Liquidity Timing in the Higher Moment Framework: Evidence from Bank Affiliated Fund

Woraphon Wattanatorn
PTT Public Company Limited
Bangkok, Thailand 10900
E-mail: woraphon.wattanatorn@pttplc.com

Chaiyuth Padungsaksawasdi*
Assistant Professor of Finance
Thammasat University
Department of Finance
Thammasat Business School
Bangkok, Thailand 10200
E-mail: chaiyuth@tbs.tu.ac.th

Pornchai Chunhachinda
Professor of Finance
Thammasat University
Department of Finance
Thammasat Business School
Bangkok, Thailand 10200
E-mail: pchinda@tu.ac.th

Sarayut Nathaphan
Assistant Professor of Finance
Mahidol University International College
Mahidol University
Nakhon Pathom, 73170
E-mail: sarayut.nah@mahidol.ac.th

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* Corresponding author

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Abstract

A nonnormal stock return distribution is common in emerging markets. We propose a new liquidity timing model in a higher moment. Overall, fund managers are able to time the market-wide liquidity even in a higher moment environment. A coskewness risk factor is statistically priced. High performing portfolios possess significantly positive liquidity timing ability, while low performing portfolios show oppositely. Thus, high performing funds increase (decrease) the funds' exposure to the market during a high (low) market liquidity period, while low performing funds wrongly forecast market liquidity. Moreover, only bank-related mutual funds possess the liquidity timing ability, supporting the information advantage hypothesis.

1. Introduction

Not only liquidity is an important risk factor for timing market return and market volatility (Acharya and Pedersen, 2005, Amihud, 2002, Amihud and Mendelson, 1986, Holmström and Tirole, 2001, and Pástor and Stambaugh, 2003), but it is also important for portfolio management (Aragon and Strahan, 2012 and Cao et al., 2013b). Mutual fund managers are obliged to manage portfolio liquidity in order to meet daily investors' redemption, especially unexpected large redemptions in a down market. Further, unlike market return which is found to be difficult to forecast, market liquidity is more persistent, allowing fund managers to forecast more accurately (Cao et al., 2013b). Although studies on mutual funds' performance are extensive, there still lacks of studies on mutual fund liquidity timing ability, especially in developing economies.[1] For example, Cao et al., (2013a and 2013b) show that both hedge funds and mutual funds have the ability to time market-wide liquidity, which managers would expose to the market more (less) during a high (low) liquidity period. Up to date, none studies the liquidity timing ability of mutual funds in emerging equity markets, even though liquidity risk plays an important role in these countries (Brown et al., 2008, Hearn, 2010, and Lam and Tam, 2011). Additionally, stock return distributions in emerging markets are more non-normal than in developed markets (Adcock and Shutes, 2005, Bae et al., 2006, Bekaert et al., 1998, Canela and Collazo, 2007, and Harvey et al., 2010).[2] Putting them together, a mean-variance approach is not sufficient to characterize return and associated risk in a high volatile environment as in emerging markets and a higher moment framework is therefore necessary to be taken into consideration (Samuelson, 1970). Moreover, seminal works (Chunhachinda et al., 1997, Kraus and Litzenberger, 1976, Harvey and Siddique, 2000, Moreno

[1] All existing studies are examined in the U.S. markets, for example, Bodson, Cavenaile, and Sougné (2013) and Karstanje et al. (2013).

[2] In a bird's eye view, this is because emerging markets are characterized by an incomplete market structure, political and economic uncertainties, weak regularities, and low-quality auditing systems and a more likelihood of a structural change, for example regulatory changes, financial market liberalization, political crises, and other shocks.

and Rodríguez, 2009) show that coskewness is priced and plays a significant role in portfolio allocation. Our paper fills the gap in this regard.

Another important trend of mutual fund studies is the bank-mutual fund relationship, which is not widely studied in prior literature. Basically, bank-related fund managers and nonbank-related fund managers have different information and constraints to manage their portfolios as follows (Berzins et al., 2013, Hao and Yan, 2012, Massa and Rehman, 2008, Mehran and Stulz, 2007). First, bank-related funds have more new investment flows because of a lower searching cost (Nathaphan and Chunhachinda, 2012 and Sirri and Tufano, 1998) and hence possess more liquidity than nonbank-related funds. Second, the relationship between the bank and it affiliated mutual funds can cause an agency problem, which affects bank-related fund's investment constraints and investment outcomes. For example, Mehran and Stulz (2007) and Hao and Yan (2012) document that a bank might encourage its affiliated mutual funds to support the client's IPO stock in order to win a future contract in another line of the bank businesses, making the mutual funds misallocate their invested portfolios and lose diversification benefits.

As aforementioned above, this study contributes to prior literature in several aspects as follows. First, to the best of our knowledge, this study provides the first evidence of liquidity timing ability in the mutual fund industry outside the U.S. Our pioneering findings are supported by the fact that liquidity risk in emerging markets shows a higher risk premium than in developed markets (Brown, Rhee, and Zhang 2008, Hearn 2010, and Lam and Tam 2011) and that incorporating the liquidity factor in financial literature is supported by Benson et al. (2015). In addition, Kearney (2012) shows that emerging markets illustrate significant growths in terms of the economies and the proportion of savings, subsequently calling for an attention in the global market. Of all, this paper fills the gap in the studies of liquidity timing ability of mutual funds. Second, prior research, especially for emerging markets suggests that higher moments return characteristics significantly affect portfolio management and portfolio allocation (Adcock and Shutes 2005, Bae, Lim, and Wei 2006, Bekaert et al. 1998, Bekaert and Harvey 2002, Canela and Collazo 2007, and Galagedera and Brooks 2007). Recently, Moreno and Rodríguez (2009) find that coskewness is a significant factor to explain risk-adjusted returns in the mutual fund industry. Taking this into consideration, we incorporate the coskewness risk factor into our liquidity timing ability models, which is not existent in prior literature and is superior to a mean-variance approach (Samuelson 1970).Third, evidence on the abilities of mutual fund managers remains mixed.[3] Contradicting results in existing studies are largely driven by differences in methodology, sample (country), and period of study. In addition, Bekaert and Harvey (1997) show that returns in emerging markets are more predictable than in developed markets. We propose our models by controlling the market timing ability of mutual fund managers in order to truly examine the role of liquidity timing ability in both the aggregate and the portfolio levels. Last, based on the bank-mutual fund relationship, our findings support the information advantage hypothesis that bank-related funds occupy superior information than nonbank-related funds. We provide new findings of liquidity timing ability between bank- and nonbank-related mutual funds, which is neglected in prior literature. Our finding suggests that bank-related funds have an ability to capture dynamic patterns in the market better than nonbank-related funds.

As one of fast growing emerging markets, we focus on the mutual fund market in Thailand for the following reasons. First, Thailand is one of the important emerging markets in the South East Asia and has exhibited a rapid economic expansion over last decade. In addition to the economic growth, the Thai mutual fund industry has impressively expanded at an average 27%

[3] For example, Kon (1983) does not find any ability of mutual fund managers, while Chang and Lewellen (1984) and Kon and Jen (1979) show that mutual fund managers have both market timing ability and stock selectivity. For more recent evidence in an international context, Comer et al. (2008) finds no evidence of the market timing ability in global asset allocation funds. This is consistent with Bauer et al. (2006), who also find no evidence of the market timing ability in New Zealand funds. While Jiang, Yao, and Yu (2007) and Bollen and Busse (2001) strongly support the market timing ability in the U.S. market.

per year.[4] Second, businesses in Thailand are dominated by debt financing through bank loans (Prommin et al., 2014). This unique characteristic allows us to study a relationship between the bank and its affiliated mutual fund. According to the information advantage hypothesis, bank-related funds gain superior information in that banks are able to share their clients' loan information with their affiliated mutual funds. Therefore, this study employing the sample in Thailand sheds a new light on the difference in liquidity timing ability between bank- and nonbank-related mutual funds.

