they found that the first thirty-minute intraday return predicts the last thirty-minute intraday return in aggregative level.

Now the question is, which one of informed or uninformed position rebalance plays a more important roles in cross-sectional level? Does the intraday reversal exist in the first to last thirty-minute trading interval?

To answer these questions, we form portfolios based on stocks' *PIR* of timing m = 10:00 and holding it over last thirty minutes of trading hours. Similar filters as [3] in table 2 are considered which require the absolute value of stocks' *PIR* is smaller than 5% and at least one existing trade happened between *m* and the begin of last thirty minutes. Equal-weighted and value-weighted returns of every deciles and the return spreads between first and second highest to lowest portfolios are reported in table 5. Their t-statistics based on Newey-West standard error are given in the parentheses.

[Insert table 4 here]

Result of both U.S. and Chinese stock market shows that, in cross-section, first thirty-minute intraday return negatively predicts last thirty-minute intraday return which is inconsistent with time-series result especially for U.S. market. In U.S. market, stocks with lowest 10% *PIR* earn about 10 basis-points equal-weighted return in the last 30-minutes which is significantly higher than other deciles. The return spread of first and second highest to lowest decile are about -8.3 and -2.7 basis-points with t-statistics of -11.4 and -6.1 respectively. The negative value and the overall trend of result support the existence of intraday reversal during these two periods with high institutional participations.

In general, relationship of first and last thirty-minute intraday return in China are same with U.S. stock market. Both equal-weighted and value-weighted return spreads are negative and most of them are also statistically significant. The magnitude of spread, which is -1.4 and -2.2 basis-points for equal-weighted and value-weighted respectively, is smaller than the one of U.S. market. The smaller reversal of first 30 to last 30 interval is a secondary proof for the story of uninformed liquidity shock raised and corrected by institutional investors. Because the major component of investors in Chinese market are individual which implies a relatively week power of institutional one in this reversal phenomenon.

In summary, we documented a solid pattern of intraday return reversal in both mature (U.S.) and developing (Chinese) stock market. Stocks with higher earlier intraday return measured by *PIR* tend to earn a lower return in the rest of trading hours.

With reasonable filters about liquidity and bid-ask bounce, a zero-sum investment of long at the lowest *PIR* and short at the highest one earns a 0.27% equal-weighted daily return on U.S. and 0.44% one in China. The return spread reminds significant after controlling well-known monthly return predictors and past daily trading information. Intraday reversal is robustness with different timing of *PIR* and the trading periods with high institutional investors activities. Even it seems to be different between the underlying driven elements of U.S. and Chinese market, the intraday return reversal is robust and long-lived phenomena among world-wide stock market.

3 Further explanations for intraday reversal

In this section, we provide several possible driving forces of the reversal pattern descripted above. We first test the impact of liquidity, which is always considered as main contributor for the short-term reversal, on the intraday level. Secondly, by stating two possible channels of investors' misbehaving calling overreaction caused by trading halt and underreaction caused by anchored expectation, we investigate the role of price limitation as an element aggravating these two channels. In the end, we identify which one of the channels mentioned above is taking responsibility for the intraday reversal.

3.1 liquidity on intraday reversal

After first discovery by Jegadeesh (1990) and Lehman (1990) in monthly and weekly level, illiquidity was always considered as the most important reason of the pattern of reversal in the short-term. The idea is some of price movement are not information-driven and this temporary deviation from fundamental value would sustain in the short-term due to the lack of liquidity. This is well-tested in the cross-section by Avramov, Chordia & Goyal (2006) showing a stronger short-term reversal with more illiquid stocks and in time-series by Nagel (2012) finding a higher reversal profit when the liquidity is evaporated.

As a kind of short-term reversal, we believe that liquidity would significantly impact the profitability of intraday reversal. We predict that intraday reversal should be stronger with the stocks which are more illiquid but less with the sufficiently liquid counter-parts. To investigate the interaction between liquidity and intraday reversal, we independently sort all sample stocks into five times five portfolio based on their *PIR*

and liquidity measures for both U.S. and Chinese stock market. Three types of liquidity measures are considered including market equity (*ME*), share turnover (*TO*) and illiquidity (Ami). At the time *m* = 10:00 of every day, we form our portfolio based on *PIR* of *m* and hold the portfolios from *m* plus fifteen minutes to market close. We also require stocks having a valid trade happened between *m* and *m+15* to enter our portfolios like the type [3] in table 2. The equal-weighted and value-weighted daily return (basis-points) of portfolios, their spreads of highest to lowest *PIR* and the difference of spreads between top and bottom liquid portfolios are reported in table 6. The t-statistics of spreads based on Newey-West standard error are given in the parentheses.

[Insert table 6 here]

The result of U.S. market shown in the panel A of table 6 strongly confirms the decisive impact of liquidity on intraday reversal. The intraday pattern in the stocks with limited liquidity shows great reversal meanwhile the one in the liquid counterparts does not. The stocks in the bottom quintile of liquidity measures, i.e. small *ME*, small turnover and big illiquidity, earn -41.7, -47.1 and -45.4 basis-points equal-weighted daily reversal profit by longing on the stocks with top quintile *PIR* and shorting on the bottom. In the other hand, the top liquid stocks only obtain a negligible return or even positive one (in *TO*) with insignificant t-statistics. The difference of reversal spreads between liquid and illiquid stocks are also significant with all three liquidity measurements. Value-weighted returns are also calculated and our result is remined. Another noteworthy result is, intraday reversal does not demand an extremely illiquid environment. As shown by the median (M) groups of three liquidity measurements, the reversal spreads are about -9 to -15 basis-points with significant statistics. Instead of saying that the illiquidity forms the reversal pattern, a more appropriate argument should be the sufficient liquidity supply, which is most from arbitrager, quickly corrects the short-term mispricing and wipe out the possible reversal pattern.

Liquidity also plays a role in the Chinese intraday reversal but in a smaller magnitude. The difference of reversal spreads between liquid and illiquid stocks is only -12.2, -0.4 and -15.0 basis-points for three measurements in China which is obviously smaller than 40+ in U.S. market. Another important difference is, even in the most liquid stocks, strategy of long bottom and short top *PIR* still earns above 29 basis-points daily return for three liquidity measures. A straight-forward idea is that, because of its

characteristic of developing, the overall liquidity of Chinese market is limited which is not sufficient to erase the temporal shock in intraday level even for most liquid stocks. However, as mentioned in the previous section, high participation of individual investors in China forms an environment with luxuriant liquidity by showing a higher average share turnover than U.S. market. It is untenable to argue against with the sufficient liquidity supply in China. Combining with this, the result is telling that the limited liquidity cannot explain the intraday reversal in Chinese market. Along with the different feature between U.S. and China mentioned in section 2, we argue that some other elements, besides of illiquidity, are driving the intraday pattern of China.

[Insert table 7 here]

To further control the impact of other possible predictor, we run a series of Fama-Macbeth regression and investigate the interaction term of liquidity measurement and *PIR*. Similar regressions as in table 3 are ran with additional liquidity controller *Ami* and three interaction terms of liquidity measurements and *PIR*. The significant coefficients of interactive term provide further evidence to the important role of liquidity after controlling possible monthly return predictor and past daily trading information.

This section provides strong evidence to show a significant impact from liquidity on intraday reversal. Reversal profit shrinks significantly from 40+ to nearly 0 basis-points with the increasement of liquidity supplying in U.S. market. Liquidity also impacts the one in China but in a smaller magnitude by showing about a 30 basis-points reversal in the portfolios with most sufficient liquidity supplying. Combining with the different characteristics of intraday patterns in U.S and Chinese market shown in section 2, other possible explanations should be researched and discovered.