Overall, our proposed liquidity timing ability model works well in both the aggregate level and the portfolio level. We select four widely used illiquidity measures for the study in emerging capital markets, namely the Amihud (2002), the adjusted-illiquidity, the zero return days, and the Roll (1984)'s effective spread, respectively for the liquidity timing factor. The liquidity timing ability factor is statistically significant. R^2 values are generally high. Specifically, low performing funds show statistically significantly negative liquidity timing ability, which fund managers expose more (less) during a low (high) liquidity period. We infer that these funds have no liquidity timing ability. Conversely, high performing funds show statistically significantly positive liquidity timing ability. It shows that the fund managers are able to generate profits from timing market-wide liquidity. Even in a higher moment environment, in which we incorporate the coskewness risk factor and the market timing factor into the model, the liquidity timing factor is still statistically significant in both the aggregate and the portfolio levels. Low performing funds show significant negative liquidity timing and high performing funds show positively significant. Moreover, the coskewness risk factor is statistically priced, showing that returns are more predictable in emerging markets (Bekaert and Harvey, 1997). Moreover, we find that *only* bank-related mutual funds show the market-wide liquidity timing ability, which is consistent with the information advantage hypothesis.

[4] Sources: Morningstar Direct database, as of April 2015.

They utilize superior information obtained from their affiliated banks to time the market liquidity. In general, the zero return days are the least powerful illiquidity measure in this study and the adjusted illiquidity measure is the best. A robustness check confirms our overall results.

The remainder of the study is organized as follows. Section 2 provide a brief overview of liquidity measures that is widely employed in emerging markets. Section 3 discusses an important aspect of the higher moment in emerging markets. Section 4 provides supportive evidence of choosing Thailand as the sample and section 5 provide an overview of the mutual fund industry. Section 6 shows data and how to classify mutual funds in this study. Sections 7 and 8 show methodology and empirical results. Section 9 is a robustness check. The last section is conclusion and summary.

2. Liquidity measurement

In this section we provide an overview of major liquidity measurement employed in finance studies. Motivated by Benson et al. (2015) on the essence of incorporating liquidity into finance research, liquidity is a crucial component for portfolio management. A success of major trading strategies (i.e., size, value, and momentum) depends on the role of liquidity.[5] [6] Additionally, an importance of liquidity as a risk factor in asset pricing is well documented in academic literature (Acharya and Pedersen 2005, Amihud 2002, and Pástor and Stambaugh 2003). Brown, Rhee, and Zhang (2008), Hearn (2010), Lam and Tam (2011), and Jun, Marathe, and Shawky (2003) show that emerging markets have lower liquidity than developed markets, supporting the important role of liquidity as additional risk factor. Due to the fact that the liquidity can be measured from different dimensions (for example, numbers of trading assets,

[5] Amihud and Mendelson (1986) document that market-observed expected returns are an increasing concave function of the bid-ask spread. Later, numerous studies (for example, Acharya and Pedersen 2005, Amihud 2002, and Pastor and Stambaugh 2003) suggest that liquidity is a relevant factor that helps explain stock returns.
[6] Bettman et al. (2010), Li et al. (2014), and Docherty et al. (2013) support the effect of liquidity to size, value, and momentum trading strategies.

trading volume, and number of zero returns), we summarize pertinent literature using major illiquidity measures focusing in emerging market studies.

Lesmond (2005) studies the liquidity risk factor in 31 emerging markets using low frequency illiquidity measures and finds that the Amihud (2002) illiquidity and the zero illiquidity measures are best performers within country analysis. Bekaert, Harvey, and Lundblad (2007) find that the zero return day is frequently observed and fairly persists in emerging markets. Further, their findings show that the zero return measure is highly correlated with the bid-ask spread, which is consistent with Lesmond (2005). In sum, several studies (for example, Bekaert, Harvey, and Lundblad 2007, and Kang and Zhang 2014) support Lesmond's (2005) findings that the Amihud measure is the best illiquidity measure of low frequency data.[7]

From aforementioned literature, in this study we adopt four widely acceptable illiquidity measures employing in emerging markets, namely the Amihud, the adjusted-illiquidity, the zero, and the Roll's effective spread. Hence, we briefly introduce each measure below.

First, one of the most classical illiquidity estimations is the Amihud's (2002) illiquidity measure of the stock *i* in month *t* ($ILLIQ_{i,t}$) presented as

$$ILLIQ_{i,t} = \frac{1}{T}\sum_{d=1}^{T}\frac{\left|R_{t,d}^{i}\right|}{V_{t,d}^{i}} \quad (1)$$

where $R_{t,d}^{i}$ is the return of the stock *i* on day *d* in month *t*. T is the total number of trading days in month *t* and $V_{t,d}^{i}$ is the trading volume in million baht of stock *i* on day *d* in month *t*. The larger the Amihud measure, the lesser the stock liquidity.[8]

[7] Even though several studies employ Pastor and Stambaugh's (2003) liquidity measure, we argue that it is not a good liquidity estimation for emerging markets because of a potential large number of zero return days. The calculation is undefined in zero return days.

[8] The Amihud's illiquidity measure can be negative in a liquid market.

Second, Kang and Zhang (2014) suggest that the Amihud measure is undefined under a zero trading volume day. Although the zero trading volume days are unusual in developed markets, it is more common in emerging markets. Several find that the zero trading volume day possesses a high correlation with the bid-ask spread (Lesmond 2005 and Bekaert, Harvey, and Lundblad 2007). Therefore, Kang and Zhang introduce a new illiquidity measure, the adjusted-illiquidity measure, which improves the efficiency of the Amihud's (2002) illiquidity measure by taking the effect of zero trading volume days into account as follows.

$$AdjILLIQ_{i,t} = \left[ln\left(\frac{1}{T} \sum_{d=1}^{T} \frac{|R_{t,d}^{i}|}{V_{t,d}^{i}} \right) \right] \times \left(1 + Zerovol_{i,t}\right) \quad (2)$$

$$Zerovol_{i,t} = \frac{number\ of\ days\ with\ zero\ trading\ volumes\ in\ month\ t}{T} \quad (3)$$

where $Zerovol_{i,t}$ is the ratio of the number of zero trading volume days in month *t* to the number of total trading days in month *t* (*T*). *ln* is natural logarithm.

Third, Lesmond, Ogden, and Trzcinka (1999) argue that the zero illiquidity captures asset liquidity in terms of adverse selection. Informed investors will trade only when the profit from their private information is larger than transaction costs. For example, if an asset is less liquid, a large transaction cost would discourage informed investors to trade that no private information is revealed. Therefore, a less liquid asset with large transaction costs is less frequently traded than a high liquid asset, potentially showing a large number of zero return days. The zero return day measure is presented below.

$$zero_{i,t} = \frac{number\ of\ days\ with\ zero\ returns\ in\ momth\ t}{T} \quad (4)$$

where $zero_{i,t}$ is the zero illiquidity measure for the stock *i* in month *t*. The higher the number of zero, the more the market illiquidity.

Last, we employ the Roll's (1984) spread. The effective spread measures the liquidity of an asset driven by transaction costs, given symmetric information. Transaction costs show a negative relationship with a serial correlation of price changes. An effective spread leads to a negative covariance of price changes in the following period. A wider spread leads to higher transaction costs. Thus, the wider the effective spread, the lesser the liquidity.

$$Roll's\ Effective\ spread_{i,t} = 2\sqrt{-cov_{i,t}}, \tag{5}$$

where $-cov_i$ is the first order serial covariance of price changes between two consecutive periods.

3. Higher moment risk factor

Skewness is an important factor in explaining security and portfolio returns (Jean 1971, 1973 and Kraus and Litzenberger 1976).[9] Seminal works in portfolio management (Adcock and Shutes 2005, Bae, Lim, and Wei 2006, Bekaert et al. 1998, Bekaert and Harvey 2002, Canela and Collazo 2007, and Galagedera and Brooks 2007) reject the normal distribution in stock returns and support the important role of skewness in investors' decision making. A positive relationship between skewness and expected stock return is also widely documented (Kon 1984, Kraus and Litzenberger 1976, Mills 1995, and Peiró 1999). This allows investors to trade skewness risk for maximizing expected return (Chunhachinda et al. 1997).

Levy and Sarnat (1972) support the importance of higher moments as a risk factor for mutual fund investors. Further, Harvey and Siddique (2000) show that coskewness (non-diversifiable skewness) is priced in asset returns.[10] Therefore, the effect of skewness risk is considered to be incorporated in this study. We follow Harvey and Siddique (2000) to form the coskewness factor as follows.

[9] Positive first moment and negative second moment properties imply sufficient conditions for positive skewness preference for risk-averse investors.
[10] Doan, Lin, and Zurbruegg (2010), Harvey et al. (2010), Harvey and Siddique (2000), Kostakis, Muhammad, and Siganos (2012), Moreno and Rodríguez (2009), and Smith (2006) show a positive relationship between the coskewness risk factor and expected stock returns.

$$S_i = \frac{E(\varepsilon_{i,t+1}\varepsilon_{m,t+1}^2)}{\sqrt{E(\varepsilon_{i,t+1}^2)}E(\varepsilon_{m,t+1}^2)} \tag{6}$$

$\varepsilon_{i,t+1}^2$ is the residuals from the regression of the returns on stock *i* on market excess returns.[11] $\varepsilon_{m,t+1}^2$ is the market residuals between the market excess returns and their mean return. We employ returns over the first 60 months in our sample period to calculate $\varepsilon_{i,t+1}^2$ and $\varepsilon_{m,t+1}^2$. Then, we calculate the coskewness factor (S_i) and rank it on monthly basis. In each month, we form three value-weighted portfolios; S^- represents the portfolio consisting of 30% of the most negative coskewness stocks; S^+ represents the portfolio consisting of 30% of the most positive coskewness stocks; and S^0 represents the portfolio consisting of the 40% remaining.[12] The coskewness risk factor (*CSK*) is defined as the difference between S^- and risk-free return (r_f).

4. Why Thailand?

Research on the effect of bank-mutual fund relationship is scant. Most evidence is devoted on developed markets.[13] Because of an increasing important role of emerging markets in the global financial system, this study aims to provide such evidence on the bank-mutual fund relationship. We select the mutual fund industry in Thailand as our interest for several reasons. First, Thailand is one of the important emerging markets in the South East Asia, and has exhibited a rapid economic expansion. A cumulative average growth rate (CAGR) of the GDP in Thailand is 6.80% from 2000 to 2015 compared with 5.40% of the world average CAGR.[14] Second, businesses in Thailand are dominated by debt financing through bank-loan

[11] The error term is obtained from $\varepsilon_{t+1} = r_{t+1} - a_{t+1} - \beta_{t+1}(r_{m,t+1})$. See Harvey and Siddique (2000).
[12] To confirm that our results are not driven by the coskewness risk factor formation procedure, in unreported tables, we form S^- from 5%, 10%, 15%, 25%, and 30% of the most negative coskewness stocks, respectively. The results remain unchanged and are available upon request.
[13] See, for example in the U.S. markets, Massa and Rehman (2008), Mehran and Stulz (2007), Hao and Yan (2012), Berzins, Liu, and Trzcinka (2013), and Ritter and Zhang (2007) find that bank-related funds outperform nonbank-related funds because of superior information.
[14] Source: World Bank

(Prommin, Jumreornvong, and Jiraporn 2014) and the Thai mutual fund industry is influenced by bank-related mutual funds (Charoenrook and Pavabutr, forthcoming). This allows us an opportunity to investigate whether bank-related funds exploit the bank's superior information as proposed by the information advantage hypothesis. This is because banks can readily access to their clients' information through other lines of bank's activities. Banks can potentially pass through information advantage to their related mutual funds.[15] Additionally, the information availability of mutual funds affect the investment decisions of investors. Consequently, bank-related funds which have lower information searching cost attract a larger positive funds flow than nonbank-related funds,[16] making themselves a less liquidity constraint. In sum, we question the effect of the bank-mutual fund relationship on the mutual fund performance and mutual fund liquidity timing ability. To the best of our knowledge, prior literature does not address this issue in emerging markets.

5. Industry overview

The mutual fund sector in Thailand was formally founded in 1975 by the collaboration between the government of Thailand and the International Finance Corporation. From 1975 to 1992, Mutual Fund Public Co., Ltd. was the only asset management company (AMC) operating in the industry. There existed 22 funds, consisting of 12 domestic funds and 10 international funds. In 1992, the Security and Exchange Act BE2535 (AD, 1992) allowed the subsidiaries of commercial banks and other financial institutions to operate in the mutual fund industry. As

[15] Information advantage hypothesis argues that bank-related funds possess superior information. They potentially utilize this superiority to enhance mutual fund performances. Banks can share clients' information obtained from the banks' activities with their affiliated mutual funds. In sum, bank-related funds gain informational advantages in several dimensions. First, they can obtain information at a cheaper cost. Second, they can access unpublished information available only at their banks such as lending information (Massa and Rehman 2008, Mehran and Stulz 2007, Hao and Yan 2012, and Berzins, Liu, and Trzcinka 2013). Last, they have the privileged benefit of receiving the IPO allocation when their associated bank is an IPO underwriter (Ritter and Zhang 2007).

[16] Sirri and Tufano (1998) show that the higher the searching cost, the smaller the fund flows. This is consistent with Frye (2001), who finds that bank-related funds have a lower searching cost than nonbank-related funds due to the fact that corporations do businesses through banking. Thus, this lower searching cost of bank-related funds attracts a larger fund flow.

of April 2015, there are 22 AMCs that the 11 bank-related AMCs operate 1,151 mutual funds, while the remaining 11 non-bank related AMCs operate 350 mutual funds.[17]

Figure 1 depicts an impressive growth in the mutual fund industry in Thailand over the period of 2000-2014. The Thai mutual fund's assets under management (AUM) is 86 billion baht in year 2000, accounting for 1.7% of the GDP and 6.7% of the market capitalization of the Stock Exchange of Thailand (SET). By the end of 2014, the AUM grows to 3,262 billion baht, accounting for 24% of the GDP and the SET. An expansion of the mutual fund industry in Thailand illustrates an increasing popularity, which people views mutual funds as an attractive investing channel.

[Figure 1]

Figure 2 depicts household savings and investment in Thailand over the period of 2000-2014. Deposit savings are the largest proportion, however they have declined since 2001. The proportion of deposit savings to the GDP has diminished over the sample period, alike. The deposit savings account for 67% of the GDP in 2000 and decline to 51% of the GDP in 2014. During the same period, conversely, mutual funds increase their sizes to 24% of the GDP. This is consistent with the life insurance sector as well, illustrating a 12% average growth. In addition, the results are consistent when looking at an increase in numbers of mutual fund accounts as depicted in Figure 3. The ratio between the numbers of mutual fund accounts to that of savings accounts has increased, implying that the number of mutual fund accounts, at least, grows faster than that of savings accounts.

[Figure 2]

[Figure 3]

6. Data and the classification of mutual funds

[17] Sources: Morningstar Direct database, as of April 2015.

In this study we gather data from various sources. Monthly AUM, net asset value, and annual reported net expense ratio are from the Morningstar Direct database. Stock price, risk-free rate, and stock market index are from DataStream. Our study period starts from January 2000 to April 2015. We exclude international funds, funds of funds, index funds, trigger funds, bond funds, and money market funds. Our focus is domestic equity mutual funds, which is free from survivorship bias.

To classify bank-related funds and nonbank-related funds, we follow bank-related funds matching suggested by Hao and Yan (2012) and Berzins, Liu, and Trzcinka (2013). We categorize our sample by hands as follows. First, we collect the names of commercial banks in Thailand provided by Bankscope. Second, we match the name of the Asset Management Companies (AMCs) with the name of the bank in order to identify as the bank-related AMC. We simply claim that the mutual funds operated under the bank-related AMC are bank-related mutual funds. For the AMCs that the names do not match with the name of commercial banks, we manually classify by using information at the mutual fund's website. We check any statement that implicitly and explicitly show a relationship between the fund and bank.[18]

In sum, at the end of April 2015, the mutual fund industry in Thailand has 1,151 bank-related mutual funds and 350 nonbank-related mutual funds.[19] Of these 1,501 funds, there are 391 domestic equity funds. For our analyses we have 271 bank-related domestic equity funds and 120 nonbank-related domestic equity funds.

7. Methodology

[18] For example, the name of Bualuang AMC does not match with the bank name. However, the statements provided on the AMC's website show that it is an affiliated company of Bangkok bank. We, therefore, classify as a bank-related AMC.