3.2 Role of price limitation

The most important difference between developing and mature stock market is the various of trading frictions. Daily price limitation as one of most representative trading frictions, is considered as an element which would causes or aggravates the pheromone of intraday reversal. We argue that price limitation may contribute to the following two channels which is so-called Overreaction caused by Trading Halt (OTH) and Underreaction caused by Anchored Expectation (UAE). Before going to the detail

empirical tests, we first give the illustrations for both possible channels.

The idea of the reason why trading halt may induce an overreaction of investors (OTH) is that traders will loss the opportunity to trade when the halt happens. With this intuition, confirmed or possible trading halt brings an additional risk to the investors and makes them despairing to facilitate the trade before the halt. Price limitation in Chinese market, as one of kind of trading halt, could do the same to the investors by wiping out one side liquidity and then amplifying the other side demand when the price is close to the limitation. This effect is also called 'magnet effect' which is empirically well-studied in Spanish (Abad & Pascual, 2007) and Taiwan (Cho, Russell, Tiao & Tsay, 2003; Hsieh, Kim & Yang, 2009) market and theoretically descripted by Chen, Petukhov & Wang (2018). If this effect of overreaction is valid, part of stocks' *PIR* in a market with price limitation should be created by investors who overreact to the previous movement. This overreaction should be corrected in the trading during the rest of trade hours forming an intraday reversal pattern.

In the other hand, the intuition of UAE is much more psychological that it is based on a representative anchor when investors update their expectation about asset's price and they are reluctant to accept new information. The most persuasive evidences in stock market are the predictability of nearness to the 52-week high discovered by George & Hwang (2004) in cross-section and Li & Yu (2012) in time-series. In the situation of intraday, we believe that the yesterday close price is a phycological anchor for investors which makes them underestimating the information component in the previous price movement and trading against to it during the rest of trading hours. This irrational trading behavior gives a price pressure in intraday level, which forms an intraday reversal pattern, until the anchor is reset when new close price is given. A price limitation could aggravate this biased expectation by offering a relatively higher possible profit meanwhile a lower possible loss in intraday because the direction of UAE is always against *PIR*. For example, in the situation of daily price limitation is -10%/10% and the *PIR* is 5%, if an investor trades based on UAE, his possible gain is 15% meanwhile the loss one is 5%. By amplifying the ratio of gain to loss, price limitation would impact the magnitude of UAE and forms an intraday reversal pattern.

Before testing the validations of both channels, we first check the impact of price limitation on the pattern of intraday reversal. The main problem of applying this empirical test is the difficulty of controlling other differences, especially the assets'

fundamental movements in both markets. However, the firms simultaneously listed in the exchanges of Chinese mainland market (Shanghai Stock Exchange or Shenzhen Stock Exchange with price limit, so-called A-share) and Hong Kong market (Hong Kong Exchanges and Clearing Limited without price limit, so-called H-share) provide us an opportunity to test the impact of price limitation after controlling the fundamental movements of sample assets. The information of these multi-listed firms is acquired from 'Wind' data-base. The data including firms' name, their share codes in A-share and H-share, and their IPO date in both markets. And then, we obtain the intraday and daily price of these firms in Hong Kong market from TRTH data-base based on their share code.

At the time m=10:00 of everyday, we sort all sample stocks, which is simultaneously listed in mainland and Hong Kong markets, into three portfolios based on their corresponding *PIRs* for both markets respectively. We hold the portfolios from m plus 15 minutes to the market close and calculate the equal-weighted portfolio return. To enter our portfolios, the stocks must be listed on both markets longer than six months. In a given day, we require at least 30 stocks in our sample to form the portfolio which implies at least 10 stocks for each group to rule out randomness. Due to limited number of multi-list firms, our sample begins from January 2005. Portfolio returns of simultaneously listed firms are given in the top panel of table 8. Besides of listing, we also require the stocks are simultaneously traded on both markets to enter portfolios as an additional test and result is given in the bottom panel. We also report the return spread between the stocks with high and low *PIR* along with the difference of spread between mainland and Hong Kong market. T-statistics are also given based on Newey-West standard error.

[Insert table 8 here]

The result shown in table 8 implies that price limitation plays a crucial role in intraday reversal. Stocks with identical fundamental variation show diverse intraday patterns in two different markets in which the most important different is price limitation. In mainland market with price limitation, return spread between stocks with high and low *PIR* is -22.4 basis-point daily meanwhile the one in Hong Kong is only -2.3 with insignificant statistic. The disappearance of reversal in Hong Kong market with these sample stocks is caused by their characteristics of high market value which qualifies them to list in both markets. The difference between two markets is

statistically significant 20 basis-point. Result remines the same after additional requirement of simultaneously trading.

The empirical evidence supports that price limitation gives rise to the intraday reversal by showing a significant reversal in mainland market with the limit meanwhile a negligible one in Hong Kong market. This implies that one or both channels of OTH and UAE would cause this intraday pattern and the price limitation amplifies the channel(s). However, further tests are required to identify which of OTH and UAE is valid that truly takes responsibility for this strong intraday pattern.

3.3 Identification for OTH and UAE

As mentioned in the previous section, both OTH and UAE can produce an intraday reversal pattern which is amplified by the daily price limitation. In this section, we try to identify which one of these two channels is valid by investigating the return over the days following the intraday reversal.

Since the possible intraday pattern of OTH and UAE is similar, we cannot answer the question mentioned above only with intraday result. However, as described in section 3.2, the intraday reversal of OTH is a rational correction of price to the previous overreaction. Since the intraday reversal is rational, the return over the following days should be flat if the correction is in precise amount or in the same direction with the reversal part if the correction is insufficient. In the other hand, the story of UAE implies that the formation of intraday reversal is based on a biased expectation. The reversal returns in intraday is irrational which is needed to be corrected during the trades in the following days. Therefore, UAE predicts that the return direction of the following days is opposite to the one of intraday reversal which corrects the intraday price pressure induced by UAE.

To identify which one is the valid driving force of intraday reversal, we investigate the return following them up to 10 trading days. Similar as type (3) of portfolios in table 2, at the time *m=10:00* of everyday *t*, we sort all sample stock into portfolios based on the deciles of their *PIR*. We extend the holding period to the close of *t+10* and observing the change of return spread between portfolios with high and low *PIR*. For both U.S. and Chinese market, we report the intraday return spread for *t+0*, daily return spread for day *t+1* to *t+5* and the accumulated return spread for *t+6* to *t+10* respectively. We

also calculate the accumulated return from *m+15* of day *t* to the close of given day. Only spread of the highest to lowest and second highest to second lowest in equal- and value-weighted return are reported for saving place. T-statistics based on Newy-West standard error are given in the parentheses. All results are given in table 9.

[Insert table 9 here]

Results of both markets provide evidence for the validation of UAE channel. In U.S. market, the equal-weighted reversal spread of highest to lowest *PIR* shrink from -27.4 to -19.7 after the trading in *t+1* even the most reversal return is explained by liquidity. Value-weighted result shows a stronger correcting pattern in day *t+1* which brings the accumulated return to positive from -5.6 to 6.8. After *t+1*, the daily return spreads are slightly negative with insignificant statistics which implies a stable price movement. Similar results can be observed in second highest to lowest. For four type return spread in *t+1*, all of them are significantly positive which is opposite to the direction of intraday reversal. The shrinking reversal return in U.S. market implies that, part of intraday reversal is driven by UAE, although U.S. market is without price limitation and intraday reversal is dominated by liquidity component. This part irrational reversal will be corrected in the following one-day trade after the reset of anchor by a new close price.