[19] Name lists of commercial banks, bank-related domestic equity funds, and nonbank-related domestic equity funds are available upon request.

We start our analysis by applying the liquidity timing model suggested by Cao et al. (2013a). From a Taylor series expansion,[20] market beta is a linear relationship with the market liquidity timing ability as shown below.

$$\beta_{mp} = \beta_{0mp} + \gamma_{mt}(L_{mt} - \overline{L_m}) \quad (7)$$

where γ_{mt} is the systematic liquidity risk. L_{mt} is the market liquidity in month *t* and $\overline{L_m}$ is the rolling mean of the previous 60-month market liquidity.[21] In this study we employ each of the four different illiquidity measures as discussed earlier in order to investigate the efficacy of each measure in each model. Because of an important role of liquidity in asset pricing and portfolio management (Benson et al., 2015), we follow the liquidity timing ability model suggested by Cao et al. (2013) as follows.

$$r_{pt} = \alpha_p + \beta_{0mp} rm_t + \beta_{smb} SMB_t + \beta_{hml} HML_t + \beta_{mom} MOM_t + \gamma_{mt}(L_{mt} - \overline{L_m}) rm_t + \varepsilon_{pt} \quad (8)$$

where r_{pt} is the p^{th} portfolio return, and rm_t is the market portfolio return in excess of one-year government bond. *SMB*, *HML*, and *MOM* are the mimic portfolio returns that capture the different effects of size, value, and momentum, respectively. γ_{mt} measures the liquidity timing ability of the portfolio's fund managers. A positive γ_{mt} illustrates that fund managers have the ability to foresee market liquidity. Thus, they increase (decrease) the funds' exposure to the market during a high (low) market liquidity period. On the other hand, a negative γ_{mt} illustrates that fund managers wrongly forecast market liquidity. Thus, they increase (decrease) the funds' exposure to the market during a low (high) market liquidity period. ε is the error term.

In order to differentiate between liquidity timing ability and traditional market timing ability, we allow fund managers to time the market return as suggested by Treynor and Mazuy (1966). Further, we take an influential higher moment effect, which is essential in emerging

[20] Prior literature in market timing models suggests that market beta is a linear function of fund managers' expectations on market returns (Admati, Bhattacharya, Ross, and Pfleiderer, 1986, and Ferson and Schadt, 1996). Busses (1999) and Cao et al. (2013a and 2013b) further show the market beta as a linear function of volatility timing and excess liquidity timing.

[21] See further detail in Cao et al. (2013a,b).

markets as discussed earlier by incorporating the coskewness risk factor (CSK) in the model. Thus, our model of the liquidity timing ability in the higher moment framework is shown as below.

$$r_{pt} = \alpha_{pt} + \beta_{0mp} rm_t + \beta_{smb} SMB_t + \beta_{hml} HML_t + \beta_{mom} MOM_t + \beta_{csk} CSK_t + \beta_{mkt} r_{mt}^2 + \gamma_{mt}(L_{mt} - \overline{L_m}) rm_t + \varepsilon_{pt} \quad (9)$$

8. Empirical Results

8.1 Summary statistics

[Table 1]

[Table 2]

Table 1 presents the summaries of the basic statistics for the entire sample, bank-related mutual funds, and nonbank-related mutual funds, respectively. On average, the mutual funds show negative returns over the sample period. Nonbank-related (NBR) funds perform better than bank-related (BR) funds, though both have indifferent levels of risk. Bank-related funds possess largest assets under management. An average age on each fund type is approximately six years. Table 2 shows the summaries of the basic statistics of the factors used in this study. A monthly average return (-0.36%) of equity mutual funds portfolio is lower than the overall stock market return (0.63%). All basic risk factors (*SMB*, *HML,* and *MOM*) are all positive, potentially showing that size, value, and momentum anomalies are prevalent in the market. Coskewness risk factor is also positive. Further, all illiquidity measures, namely the Amihud, the AdjILLIQ, the Zero, and the Roll, are positive, which reflects a level of illiquidity in the market.

Panels A and B of Table 3 show the Pearson correlation between the returns of risk factors and between liquidity measures. In general, all risk factors are correlated in the same direction. However, the coskewness risk factor shows the weakest relationship, but it is statistically positively correlated to value anomalies. A multicollinearity problem among these factors is out of concern.[22] All illiquidity measures as presented in Panel B are positively correlated, showing consistent preliminary evidence on the efficacy of each estimation.

[Table 3]

8.2 Liquidity timing in mutual funds

We start our analysis by testing our liquidity timing ability model. Table 4 presents the liquidity timing ability of the mutual funds over the entire sample period. We present our models by using each of the illiquidity measures for comparisons. Overall, the results show strong evidence to support market liquidity timing ability in the mutual funds industry. All three illiquidity measures (the Amihud, the Adj-illiquidity, and the Roll's effective spread) illustrate a positive significant relationship with value-weighted mutual funds' portfolio excess returns, showing that mutual fund managers are able to time market-wide liquidity. Adjusted R^2 values for all models are very high (97% to 98%), showing the efficiency of the proposed model. Interestingly, incorporating liquidity timing factor eliminates abnormal returns. The alpha in each model is closed to zero. The size and the value premium trading strategies are prevalent, in general.[23] Additionally, it is interesting to note that the momentum is positive, but it is not significant for all models.

[Table 4]

Next, we categorize mutual fund portfolios into decides. Decile 1 represents the lowest fund performance and decile 10 represents the highest fund performance. We form each portfolio based on 12-month lag returns and rebalance on a monthly basis. The results on each illiquidity measure on the portfolio level are presented in Panels A (the Amihud), B (the Adj-illiquidity), C (the Zero), and D (the Roll's effective spread) of Table 5, respectively.

[Table 5]

[22] The VIF results are available upon request.
[23] However, the value premium is less statistically significant than the size effect. A possible explanation is that value stocks are partially explained by the size effect (Lambert and Hubner, 2014).

Overall, the market liquidity timing factor is priced at the portfolio level except for the zero measure. Low performing funds (deciles 1 to 3) have no market liquidity timing ability, showing statistically significant negative coefficients. Fund managers wrongly forecast market liquidity. They increase (decrease) the funds' exposure to the market during a low (high) market liquidity period. However, the remaining mutual fund portfolios show significantly positive market liquidity timing, suggesting that they successfully time the market by increasing (decreasing) market exposure during a high (low) market liquidity. R^2 values are still large (approximately 96%) in the middle deciles and are smaller for the uppermost and lowermost deciles. The liquidity timing ability seems to diminish the power of the size and value anomalies, in which most of them are statistically insignificant. We infer that mutual funds managers heavily rely on timing market-wide liquidity. However, the momentum effect plays a crucial roles at the portfolio level, especially for the uppermost and lowermost deciles. Low performing funds follow the momentum strategy and have no liquidity timing ability, subsequently generating significant negative abnormal returns. Oppositely, high performing funds uses contrarian strategy and have liquidity timing ability, generating significant positive abnormal returns. Monthly abnormal returns for mutual fund portfolios are approximately 2.98% to 4.69% for the best performing portfolio (decile 10) and -2.65% to -3.67% for the worst performing portfolio (decile 1).

For the zero illiquidity measure as shown in Panel C of Table 5, we find insignificant positive (negative) market liquidity timing coefficients in top (bottom) portfolios. Nevertheless, the abnormal returns are still significant, albeit smaller R^2 values than the other findings. It seems that the other trading strategies takes more roles in this case.

8.3 Liquidity timing in the higher moment framework

In this section we improve the model by incorporating a coskewness risk factor. Prior literature finds that coskewness considered as a non-diversifiable risk is priced (Harvey and Siddique (2000), Doan, Lin, and Zurbruegg (2010), Harvey et al. (2010), Kostakis, Muhammad, and Siganos (2012), Moreno and Rodríguez (2009), and Smith (2007)). They find a positive relationship between the coskewness risk factor and expected stock returns. To avoid the model misspecification, we add the market timing ability factor as suggested by Treynor and Mazuy (1966).