Similar result is obtained in Chinese market but in a greater magnitude. For equal-weighted spread of highest to lowest, reversal shrinks from -43.9 to -16.6 basis-points after the trading of *t+1*. More importantly, the spread keeps shrinking in the rest trading day, and turn positive in the end of *t+10* (14 with 2 t-statistics). For the one of second highest to lowest, although without turning significantly positive, the reversal spread is also near to 0. For both equal-weighted and value-weighted results, significant positive returns, which is against to the movement of intraday reversal, are obtained in the following 10 days except *t+5*. The positive accumulated return ended at *t+10* could be raised by the 15-minute gap between *PIR* and holding timing or the already existed reversal before time *m*. Considering of high liquidity in Chinese market, the result implies that, because of high participation of individual investors, intraday reversal in China is a phenomenon of mispricing induced by UAE which should be stronger for the individual investors. And all the mispricing will be corrected in the following days. This empirical result also helps to explain the strong auto-correlation of daily return in Chinese market.

For easy observation, we plot the accumulated equal-weighted return of holding portfolio investing in H-L of *PIR*. As shown in the figure 2, we first plot a bar for actual *PIR* spread of H-L at leftmost end and mark its magnitude in the left Y-axis in percentage. Then, we plot the accumulated return from *m* of day *t* up to following 60 trading days and each dot represents the accumulated return from *m+15* of day *t* to the end of given day. The background of *PIR* spread and return before *m+15* is set as grey reminding that the return of this part is unprocurable. We adjusted the line to make *m+15* as 0 which is the beginning of our portfolio holding. The accumulated returns are marked as basis-points shown in the right Y-axis.

[Insert figure 2 here]

The figure confirms the channel of UAE in a visual manner. In U.S. market, the fluctuation of H-L spread drop to the -27 at intraday and then recover to about 20 at the end of day *t+1*. Although it seems to continually decrease from *t+2* to *t+10*, it will settle at about -20 basis-points at the end of *t+60*. Result implies that about 7 of total -27 basis-points reversal is induced by the UAE and the rest of them is liquidity-driven. In Chinese market, the shrink of reversal is much stronger which forms a giant spike at the close of day *t*. The spread keeps increasing at the following days and back to 0 at the end of *t+4*. After *t+5*, a sustainable increasement of spread is shown and settle at above 40 basis-points at the end of *t+60*. It seems that the recovery of intraday reversal is stronger than intraday reversal itself even after the consideration of return from *m* to *m+15*. However, the 60-day holding of recovery is too long for 0.8% return which reduce its economic importance in comparison with -0.44% for only 1-day-less holding of intraday reversal. Anyway, the existence of recovery supports the channel of UAE in which the intraday reversal is partly driven by a bias expectation. This part of reversal is limited in U.S. but almost entire for Chinese market. Figure 2 also shows some details about reversal which is unobservable in the previous tables. The reversal from *m* to *m+15* of U.S. (about 23 basis-points) is higher than Chinese market (about 16 basis-points) although the *PIR* spread is similar about 4.2%. The faster reversal confirms the major role of liquidity in U.S. market because the price movement of liquidity shock and corresponding reversal should be more sensitive and immediate after great *PIR* than the UAE-driven one.

In summary, this section tests several possible driving forces of intraday reversal. Firstly, we check the impact of stock liquidity, which has been always considered as the

most important element in general short-term reversal pattern, on this phenomenon. We find that liquidity sufficiently explains the intraday reversal in U.S. market but limitedly in Chinese market. Secondly, by raising two possible channels called overreaction caused by trading halt and underreaction caused by anchored expectation, we check the role of daily price limitation on intraday reversal with multi-listed firms' data in Chinese mainland and Hong Kong exchange. Empirical result confirms that reversal does exist in the mainland with price limitation but not in Hong Kong. In the end, we try to identify which one of OTH and UAE is valid channel to produce the intraday pattern. An opposite direction of returns in the following days provides evidence to the UAE which predicts the intraday reversal is caused by the biased expectation and it need to be corrected in the following trading days.

4 Conclusion

This paper provide evidence for the existence of cross-sectional intraday reversal by showing the stocks with a higher previous intraday return earn a lower return in the rest hours of daily trading. Intraday reversal is robust in both mature and developing markets even if we control the extremely price movement and possible bid-ask bounce. Different timing of *PIR* and only the prediction of first to last 30 minutes, which are the period with high pacification of institutional investors, are considered and reversal pattern survives.

Several possible driving forces for this strong phenomenon are considered including liquidity, price limitation, overreaction caused by trading halt and underreaction caused by anchored expectation. Firstly, we find the impact of liquidity on intraday reversal is crucial just as on other frequency of short-term reversal. In addition, liquidity seems to be decisive in the mature market (U.S.) but not in a developing one (Chinese) which is sufficiently liquid because of high participant of individual investors. To fill the gap of driving factor of intraday reversal in China, we further study the role of price limitation, which is considered as a promoter to the impact of OTH and UAE. With data of multi-listed firm in mainland and Hongkong market, we confirm the impact of price limitation on intraday reversal by showing a significant reversal spread of these firms in mainland market but not in Hongkong. Finally, the question, which one of OTH and UAE is valid channel to intraday reversal, is answered by investigating the following day return. We confirm the UAE as valid one by showing

a shrink of reversal return.

By showing this intraday pattern, we contribute to the literatures studying the reversal pattern, intraday pattern and price anchor in different manners. In particularly, the discovery of the role of UAE, we find evidence that psychological element significant impacts the behavior of investors and then the market efficiency especially when the power of arbitrage is limited. With the growing demand of intraday or high-frequency trading, we also help both the academics and practitioners to better understanding the possible mispricing in intraday level.

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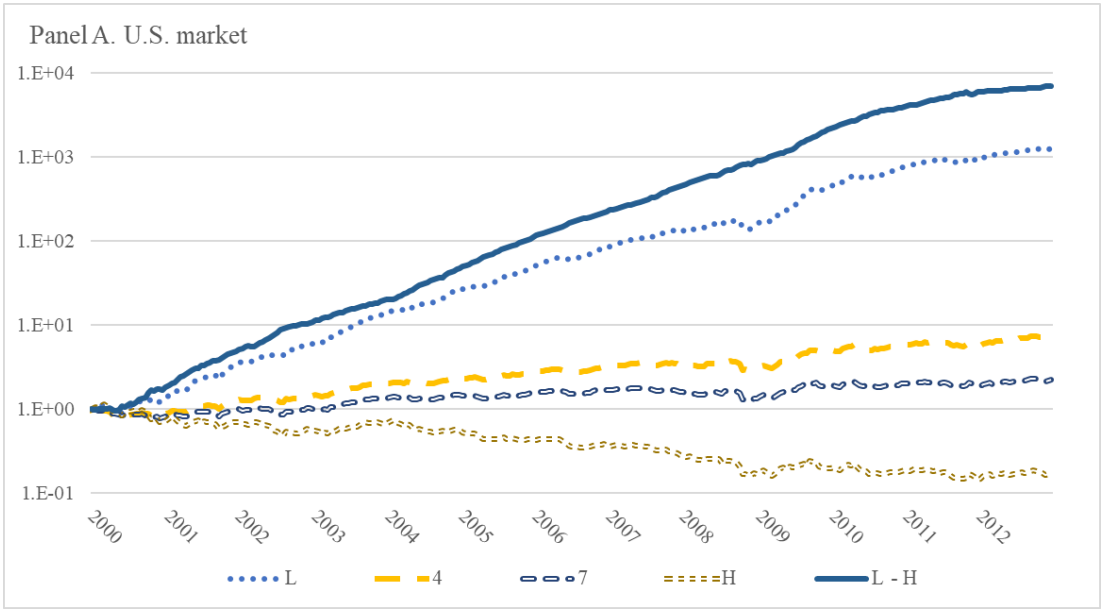
Figure 1. Wealth Change of Continuously Investing in Intraday Reversal Strategy

This figure plots the accumulated change of wealth which keeps investing in the stocks with different deciles of *PIR*. Portfolios as type [3] in table 2 for both U.S. and Chinese market are considered as portfolio return. We only report the wealth of highest, fourth, seventh and lowest decile *PIR* for easily observation. Panel A shows the one of U.S. market and Panel B shows Chinese.