Under our higher moment framework, the coskewness risk factor (β_{CSK}) and market timing ability factor (β_{mkt}) are significantly priced in all liquidity models at an aggregate level as presented in Table 6. This confirms an important role of the higher moment in developing markets. In general, the results in the higher moment framework are consistent with our prior results as shown in Table 4. The market liquidity timing factor (γ_{mt}) is still positively significant for the three liquidity measures (the Amihud, Adj-illiquidity, and Roll's spread), confirming that mutual fund managers successfully forecast market liquidity in the higher moment environment. Consistent with Bekaert and Harvey (1997), we find that the market timing factor in all models is positively significant, promising that returns in emerging markets are predictable. In addition, the coskewness risk factor is negatively significant in all models, showing the important role of coskewness in emerging equity markets. The result is consistent with Moreno and Rodríguez (2009), who suggest that the coskewness influences an estimation of an average of mutual funds' alphas.[24] The average alphas in each model are insignificantly negative and close to zero, but the effect of coskewness is prominent. Moreover, fund managers show market timing ability in all liquidity measures. Thus, we conclude that our liquidity

[24] In addition, our evidence on negative coskewness risk factor is similar to Moreno and Rodríguez (2009). See their Tables 4, 5, and 7 for all funds (Panel A) and aggressive growth funds (Panel B) for comparison with our results.

timing model in the higher moment is more effective than the tradition CAPM, the three-factor model, and the four-factor model, respectively.

We further examine our results in portfolio levels as presented in Table 7. Overall, the liquidity timing ability factor is positively significant in good performing funds (deciles 5-10) and negatively significant in bad performing funds (deciles 1-4). In general, our results in the decile portfolios are consistent with the quintile portfolios of Moreno and Rodríguez (2009).[25] Interestingly, the alphas in low performing funds in the higher moment seem to improve, but they seem to decrease in high-performing funds. For example, comparing between Panel A of Tables 5 (without the higher moment) and 7 (with the higher moment), we find that the difference between alphas of the worst performing portfolio (decile 1) is 0.6% improvement, while that of best performing portfolio is 0.4% drop. This shows that poor performing funds earn benefits from the coskewness. Looking at the market timing factor, most of them are statistically significant,[26] with the exception of the Roll measure. Moreover, size effect seems to diminish in the portfolio levels, while the momentum effect seems to enhance. Adjusted-R^2 values in each model slightly increase compared with the previous results. In sum, we conclude that mutual fund managers are able to time the market liquidity under a higher moment framework.

[Table 6]

[Table 7]

8.3 Market liquidity timing ability: Bank-related mutual funds and nonbank-related mutual funds

[25] The Roll market liquidity timing are less significant than in case of the aggregate level as shown in Table 5 and the zero measure turns to be statistically significant at extreme levels.
[26] It is noted that the market timing variables for the zero measure are all statistically significant.

In this section we focus on the liquidity timing ability in the higher moment between two groups of mutal funds based on their relationship with a commercial bank. This line of research is mostly neglected in prior studies. Massa and Rehman (2008), Mehran and Stulz (2007), Hao and Yan (2012), and Berzins, Liu, and Trzcinka (2013) argue that bank-related funds have information advantage over nonbank-related funds. They can enhance their mutual fund performances by using the superior information obtained from their affiliated banks. The funds can potentially boot their performances by strategically investing in IPO stocks when their affiliated banks are underwriters (Ritter and Zhang 2007). In addition, bank-related funds have less liquidity constraint, because they are able to attract larger funds flow than nonbank-related funds.

[Table 8]

Panels A and B of Table 8 show the results for the bank-related mutual funds and nonbank-related mutual funds under a higher moment framework. Obviously, only bank-related mutual funds are able to time market-wide liquidity, supporting the information advantage hypothesis that bank-related funds have superior information than nonbank-related funds. However, all liquidity timing factors show positive for both groups, but the statistical significance is present only for the Amihud and the Adjusted illiquidity measures for the bank-related funds. Overall, both bank-related funds and nonbank-related funds have significant and negative alphas, but significant and positive market timing ability (β_{mkt}). Nonbank-related funds have lower negative alphas than bank-related funds. This is consistent with prior studies on the performance of bank-mutual fund relationship. A negative relationship between the fund performances and coskewness risk factor is present in both groups. Adjusted-R^2 is relatively higher for bank-related funds than nonbank-related funds.

9. Robustness check

[Table 9]

In this section we demean the liquidity factor by different numbers of lags for a robustness check. We employ 36, 39, 42, 45, 48, 51, 54, 57, and 60 lagged returns for the mean liquidity computation, respectively. For brevity, Table 9 shows the results of the liquidity timing model under a higher moment using 48 lagged months.[27] The results are consistent with prior findings. We conclude that the liquidity timing variable is not influenced by the number of lagged months.

10. Conclusion and summary

Recent studies show an important role of liquidity timing ability of mutual funds and returns in emerging stock markets are nonnormal. In this study we propose a new liquidity timing ability model of mutual funds in a higher moment framework. Our study contributes to prior literature at least fourfold. First, our proposed liquidity timing model allows for the coskewness risk factor, which is negligible in prior studies, especially in emerging markets. We show that the market-wide liquidity timing ability in the mutual fund industry exists not only in developed countries. To our knowledge, this is the first paper to provide such evidence outside the U.S. market. Our evidence suggests that mutual funds change their portfolios' exposure to the market according to the market liquidity. Second, we select four low-frequency illiquidity measures, namely the Amihud (2002), the adjusted-illiquidity, the zero return days, and the Roll (1984)'s effective spread, that are widely used in studies of emerging markets. The adjusted-illiquidity measure is the best for capturing the market illiquidity, while the zero return days measure is the worst in the sample.

Third, at portfolio levels, high performing funds show positive liquidity timing ability. They increase (decrease) the funds' exposure to the market during a high (low) market liquidity

[27] The results of the other lagged months are available upon request.

period. Alternatively, they time the market-wide liquidity. Oppositely, low performing funds wrongly forecast the market liquidity, showing negative market liquidity ability. Last, *only* bank-related mutual funds possess liquidity timing ability, supporting the information advantage hypothesis that bank-related funds utilize superior information obtained by their affiliated banks. Our results are robust, which is not sensitive to the number of lagged months used in the computation of the liquidity timing ability factor.

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Figure 1 Mutual fund industry in Thailand.

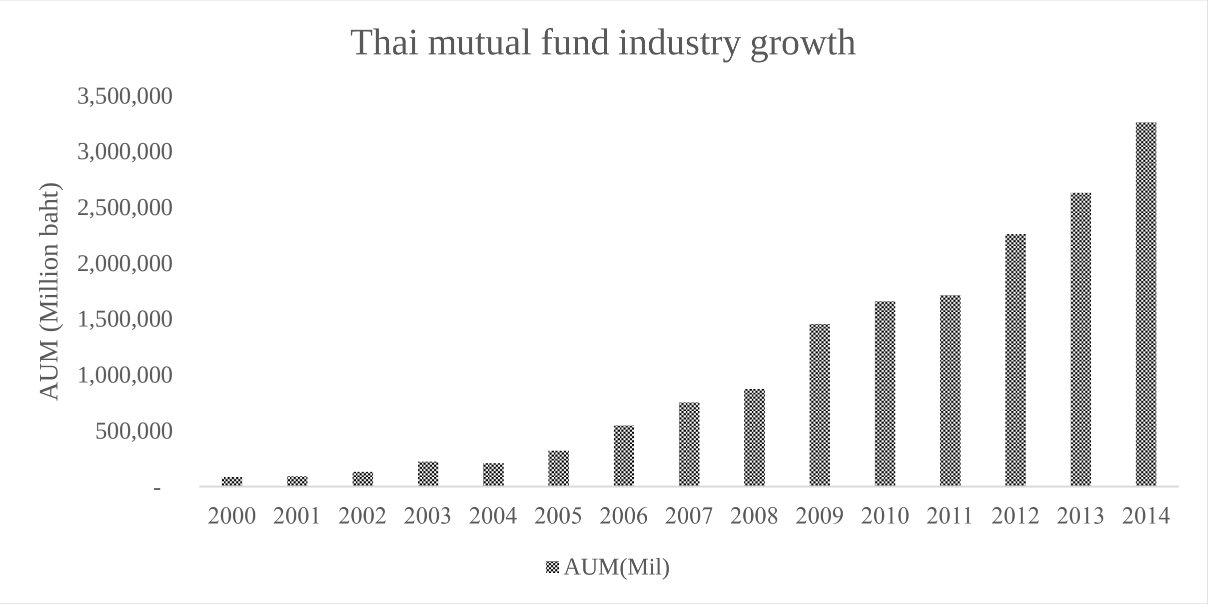

Figure 2 Household savings and investment in Thailand.