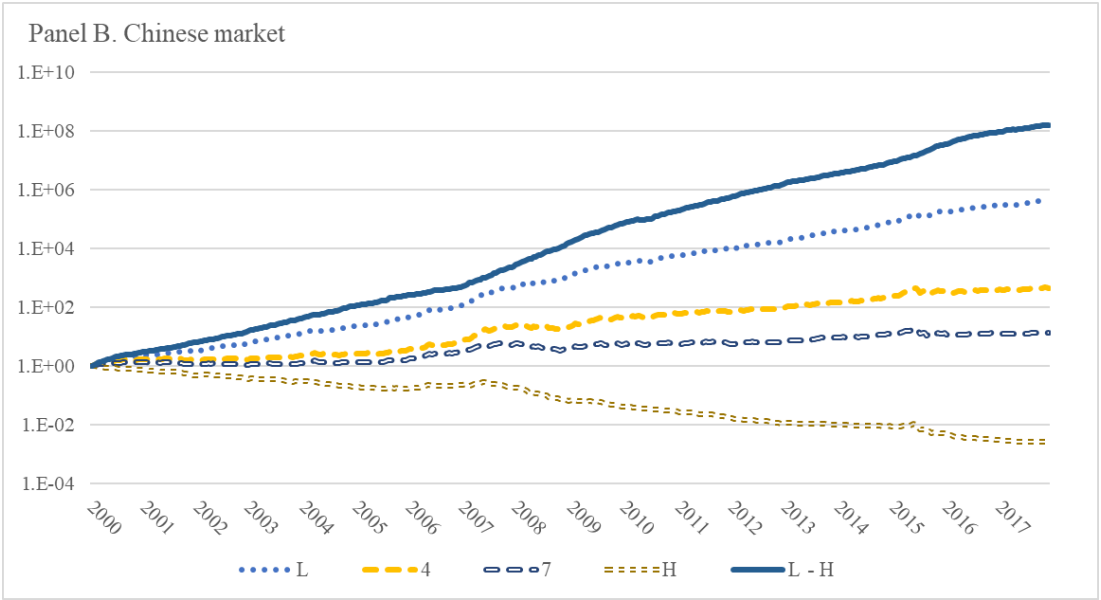
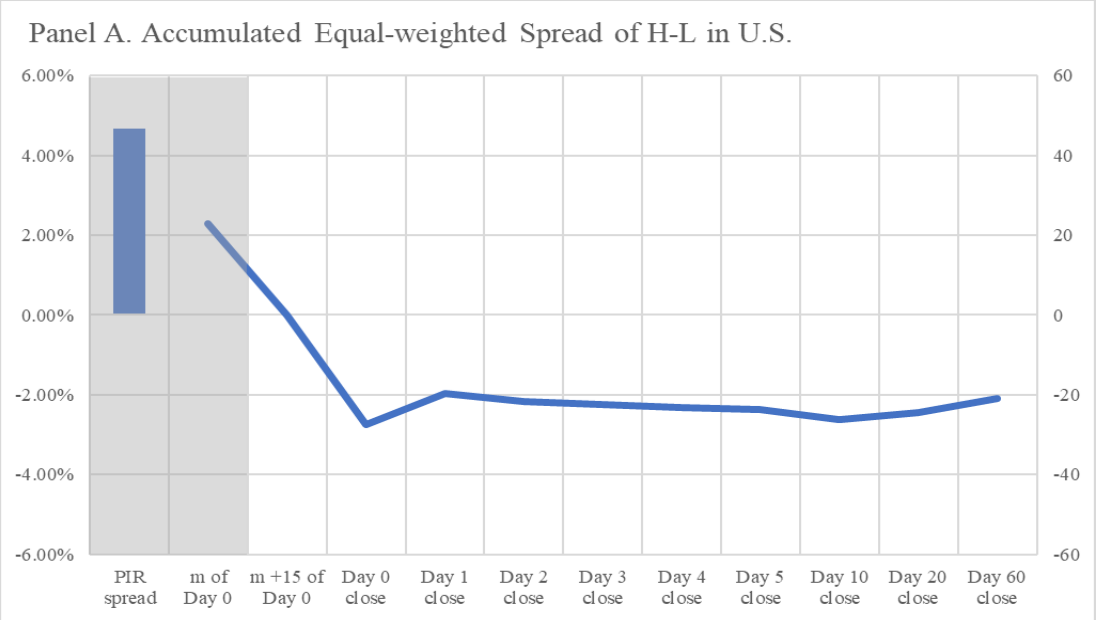


Figure 2. Accumulated Return of Long-short strategy on *PIR* with timing *m* = 10:00.

This figure plots the accumulated return of investing in long-short portfolio based on *PIR* up to 60 trading days for both U.S. and Chinese market. The timing m of *PIR* is 10:00 and the invested stocks are with the highest (long) and lowest *PIR*. Similar portfolio of H-L as type [3] in table 2 is considered. We also plot the average *PIR* spread between long and short portfolios and the average return of 15-minutes gap between the time of single observation and holding in the left within grey background. The accumulated holding returns and 15-minute gap return are given in basis-points shown in the right Y-axis. The *PIR* spread is reported in percentage in the left Y-axis. Panel A shows the result of U.S. market and Panel B shows the one of Chinese.



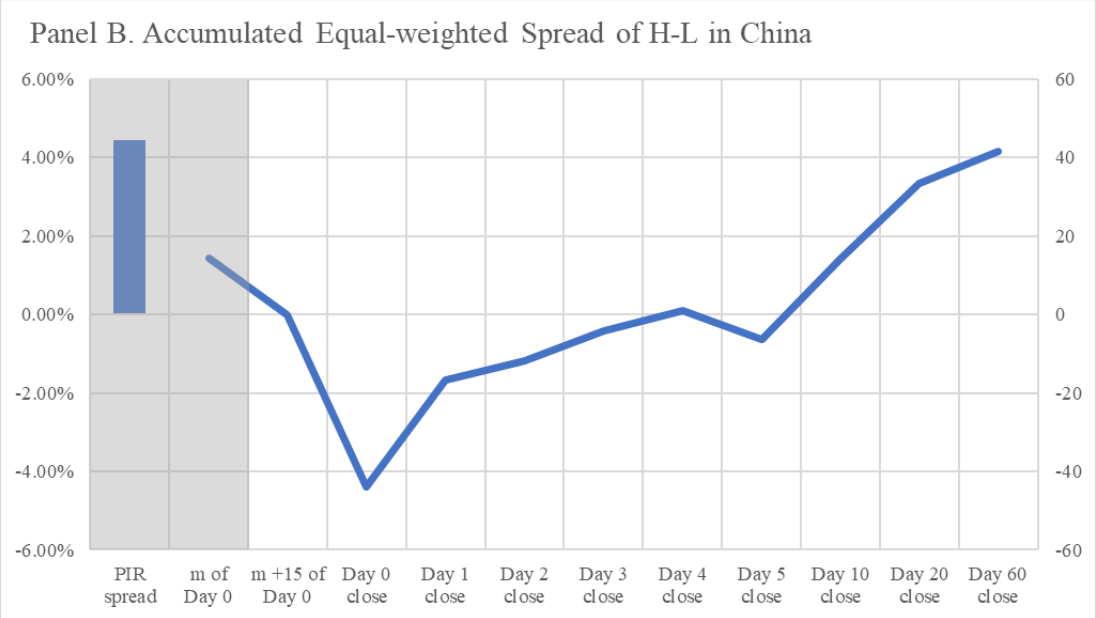


Table 1. Summary Statistics

This table reports the time-series average of daily equal-weight previous intraday returns (*PIR*) with timing *m* (10:00), daily returns (*Ret*) and firm characteristics for five intraday portfolios in U.S. and China stock market respectively. Portfolios are sorted by *PIR*, which is return from yesterday close price to price of the last trade before *m*. At the time *m* of everyday, we sort all common stocks into five groups based on the quintile of the ranked value of *PIR*. For U.S. stock market, we consider the stocks traded in NYSE/AMEX/NASDAQ and whose sharecodes are '10' or '11' as our sample stocks. And for China, common stocks are the firms' shares traded in Shanghai Stock Exchange and Shenzhen Stock Exchange and whose sharecodes begin with '0', '3' or '6'. *PIR* is the ex-ant previous intraday return defined above. *Log(ME)* is the denary logarithm of a firm's market equity. *BM* is the book value of equity divided by market value at the end of last month with latest available data. *Vola* is the volatility of daily return into last calendar month. *Rev* is the short-term reversal which is the return in last month. *Mom* is the cumulative return over the past year with one-month gap. *TO* is share turnover which is the trading volume in the last calendar month divided by the share outstanding at the end of last month. *Ami* is the measurement of illiquidity which is the average value of absolute daily return divided by trading dollar times 10^6 over last six calendar months. *Ret* is daily close-to-close return.

The portfolio is rebalanced every day. To enter our portfolio, we require our stocks' price equal to or higher than 5 dollars (US dollar for U.S stock market and RMB dollar for China stock market). We also require our stocks to have at least 10 nonmissing daily stock returns in previous calendar month and listed on the exchange longer than 6 months. The summary statistics of U.S. market is reported on the upper and the one of China market is on the bottom. Besides five *PIR* portfolios, we also report the characteristics differences between highest to lowest and their t-statistics based on Newey-West standard error with 120 lags are given in the parentheses. Except the *log(ME)* and *BM*, all other characteristics are reported in percentage.

Equal-weighted Firm Characteristics for Five *PIR* (timing *m* = 10:00) Portfolios									
	PIR	*log(ME)*	*BM*	*Vola*	*Rev*	*Mom*	*TO*	*Ami*	*Ret*
United States									
PIR L	-2.32	5.74	0.64	3.29	2.11	25.34	0.89	0.08	-1.84
PIR 2	-0.60	5.96	0.62	2.68	1.72	19.08	0.79	0.03	-0.50
PIR 3	-0.03	6.00	0.62	2.54	1.71	18.44	0.75	0.03	0.02
PIR 4	0.55	5.98	0.62	2.66	1.69	20.28	0.80	0.03	0.53
PIR H	2.46	5.77	0.67	3.25	1.90	27.46	0.92	0.08	2.02
H - L	4.78	0.03	0.03	-0.04	-0.21	2.12	0.03	0.00	3.87
	(19.40)	(6.55)	(4.23)	(-2.37)	(-1.92)	(5.13)	(4.96)	(-2.29)	(18.52)
China									
PIR L	-1.89	6.57	0.33	2.96	3.38	31.27	1.53	0.03	-1.55
PIR 2	-0.73	6.58	0.37	2.73	1.42	23.39	1.34	0.02	-0.56
PIR 3	-0.16	6.57	0.38	2.67	1.12	21.56	1.28	0.02	-0.06
PIR 4	0.48	6.58	0.37	2.71	1.45	23.28	1.31	0.02	0.50
PIR H	2.21	6.59	0.34	2.89	2.76	29.10	1.45	0.02	2.07
H - L	4.10	0.02	0.01	-0.07	-0.61	-2.17	-0.07	0.00	3.62
	(22.27)	(4.28)	(6.41)	(-8.23)	(-5.55)	(-3.79)	(-6.44)	(-2.27)	(21.86)

Table 2. Intraday portfolio return sorted by previous intraday return.

At the time *m* of everyday, we sort all sample stocks into 10 portfolios based on their *PIRs*, which are the price of last trade before *m* divided by the close price of last trading day. The portfolios are held from time m to the end of day and equal-weight and value-weight return are calculated. To enter our portfolios, we require the stocks to have stock price higher than 5 (US dollar for U.S. stocks and RMB dollar for China stocks), not into a day with dividend-paying or share break, at least 10 nonmissing daily return in previous month, at least 120 available previous daily return and appearance in CRSP or CSMAR longer than 6 months.

For the result of U.S. shown in panel A, we consider all common stocks traded in NYSE/ AMEX/ NASDAQ whose share classes are '10' or '11'. *PIR* timing *m* is 10:00 which is the 30 minutes after market opening. Four types of portfolio return are considered here: 1) holding price are the close price of time *m* and absolute values of *PIR* are smaller than 50%; 2) holding price is the close price of 15 minutes after *m*, a valid trade existing between *m* and *m+15* and absolute value of *PIRs* and 15-minute gap are smaller than 50%; 3) in addition to 2), we exclude stocks whose absolute value of *PIR* are higher than 5%; and 4) in addition to 3), we only consider the stocks in top 30% market equity. The sample period is from January 2000 to December 2012.

For the result of China shown in panel B, we consider all common stocks traded in Shanghai Stock Exchange and Shenzhen Stock Exchange whose share codes are begin with '60', '30' and '00'. *PIR* timing *m* is 10:00 which is the 30 minutes after market opening. Four types of portfolio return are considered here: 1) holding price are the close price of time *m*; 2) holding price is the close price of 15 minutes after *m*; 3) in addition to 2), we exclude the stocks whose absolute value of *PIR* are higher than 5%; and 4) in addition to 3), we only consider the stocks with top 30% market equity (total). The sample period is from January 2000 to December 2017.

For each type portfolio of US and CN, both value-weighted and equal-weighted returns of every portfolios and the difference from highest to lowest (H - L) and second highest to lowest (9 - 2) are reported respectively. Returns are reported in basis-points and t-statistics are based on Newy-West standard error with 120 lags.