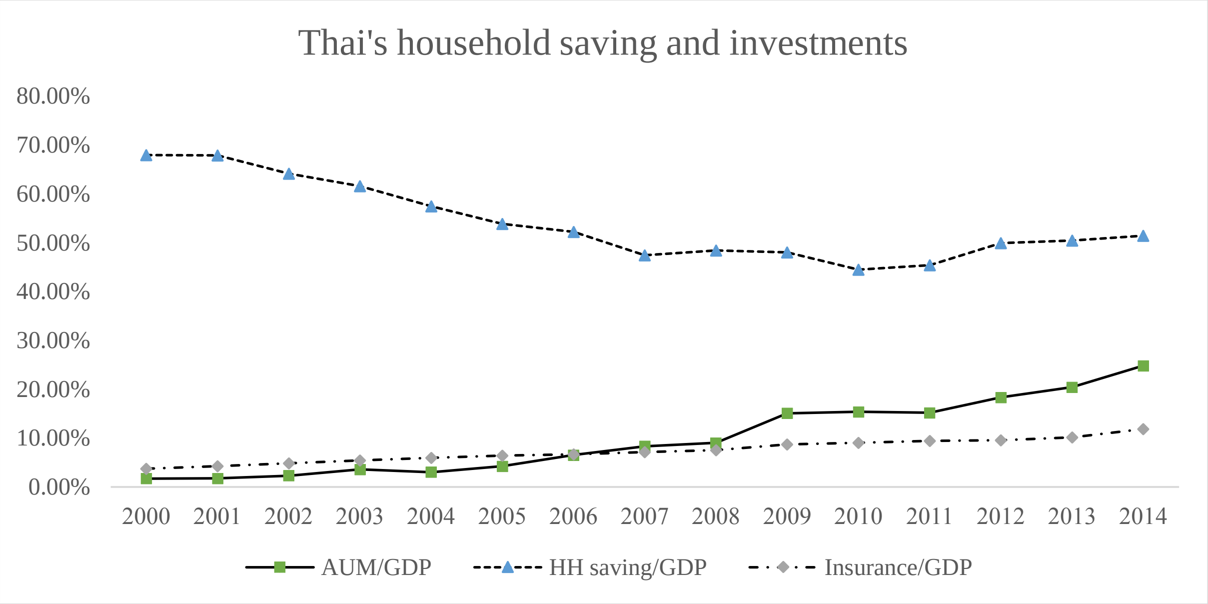

Figure 3 Personal investment in mutual funds.

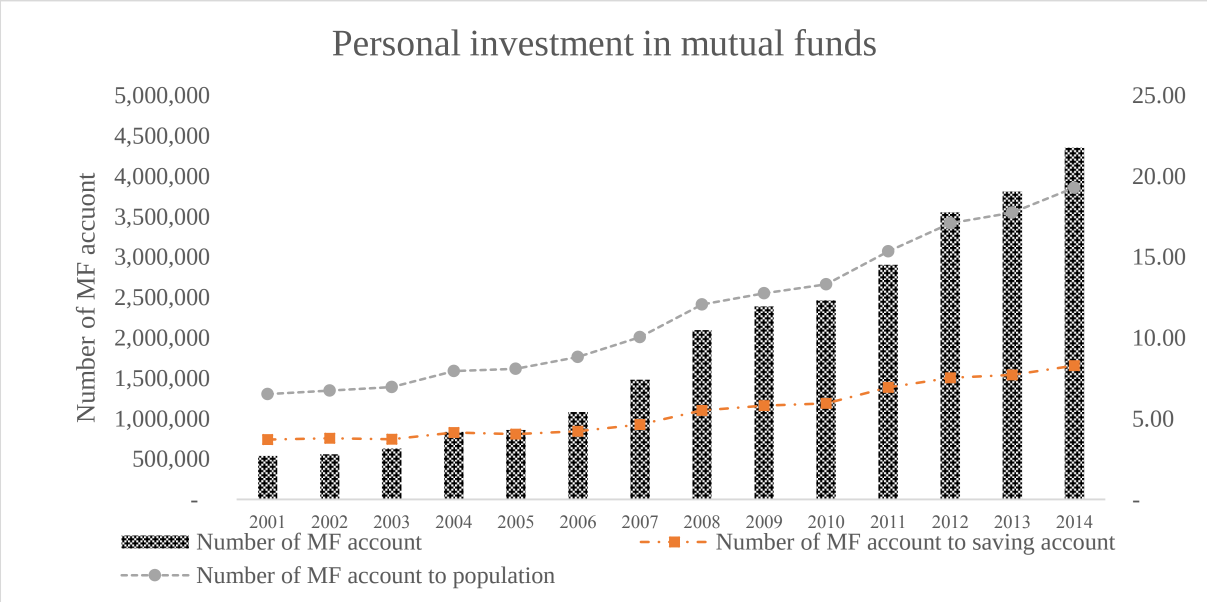

Table 1 Descriptive statistics.

This table provides a summary of descriptive statistics for mutual funds in this study. $\bar{R}$, Med (R), and σ are the arithmetic mean return, the median return, and the standard deviation, respectively. Age, $\overline{AUM}$, and $\overline{Fee}$ are the cross-sectional average fund age, the average of assets under management in Thai baht, and the fund annual net expense ratio, respectively. BR and NBR are bank-related mutual funds and nonbank-related mutual funds.

Sample	$\bar{R}$	Med (R)	σ	$\overline{AUM}$ (Baht)	$\overline{Fee}$	Age (Year)
Full	-0.003	-0.002	0.032	695,612,222	1.714	6.46
BR	-0.003	-0.002	0.026	842,094,118	1.760	6.36
NBR	-0.002	-0.000	0.025	399,249,016	1.626	6.68

Table 2 Risk factors and illiquidity measures

This table provides a summary of descriptive statistics for risk factors and illiquidity measures. Panel A shows the basic statistics for all risk factors used in the study. R_i and R_m are the average return of mutual funds and market return in excess of one-year government bond. σ is the standard deviation. *SMB*, *HML*, and *MOM* are the mimic portfolio returns accounting for the size, value, and momentum, respectively. *CSK* is the coskewness risk factor. Panel B shows the basic statistics for illiquidity measures, namely the Amihud illiquidity (*Amihud*), the adjusted-illiquidity (*AdjILLIQ*), the zero returns day (*Zero*), and the Roll's effective spread (*Roll*), respectively.

Panel A: Risk factors			
	Mean	Median	σ
R_i	-0.003	-0.002	0.032
R_m	0.006	0.013	0.070
SMB	0.005	0.005	0.103
HML	0.001	-0.002	0.129
MOM	0.060	0.058	0.011
CSK	0.002	0.000	0.032
Panel B: Illiquidity measures			
Amihud	0.833	0.481	1.047
AdjILLIQ	0.634	0.733	0.830
Zero	0.256	0.261	0.043
Roll	8.259	7.315	3.034

Table 3 Pearson correlation

This table shows the Pearson correlation. Panels A and B show the correlations between all risk factors and illiquidity measures employed in this study. The variables denotations are the same as in Table 2. The null hypothesis is $\rho = 0$. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Risk factors

	R_i	R_m	*SMB*	*HML*	*MOM*	*CSK*
R_i	1.000					
R_m	0.975***	1.000				
SMB	0.637***	0.561***	1.000			
HML	0.372***	0.351***	0.789***	1.000		
MOM	-0.050	-0.060	0.139**	0.150***	1.000	
CSK	-0.010	0.030	-0.031	0.143**	0.000	1.000

Panel B: Illiquidity measures

	Amihud	*AdjILLIQ*	*Zero*	*Roll*
Amihud	1.000			
AdjILLIQ	0.844***	1.000		
Zero	0.139***	0.300***	1.000	
Roll	0.300***	0.213***	0.146***	1.000

Table 4 Liquidity timing ability at an aggregate level.