Panel A. U. S. (*PIR* Timing *m* = 10:00)												
	L	2	3	4	5	6	7	8	9	H	H-L	9-2
(1) EW	77.9	20.2	12.1	8.0	5.7	3.2	0.2	-3.4	-8.5	-68.9	-146.8	-28.7
	(10.3)	(9.9)	(7.0)	(5.0)	(3.6)	(2.0)	(0.1)	(-1.9)	(-4.1)	(-18.3)	(-15.6)	(-16.0)
(1) VW	23.4	3.3	2.4	1.7	2.1	0.5	0.1	0.5	1.2	-22.4	-45.9	-2.1
	(4.0)	(1.6)	(1.2)	(1.2)	(1.5)	(0.3)	(0.1)	(0.3)	(0.7)	(-4.9)	(-8.6)	(-0.9)
(2) EW	44.2	11.9	8.7	6.7	5.9	4.7	3.2	2.0	0.9	-42.1	-86.3	-11.0
	(6.8)	(5.5)	(4.6)	(3.9)	(3.7)	(2.8)	(2.0)	(1.1)	(0.5)	(-14.7)	(-13.0)	(-7.6)
(2) VW	17.7	3.2	2.5	2.1	2.3	1.2	0.8	0.6	2.0	-18.3	-36.0	-1.2
	(3.1)	(1.7)	(1.4)	(1.5)	(1.6)	(0.8)	(0.5)	(0.4)	(1.1)	(-4.1)	(-6.7)	(-0.6)
(3) EW	23.0	11.7	8.4	6.7	5.6	4.5	3.0	1.8	0.8	-4.5	-27.4	-10.9
	(9.3)	(5.6)	(4.5)	(4.0)	(3.4)	(2.6)	(1.8)	(1.0)	(0.4)	(-2.0)	(-14.1)	(-8.7)
(3) VW	3.6	2.9	2.7	2.2	2.0	1.1	0.3	0.8	0.8	-1.9	-5.6	-2.1
	(1.5)	(1.5)	(1.6)	(1.5)	(1.3)	(0.7)	(0.2)	(0.5)	(0.5)	(-0.8)	(-2.0)	(-1.2)
(4) EW	8.1	7.1	5.9	5.2	4.6	3.7	2.7	3.0	2.1	1.4	-6.8	-5.0
	(3.4)	(3.7)	(3.4)	(3.3)	(3.0)	(2.3)	(1.7)	(1.7)	(1.1)	(0.7)	(-3.5)	(-3.3)
(4) VW	1.8	2.4	2.5	1.8	1.6	1.8	-0.5	0.6	0.7	-0.5	-2.3	-1.7
	(0.8)	(1.3)	(1.4)	(1.3)	(1.0)	(1.2)	(-0.3)	(0.4)	(0.4)	(-0.2)	(-0.9)	(-1.0)
Panel B. China (*PIR* Timing *m* = 10:00)												
	L	2	3	4	5	6	7	8	9	H	H-L	9-2
(1) EW	48.4	29.9	22.2	18.4	14.3	10.5	6.6	1.5	-6.3	-20.7	-69.2	-36.2
	(13.7)	(10.4)	(7.7)	(6.3)	(5.2)	(4.0)	(2.6)	(0.6)	(-2.6)	(-8.6)	(-16.2)	(-14.4)
(1) VW	40.7	22.7	17.7	14.6	13.9	10.0	8.1	4.6	-2.1	-13.2	-53.9	-24.8
	(12.5)	(9.1)	(6.9)	(5.8)	(5.0)	(4.3)	(3.3)	(2.2)	(-0.9)	(-5.3)	(-14.5)	(-11.2)
(2) EW	34.5	23.1	18.0	16.0	13.1	10.1	6.7	1.7	-5.2	-15.3	-49.9	-28.3
	(12.4)	(9.1)	(7.0)	(6.0)	(5.3)	(4.5)	(3.1)	(0.8)	(-2.5)	(-7.9)	(-15.4)	(-11.4)
(2) VW	30.1	17.7	15.2	13.2	12.8	9.2	7.2	3.3	-3.4	-10.7	-40.8	-21.1
	(11.3)	(7.9)	(6.3)	(5.6)	(5.1)	(4.7)	(3.5)	(1.9)	(-1.6)	(-5.1)	(-14.0)	(-9.3)
(3) EW	31.3	21.9	17.7	15.5	13.1	10.4	7.2	2.7	-3.9	-12.7	-43.9	-25.7
	(13.0)	(8.7)	(6.7)	(5.6)	(4.9)	(4.4)	(3.2)	(1.3)	(-1.7)	(-5.9)	(-17.9)	(-12.4)
(3) VW	26.6	17.1	15.0	13.1	12.4	9.3	7.9	3.9	-1.4	-9.0	-35.6	-18.5
	(11.6)	(7.5)	(6.2)	(5.5)	(4.8)	(4.7)	(3.8)	(2.0)	(-0.7)	(-4.0)	(-15.9)	(-9.5)
(4) EW	30.1	19.8	15.7	13.3	11.9	9.8	5.9	2.2	-3.9	-9.9	-40.0	-23.7
	(11.9)	(8.1)	(6.3)	(5.4)	(4.5)	(4.5)	(2.8)	(1.0)	(-1.6)	(-4.1)	(-15.9)	(-11.1)
(4) VW	26.3	16.2	13.6	11.9	11.6	10.5	6.1	3.3	-2.6	-7.1	-33.4	-18.8
	(10.8)	(7.3)	(5.9)	(5.3)	(4.7)	(5.0)	(3.0)	(1.7)	(-1.1)	(-3.2)	(-15.1)	(-8.6)

Table 3. Fama-Macbeth Regression of *PIR* and following return

Every day, we run a cross-sectional regression of return from time *m+15* to market close on the *PIR* of *m*, firms' characteristics and the daily trading data of last five trading days for both U.S and Chinese stock market. The time-series average of regression coefficients is reported. The definitions of firms' characteristics are same as table 1. *DRet* and *DTO* represent the past daily return and daily share turnover and the subscripts give the time interval. Only the stocks filtered by standard 3) in table 2 are considered. The sample period is from 1st January 2000 to 31st December 2012 for U.S. and 1st January 2000 to 31st December 2015 for China. The t-statistics are in parentheses calculated based on the Newey-West standard error with 120 lags.

	US			CN		
PIR	-0.114	-0.107	-0.109	-0.106	-0.121	-0.124
	(-4.34)	(-6.10)	(-5.73)	(-24.87)	(-28.61)	(-28.53)
log(ME)		0.001	0.000		0.000	0.000
		(1.17)	(0.94)		(-8.00)	(-8.10)
log(BM)		0.000	0.000		0.000	0.000
		(0.27)	(0.06)		(1.07)	(2.12)
Rev		0.016	0.016		0.000	0.000
		(1.47)	(1.55)		(-0.10)	(0.14)
Mom		0.002	0.002		0.001	0.000
		(1.33)	(1.30)		(3.48)	(3.12)
TO		-0.081	-0.242		-0.031	-0.058
		(-1.28)	(-1.89)		(-6.27)	(-8.25)
Vola		-0.072	-0.083		0.007	0.010
		(-1.64)	(-1.71)		(1.71)	(2.67)
$DRet_{-1}$			-0.025			-0.012
			(-1.06)			(-3.60)
DTO_{-1}			-0.363			0.082
			(-1.64)			(10.73)
$DRet_{-2,-4}$			-0.017			-0.010
			(-1.79)			(-11.31)
$DTO_{-2,-4}$			0.153			-0.002
			(1.51)			(-0.78)
$DRet_{-5}$			-0.027			-0.013
			(-0.96)			(-12.58)
DTO_{-5}			0.114			-0.028
			(1.72)			(-8.56)

Table 4. Different timing of *PIR*

Similar portfolios as the filter 3) in table 2 with different timing *m* are formed and the holding returns are given in this table. For both U.S and Chinese stock market, we form the portfolios based on the decile of *PIR* every thirty minutes and hold the portfolio from the 15 minutes after the PIR timing to the market close. We only report the difference between the highest to the lowest (H-L) and second highest to second lowest (9-2) for saving place. The t-statistics given in the parentheses are based on Newey-West standard error.