This table demonstrates the liquidity timing ability model at an aggregate level using four major liquidity measures. The illiquidity measure in this study is the Amihud illiquidity (*Amihud*), the adjusted-illiquidity (*AdjILLIQ*), the zero returns day (*Zero*), and the Roll's effective spread (*Roll*), respectively. γ_{mt} is the estimated coefficient of liquidity timing ability. Adjusted R squared values (R^2) are in percentage. The other variables denotations are shown in Table 2. *p*-values obtained by Newey and West (1987) procedure are shown in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	γ_{mt}	R^2
Amihud	-0.001	0.680***	0.636***	-0.303**	0.062	0.028***	97.85
	(0.698)	(0.000)	(0.009)	(0.039)	(0.253)	(0.002)	
AdjILLIQ	-0.001	0.669***	0.698***	-0.309**	0.055	0.047***	97.88
	(0.757)	(0.000)	(0.004)	(0.034)	(0.322)	(0.000)	
Zero	0.001	0.680***	0.688***	-0.395**	0.009	-0.119	97.35
	(0.525)	(0.000)	(0.008)	(0.017)	(0.851)	(0.725)	
Roll	0.000	0.646***	0.434**	-0.218	0.0200	0.015***	98.08
	(0.770)	(0.000)	(0.042)	(0.106)	(0.676)	(0.000)	

Table 5 Liquidity timing ability at a portfolio level.

This table demonstrates the liquidity timing ability model at a value-weighted portfolio level using four major liquidity measures. We present our results in decile portfolios. The other variables denotations are shown in Table 4. *p*-values obtained by Newey and West (1987) procedure are shown in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Amihud illiquidity measure

Port.	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	γ_{mt}	R^2
1	-0.026**	0.462***	-0.021	0.204	0.328*	-0.125***	79.23
	(0.011)	(0.000)	(0.965)	(0.490)	(0.081)	(0.000)	
2	-0.022**	0.376***	0.003	0.123	0.338*	-0.161***	80.20
	(0.035)	(0.000)	(0.994)	(0.603)	(0.077)	(0.000)	
3	-0.016	0.528***	0.770*	-0.308	0.292*	-0.085***	86.26
	(0.107)	(0.000)	(0.064)	(0.1451)	(0.097)	(0.000)	
4	-0.013**	0.766***	0.840***	-0.372**	0.249**	0.008	96.10
	(0.035)	(0.000)	(0.006)	(0.024)	(0.020)	(0.527)	
5	-0.009*	0.828***	0.881***	-0.357*	0.214**	0.043***	96.37
	(0.067)	(0.000)	(0.001)	(0.051)	(0.022)	(0.001)	
6	-0.004	0.856***	0.908***	-0.421*	0.111	0.047***	96.12
	(0.485)	(0.000)	(0.003)	(0.061)	(0.273)	(0.000)	
7	0.006	0.830***	1.019**	-0.545	-0.035	0.044**	93.00
	(0.405)	(0.000)	(0.037)	(0.109)	(0.805)	(0.017)	
8	0.019*	0.787***	1.184**	-0.565	-0.240	0.080***	89.62
	(0.057)	(0.000)	(0.042)	(0.135)	(0.171)	(0.000)	
9	0.024**	0.686***	0.496	-0.401	-0.298	0.216***	81.42
	(0.047)	(0.000)	(0.448)	(0.231)	(0.158)	(0.000)	
10	0.029***	0.675***	0.309	-0.395	-0.336*	0.214***	80.52
	(0.008)	(0.000)	(0.638)	(0.327)	(0.099)	(0.000)	
10-1	0.0265**	0.462***	-0.0211	0.204	0.3282*	-0.1257***	79.23
	(0.0044)	(0.0133)	(0.7330)	(0.2858)	(0.0638)	(0.0000)	

Table 5 (Continued)

Panel B: Adjusted illiquidity measure

Port.	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	γ_{mt}	R^2
1	-0.026***	0.508***	-0.284	0.186	0.339**	-0.229***	81.77
	(0.005)	(0.000)	(0.568)	(0.524)	(0.040)	(0.000)	
2	-0.023**	0.439***	-0.346	0.134	0.365**	-0.280***	82.58
	(0.020)	(0.000)	(0.479)	(0.598)	(0.034)	(0.000)	
3	-0.016*	0.563***	0.581	-0.289	0.311*	-0.142***	86.48
	(0.081)	(0.000)	(0.158)	(0.193)	(0.059)	(0.000)	
4	-0.012**	0.762***	0.861***	-0.379**	0.245**	0.012	96.10
	(0.041)	(0.000)	(0.006)	(0.023)	(0.024)	(0.543)	
5	-0.009*	0.810***	0.978***	-0.368*	0.204**	0.072***	96.40
	(0.091)	(0.000)	(0.001)	(0.053)	(0.038)	(0.000)	
6	-0.003	0.837***	1.012***	-0.426*	0.102	0.081***	96.22
	(0.525)	(0.000)	(0.001)	(0.060)	(0.327)	(0.000)	
7	0.006	0.815***	1.108**	-0.527	-0.035	0.085***	93.34
	(0.422)	(0.000)	(0.015)	(0.107)	(0.803)	(0.000)	
8	0.019*	0.756***	1.355**	-0.566	-0.252	0.140***	90.09
	(0.053)	(0.000)	(0.015)	(0.132)	(0.142)	(0.000)	
9	0.025**	0.600***	0.966	-0.425	-0.338*	0.370***	84.38
	(0.032)	(0.000)	(0.114)	(0.208)	(0.081)	(0.000)	
10	0.031***	0.589***	0.780	-0.434	-0.382**	0.359***	82.34
	(0.003)	(0.000)	(0.203)	(0.271)	(0.037)	(0.000)	
10-1	0.057***	0.080	1.065	-0.621	-0.721**	0.589***	66.21
	(0.001)	(0.237)	(0.246)	(0.247)	(0.019)	(0.000)	

Table 5 (Continued)

Panel C: Zero

Port.	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	γ_{mt}	R^2
1	-0.036***	0.773***	-0.895	0.879*	0.483**	-1.206	70.04
	(0.002)	(0.000)	(0.291)	(0.083)	(0.025)	(0.227)	
2	-0.035***	0.718***	-1.000	0.943*	0.553**	-1.224	62.94
	(0.006)	(0.003)	(0.242)	(0.061)	(0.022)	(0.267)	
3	-0.020*	0.915***	-0.185	0.302	0.355*	-1.795***	83.02
	(0.053)	(0.000)	(0.675)	(0.328)	(0.059)	(0.006)	
4	-0.011*	0.835***	0.714***	-0.342**	0.215*	-0.422	96.12
	(0.096)	(0.000)	(0.007)	(0.043)	(0.064)	(0.280)	
5	-0.004	0.829***	0.960**	-0.499**	0.132	-0.189	95.57
	(0.339)	(0.000)	(0.017)	(0.045)	(0.133)	(0.668)	
6	0.000	0.808***	1.095**	-0.617**	0.035	0.065	95.21
	(0.923)	(0.000)	(0.010)	(0.027)	(0.713)	(0.890)	
7	0.011*	0.817***	1.128**	-0.701**	-0.114	-0.110	92.20
	(0.079)	(0.000)	(0.018)	(0.039)	(0.335)	(0.887)	
8	0.026***	0.657***	1.600**	-0.937**	-0.356**	0.388	86.74
	(0.001)	(0.000)	(0.017)	(0.030)	(0.015)	(0.671)	
9	0.041***	0.234	1.825	-1.491**	-0.587**	1.602	55.20
	(0.004)	(0.422)	(0.105)	(0.031)	(0.028)	(0.257)	
10	0.046***	0.210	1.662	-1.489**	-0.617**	1.688	54.09
	(0.004)	(0.407)	(0.120)	(0.033)	(0.041)	(0.179)	
10-1	0.082***	-0.563	2.557	-2.369**	-1.101**	2.894	10.33
	(0.001)	(0.200)	(0.146)	(0.031)	(0.023)	(0.165)	

Table 5 (Continued)