	Equal-Weighted				Value-Weighted			
	H-L	t(H-L)	9-2	t(9-2)	B-S	t(H-L)	9-2	t(9-2)
Panel A. United States								
10:00	-27.4	(-14.1)	-10.9	(-8.7)	-5.6	(-2.0)	-2.1	(-1.2)
10:30	-21.0	(-11.4)	-7.7	(-8.1)	-8.4	(-3.7)	-3.6	(-2.5)
11:00	-18.0	(-11.2)	-6.6	(-7.4)	-8.8	(-4.7)	-3.9	(-2.6)
11:30	-16.4	(-10.4)	-6.1	(-7.3)	-10.3	(-6.5)	-5.1	(-3.7)
12:00	-15.6	(-10.4)	-6.3	(-8.1)	-12.0	(-7.6)	-6.7	(-5.4)
12:30	-15.7	(-10.7)	-6.2	(-7.8)	-12.3	(-8.4)	-7.4	(-6.0)
13:00	-14.7	(-10.4)	-5.7	(-7.3)	-12.5	(-8.1)	-6.8	(-4.9)
13:30	-15.4	(-11.8)	-6.7	(-10.1)	-13.8	(-8.5)	-7.5	(-6.2)
14:00	-13.9	(-12.1)	-5.9	(-9.7)	-12.1	(-7.1)	-7.7	(-6.4)
14:30	-12.6	(-12.9)	-5.6	(-11.8)	-12.7	(-9.4)	-8.1	(-7.9)
15:00	-10.1	(-12.6)	-4.1	(-11.1)	-10.8	(-8.3)	-5.7	(-7.6)
15:30	-5.0	(-14.3)	-1.0	(-3.8)	-4.8	(-5.1)	-1.6	(-3.5)
Panel B. China								
10:00	-43.9	(-17.9)	-25.7	(-12.4)	-35.6	(-15.9)	-18.5	(-9.5)
10:30	-33.6	(-17.7)	-20.5	(-13.5)	-26.7	(-14.9)	-16.1	(-11.0)
11:00	-25.7	(-16.6)	-15.9	(-14.0)	-21.7	(-14.8)	-12.3	(-10.4)
11:30	-25.3	(-16.6)	-15.1	(-14.0)	-22.8	(-12.9)	-13.1	(-10.2)
13:30	-14.5	(-10.4)	-8.2	(-9.5)	-13.4	(-9.0)	-8.0	(-7.3)
14:00	-4.1	(-3.3)	-1.8	(-2.3)	-5.7	(-4.1)	-3.1	(-3.4)
14:30	0.5	(0.6)	1.1	(1.9)	-1.9	(-2.3)	-0.6	(-0.9)

Table 5. *PIR* of first 30 minutes and last 30 minutes intraday return

This table reports the return spread of holding the *PIR*-based portfolio during the last 30 minutes of trading day which is from 15:30 to 16:00 for U.S and from 14:30 to 15:00. The timing *m* of *PIR* is 10:00 which is the end of first 30 minutes of trading day. Both equal-weighted and value-weighted return are reported. The t-statistics given in the parentheses are based on Newey-West standard error with 120 lags.

	L	2	3	4	5	6	7	8	9	H	H-L	9-2
United States												
EW	10.3	6.1	5.0	4.3	3.7	3.7	3.6	3.6	3.3	2.0	-8.3	-2.7
	(9.1)	(6.7)	(6.4)	(6.1)	(5.4)	(5.5)	(5.3)	(5.3)	(5.2)	(2.7)	(-11.4)	(-6.1)
VW	4.2	2.4	2.1	1.6	1.4	1.0	0.6	0.0	-0.2	-3.8	-8.0	-2.6
	(5.1)	(3.8)	(3.2)	(2.4)	(2.5)	(1.7)	(1.1)	(-0.0)	(-0.3)	(-3.2)	(-6.7)	(-5.0)
China												
EW	4.3	5.7	5.7	6.0	6.3	6.4	6.3	5.9	5.5	3.0	-1.4	-0.2
	(3.4)	(5.3)	(6.1)	(6.2)	(6.9)	(7.3)	(7.2)	(6.9)	(6.1)	(3.5)	(-1.8)	(-0.4)
VW	6.1	5.7	6.0	5.9	6.0	5.8	6.4	5.6	5.7	4.0	-2.2	0.0
	(4.4)	(5.3)	(6.4)	(6.4)	(6.5)	(6.6)	(7.8)	(7.6)	(7.0)	(4.3)	(-2.3)	(0.1)

Table 6. Double sorted portfolios based on *PIR* and liquidity

At the time *m* of every day, we independently sort all sample stocks in five times five portfolios based on *PIR* with timing *m* and liquidity measures. And then, we hold the portfolios from *m* + 15 minutes to the market close today. For both market, filter 3) mentioned in table 2 is considered. Equal-weighted and value-weighted return, spreads and t-statistics of the spreads are reported. We only report the lowest, median and highest portfolios to save place. Return are reported in basis points and t-statistics are based on Newey-West standard error with 120 lags. Three liquidity measurements are considered, including market equity (*ME*), share turnover (*TO*) and illiquidity (*Ami*). The descriptions of them are same as in table 1.

	Market Equity				Turnover				Illiquidity			
	S	M	B	B-S	S	M	B	B-S	S	M	B	B-S
Panel A. U. S.												
Equal-weighted Return												
PIR 1	33.3	13.0	3.8		38.1	16.9	0.7		2.7	10.7	36.4	
PIR 3	7.9	5.2	3.3		8.6	5.4	-0.6		3.0	5.1	9.0	
PIR 5	-8.4	0.4	2.1		-9.1	1.5	-0.6		2.1	1.4	-9.6	
5 - 1	-41.7	-12.6	-1.8	40.0	-47.1	-15.4	-1.3	45.8	-0.7	-9.3	-46.0	-45.4
	(-16)	(-5.4)	(-0.9)	(13)	(-19)	(-6.7)	(-0.7)	(18)	(-0.3)	(-3.7)	(-18)	(-14)
Value-weighted Return												
PIR 1	31.6	13.0	0.9		19.0	4.5	-4.1		0.6	11.9	36.5	
PIR 3	7.9	5.1	0.9		4.7	1.2	-3.2		0.8	5.3	8.7	
PIR 5	-8.4	0.4	-0.6		-9.0	0.9	0.7		-0.5	0.4	-11.9	
5 - 1	-40.0	-12.7	-1.4	38.5	-28.0	-3.6	4.8	32.8	-1.1	-11.5	-48.4	-47.3
	(-15)	(-5.3)	(-0.6)	(10)	(-6.0)	(-1.6)	(2.3)	(7.4)	(-0.4)	(-5.3)	(-23)	(-15)
Panel B. China												
Equal-weighted Return												
PIR 1	36.4	28.6	20.3		30.2	29.1	26.9		17.7	29.6	36.5	
PIR 3	18.7	12.4	8.2		13.4	13.2	11.7		7.6	12.9	17.9	
PIR 5	-5.4	-9.6	-9.3		-7.3	-7.2	-10.2		-10.1	-8.7	-6.4	
5 - 1	-41.8	-38.1	-29.7	12.2	-37.6	-36.2	-37.2	0.4	-27.8	-38.2	-42.9	-15.0
	(-17)	(-15)	(-13)	(6.8)	(-19.4)	(-14)	(-13)	(0.3)	(-11)	(-16)	(-17)	(-7.6)
Value-weighted Return												
PIR 1	38.9	31.4	18.2		22.4	25.3	25.5		15.8	32.4	37.8	
PIR 3	20.5	14.6	9.9		11.5	11.5	11.6		9.3	14.5	18.8	
PIR 5	-2.4	-6.6	-5.0		-4.7	-5.0	-8.1		-4.9	-6.2	-4.1	
5 - 1	-41.3	-38.1	-23.1	18.1	-27.1	-30.3	-33.6	-6.5	-20.7	-38.6	-42.0	-21.3
	(-17)	(-16)	(-10)	(8.4)	(-14)	(-12)	(-11)	(-2.8)	(-9.0)	(-16)	(-18)	(-9.9)

Table 7. Fama-Macbeth Regression

Every day, we run a cross-sectional regression of return from time *m+15* to market close on the *PIR* of *m* and its interaction with liquidity measurements for both U.S and Chinese stock market. We control the firms' characteristics and past daily trading information for the regression. The time-series average of regression coefficients is reported. The definitions of firms' characteristics are same as table 1. Past daily trading controls are same as table 3. Only the stocks filtered by standard 3) in table 2 are considered. The sample period is from January 2000 to December 2012 for U.S. and January 2000 to December 2017 for China. The t-statistics are in parentheses calculated based on the Newey-West standard error with 120 lags.

	United States					China				
PIR	-0.081	-0.043	-1.013	-0.155	-0.715	-0.125	-0.110	-0.263	-0.130	-0.173
	(-3.26)	(-1.50)	(-3.68)	(-3.41)	(-2.42)	(-28)	(-24)	(-10)	(-28)	(-7.02)
*PIR*Ami*		-0.044			-0.033		-0.142			-0.084
		(-2.09)			(-1.38)		(-4.49)			(-2.95)
*PIR**			0.071		0.049			0.009		0.004
log(ME)			(3.16)		(1.92)			(5.52)		(2.33)
*PIR*TO*				7.111	1.612				1.723	1.156
				(1.76)	(0.36)				(2.92)	(2.54)
log(ME)	0.001	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
	(1.34)	(1.30)	(1.08)	(1.34)	(0.99)	(-6.00)	(-5.99)	(-6.27)	(-5.95)	(-6.50)
log(BM)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.12)	(0.12)	(0.14)	(0.12)	(0.15)	(2.76)	(2.80)	(2.77)	(2.81)	(2.84)
Rev	0.017	0.017	0.017	0.017	0.017	0.000	0.000	0.000	0.000	0.000
	(1.55)	(1.56)	(1.55)	(1.56)	(1.56)	(-0.45)	(-0.48)	(-0.48)	(-0.48)	(-0.51)
Mom	0.002	0.002	0.002	0.002	0.002	0.000	0.000	0.000	0.000	0.000
	(1.23)	(1.21)	(1.23)	(1.25)	(1.23)	(3.12)	(3.13)	(3.13)	(3.15)	(3.16)
TO	-0.236	-0.239	-0.239	-0.194	-0.177	-0.054	-0.054	-0.054	-0.050	-0.053
	(-1.81)	(-1.82)	(-1.83)	(-1.56)	(-1.41)	(-7.32)	(-7.29)	(-7.28)	(-6.85)	(-6.74)
Vola	-0.083	-0.082	-0.085	-0.083	-0.086	0.007	0.007	0.008	0.007	0.007
	(-1.65)	(-1.65)	(-1.65)	(-1.64)	(-1.64)	(2.02)	(2.01)	(2.04)	(1.99)	(2.00)
Ami	2.182	2.093	2.079	2.225	1.891	0.004	0.004	0.004	0.004	0.004
	(1.15)	(1.21)	(1.10)	(1.18)	(1.14)	(4.38)	(4.14)	(4.37)	(4.36)	(4.14)
Daily Ret. Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table 8. Intraday reversal of firms simultaneously listed and traded in Hongkong and Mainland exchange

Every day, we group the stocks, which are simultaneously listed in the Chinese mainland stock exchange (Shanghai Stock Exchange and Shenzhen Stock Exchange, A share) and Hong Kong Exchanges and Clearing Limited (H share), into three portfolios based on their *PIR* in the corresponding market of both stock market respectively. The timing *m* of both *PIR* is 10:00. Table reports the equal-weighted return of each portfolio from 10:15 to the market close. To enter our portfolio, the stocks must be listed in both markets longer than 6 months. The upper panel only requires stocks are simultaneously listed and the bottom panel additionally requires stocks are simultaneously traded in given day. Returns are reported in basis-points and t-statistics based on Newey-West standard error with 120 lags are given in parentheses.

	L	M	H	H-L
Simultaneously listed				
Mainland	18.4	10.5	-4.1	-22.4
	(6.4)	(4.2)	(-1.8)	(-9.3)
Hongkong	1.9	-3.3	-0.4	-2.3
	(0.7)	(-1.5)	(-0.2)	(-1.0)
M - H				-20.1
				(-4.9)
Simultaneously listed and traded				
Mainland	21.3	11.5	-5.5	-26.7
	(5.5)	(3.6)	(-2.0)	(-7.4)
Hongkong	-2.3	-5.3	-6.1	-3.8
	(-0.6)	(-2.2)	(-1.8)	(-0.9)
M - H				-22.7
				(-4.1)

Table 9. *PIR* and return in following days

We sort all stocks traded in the U.S./Chinese stock market into portfolios based on the decile of *PIR*. Besides the following intraday return within same day, we investigate the return of portfolios in the following trading days. Same filters as 3) in table 1 for both China and U.S. stock market are considered. The *PIR* timing is 10:00 for China and U.S.

We report the equal-weighted and value-weighted return in the following five trading days respectively for both stock market. For day t+0, intraday holding return are reported and daily return are given for other five days. We also report the accumulated return from holding time, which is 15 minutes later after signal timing, to the end of given day. T-statistics are calculated based on Newy-West standard error with 120 lags.

	EW Return		VW Return		EW Ac. Return		VW Ac. Return	
t+	H-L	9-2	H-L	9-2	H-L	9-2	H-L	9-2
United States								
0	-27.4	-10.9	-5.6	-2.1	-27.4	-10.9	-5.6	-2.1
	(-14.1)	(-8.7)	(-2.0)	(-1.2)	(-14.1)	(-8.7)	(-2.0)	(-1.2)
1	7.7	5.1	12.5	5.7	-19.7	-5.7	6.8	3.6
	(4.1)	(3.6)	(3.9)	(2.7)	(-8.4)	(-3.4)	(1.6)	(1.6)
2	-2.2	-0.7	-4.6	-4.7	-21.7	-6.3	2.6	-1.1
	(-1.5)	(-0.6)	(-1.5)	(-2.5)	(-8.3)	(-3.1)	(0.7)	(-0.5)
3	-0.8	-0.2	-5.5	-2.5	-22.5	-6.4	-2.9	-3.5
	(-0.4)	(-0.1)	(-1.9)	(-1.4)	(-6.7)	(-2.5)	(-0.6)	(-1.2)
4	-0.6	-2.0	-3.3	-4.1	-23.2	-8.3	-6.1	-7.7
	(-0.4)	(-2.1)	(-1.2)	(-2.4)	(-6.6)	(-3.1)	(-1.0)	(-2.2)
5	-0.8	-1.5	-2.7	-1.4	-23.6	-9.4	-8.2	-8.5
	(-0.5)	(-1.3)	(-1.1)	(-0.9)	(-6.9)	(-3.7)	(-1.4)	(-2.6)
6 to 10	-2.1	1.8	-6.6	-0.6	-26.1	-8.1	-14.9	-9.5
	(-0.7)	(0.7)	(-1.2)	(-0.1)	(-5.8)	(-2.1)	(-1.7)	(-1.7)
China								
0	-43.9	-25.7	-35.6	-18.5	-43.9	-25.7	-35.6	-18.5
	(-17.9)	(-12.4)	(-15.9)	(-9.5)	(-17.9)	(-12.4)	(-15.9)	(-9.5)
1	27.0	9.0	30.7	11.4	-16.6	-16.5	-4.7	-6.9
	(6.9)	(4.7)	(7.9)	(5.6)	(-5.8)	(-8.3)	(-1.4)	(-2.8)
2	5.2	1.6	6.5	3.6	-11.9	-15.1	1.5	-3.8
	(3.1)	(1.6)	(2.9)	(2.4)	(-2.9)	(-6.0)	(0.3)	(-1.3)
3	8.4	4.8	5.4	3.1	-4.1	-10.4	6.5	-0.9
	(5.1)	(5.3)	(2.8)	(1.9)	(-0.8)	(-3.9)	(1.2)	(-0.2)
4	5.8	3.1	4.5	1.2	0.9	-7.7	9.7	-0.1
	(4.5)	(3.0)	(2.6)	(0.6)	(0.2)	(-2.5)	(1.6)	(-0.0)
5	-6.2	-2.2	-5.4	-4.7	-6.3	-10.3	2.8	-4.8
	(-6.0)	(-2.9)	(-3.3)	(-3.5)	(-1.2)	(-3.3)	(0.4)	(-0.9)
6 to 10	19.8	10.4	16.0	7.0	14.0	0.0	20.0	2.8
	(7.0)	(6.8)	(4.6)	(2.6)	(2.0)	(0.0)	(2.6)	(0.5)