Panel D: Roll effective spread

Port.	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	γ_{mt}	R^2
1	-0.036***	0.592***	0.381	0.150	0.523***	-0.042***	74.94
	(0.000)	(0.000)	(0.506)	(0.641)	(0.009)	(0.000)	
2	-0.035***	0.547***	0.601	0.002	0.588**	-0.058***	73.90
	(0.004)	(0.000)	(0.306)	(0.992)	(0.011)	(0.000)	
3	-0.023**	0.617***	1.059**	-0.354	0.425**	-0.029***	84.37
	(0.019)	(0.000)	(0.023)	(0.120)	(0.015)	(0.000)	
4	-0.012**	0.752***	0.692***	-0.291*	0.237**	0.009**	96.26
	(0.048)	(0.000)	(0.006)	(0.061)	(0.033)	(0.023)	
5	-0.006	0.776***	0.578**	-0.232	0.149*	0.023***	96.68
	(0.171)	(0.000)	(0.013)	(0.179)	(0.073)	(0.000)	
6	-0.000	0.803***	0.671**	-0.345	0.038	0.020***	96.04
	(0.941)	(0.000)	(0.023)	(0.109)	(0.659)	(0.000)	
7	0.009	0.774***	0.632	-0.366	-0.100	0.027***	93.72
	(0.140)	(0.000)	(0.155)	(0.191)	(0.386)	(0.000)	
8	0.025***	0.695***	0.704	-0.385	-0.361***	0.038***	90.01
	(0.002)	(0.000)	(0.229)	(0.242)	(0.009)	(0.000)	
9	0.041***	0.453***	-0.397	-0.177	-0.631**	0.083***	74.09
	(0.002)	(0.000)	(0.619)	(0.664)	(0.010)	(0.000)	
10	0.046***	0.445***	-0.546	-0.191	-0.666**	0.081***	72.42
	(0.002)	(0.000)	(0.503)	(0.685)	(0.016)	(0.000)	
10-1	0.083***	-0.146**	-0.928	-0.341	-1.189***	0.123***	41.30
	(0.000)	(0.027)	(0.457)	(0.610)	(0.007)	(0.000)	

Table 6 Liquidity timing ability at an aggregate level in the higher moment framework.

This table demonstrates the liquidity timing ability model at an aggregate level in the higher moment framework using four major liquidity measures. *CSK* is a coskewness risk factor and β_{mkt} is the estimated coefficient of market timing ability. The other variables denotations are shown in Table 4. *p*-values obtained by Newey and West (1987) procedure are shown in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	α_{pt}	β_{beta}	β_{smb}	β_{hml}	β_{mom}	β_{csk}	β_{mkt}	γ_{mt}	R^2
Amihud	-0.002	0.716***	0.406**	-0.202	0.018	-0.091*	0.312***	0.011**	98.18
	(0.420)	(0.000)	(0.048)	(0.121)	(0.644)	(0.050)	(0.000)	(0.016)	
AdjILLIQ	-0.002	0.711***	0.436**	-0.209	0.015	-0.090*	0.308***	0.018**	98.17
	(0.467)	(0.000)	(0.032)	(0.108)	(0.711)	(0.054)	(0.000)	(0.022)	
Zero	-0.001	0.713***	0.391**	-0.215*	-0.003	-0.107**	0.387***	0.032	98.12
	(0.590)	(0.000)	(0.019)	(0.056)	(0.941)	(0.025)	(0.000)	(0.885)	
Roll	-0.001	0.694***	0.367*	-0.188	0.005	-0.092*	0.249**	0.006*	98.16
	(0.623)	(0.000)	(0.076)	(0.149)	(0.887)	(0.056)	(0.012)	(0.095)	

Table 7 Liquidity timing ability at a portfolio level in the higher moment framework.

This table demonstrates the liquidity timing ability model in the higher moment framework at a value-weighted portfolio level using four major liquidity measures. We present our results in decile portfolios. The other variables denotations are shown in Table 4. *p*-values obtained by Newey and West (1987) procedure are shown in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Amihud illiquidity measure

Port.	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	β_{csk}	β_{mkt}	γ_{mt}	R^2
1	-0.020*	0.402***	0.285	0.027	0.368*	0.279*	-0.353	-0.106***	79.52
	(0.067)	(0.000)	(0.565)	(0.921)	(0.055)	(0.081)	(0.104)	(0.000)	
2	-0.016	0.315***	0.314	-0.058	0.377*	0.294**	-0.354	-0.142***	80.60
	(0.138)	(0.000)	(0.492)	(0.789)	(0.052)	(0.030)	(0.135)	(0.000)	
3	-0.018*	0.539***	0.734*	-0.272	0.293*	-0.087	0.021	-0.087***	86.06
	(0.063)	(0.000)	(0.068)	(0.174)	(0.094)	(0.524)	(0.889)	(0.000)	
4	-0.013**	0.810***	0.559**	-0.251*	0.195**	-0.100	0.384***	-0.011	96.43
	(0.020)	(0.000)	(0.035)	(0.096)	(0.0422)	(0.241)	(0.000)	(0.351)	
5	-0.011**	0.877***	0.581**	-0.219	0.160**	-0.142	0.397***	0.022**	96.71
	(0.015)	(0.000)	(0.012)	(0.180)	(0.023)	(0.103)	(0.000)	(0.043)	
6	-0.005	0.901***	0.636**	-0.295	0.063	-0.133*	0.357***	0.028***	96.36
	(0.201)	(0.000)	(0.022)	(0.135)	(0.457)	(0.097)	(0.000)	(0.000)	
7	0.005	0.900***	0.574	-0.352	-0.120	-0.165	0.606***	0.012	93.75
	(0.425)	(0.000)	(0.174)	(0.237)	(0.303)	(0.180)	(0.000)	(0.443)	
8	0.014	0.877***	0.654	-0.308	-0.329**	-0.299**	0.682***	0.043*	90.75
	(0.117)	(0.000)	(0.187)	(0.343)	(0.034)	(0.019)	(0.001)	(0.050)	
9	0.019*	0.782***	-0.081	-0.127	-0.398*	-0.304**	0.753***	0.176***	83.11
	(0.096)	(0.000)	(0.897)	(0.685)	(0.054)	(0.038)	(0.001)	(0.000)	
10	0.025**	0.755***	-0.163	-0.167	-0.417**	-0.261*	0.612***	0.181***	81.58
	(0.018)	(0.000)	(0.809)	(0.668)	(0.021)	(0.072)	(0.006)	(0.000)	
10-1	0.046**	0.304***	1.000	-0.338	-0.785**	-0.540**	0.966**	0.287***	61.35
	(0.017)	(0.000)	(0.655)	(0.712)	(0.016)	(0.037)	(0.014)	(0.000)	

Panel B: Adjusted-illiquidity measure

Port.	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	β_{csk}	β_{mkt}	γ_{mt}	R^2
1	-0.020**	0.473***	-0.140	0.083	0.343*	0.225	-0.108	-0.217***	81.66
	(0.047)	(0.000)	(0.754)	(0.762)	(0.057)	(0.108)	(0.608)	(0.000)	
2	-0.017	0.400***	-0.177	0.019	0.372**	0.246*	-0.132	-0.266***	82.56
	(0.111)	(0.000)	(0.649)	(0.933)	(0.043)	(0.069)	(0.616)	(0.000)	
3	-0.019*	0.587***	0.458	-0.224	0.299*	-0.108	0.121	-0.154***	86.32
	(0.052)	(0.000)	(0.179)	(0.259)	(0.085)	(0.442)	(0.483)	(0.000)	
4	-0.013**	0.819***	0.503**	-0.246	0.188*	-0.110	0.425***	-0.026	96.47
	(0.022)	(0.000)	(0.047)	(0.102)	(0.054)	(0.196)	(0.000)	(0.117)	
5	-0.011**	0.867***	0.639**	-0.232	0.154**	-0.141	0.389***	0.035**	96.69
	(0.022)	(0.000)	(0.010)	(0.167)	(0.039)	(0.113)	(0.000)	(0.036)	
6	-0.005	0.884***	0.728***	-0.310	0.062	-0.126	0.322***	0.051***	96.39
	(0.237)	(0.000)	(0.008)	(0.114)	(0.495)	(0.125)	(0.001)	(0.000)	
7	0.004	0.887***	0.658	-0.358	-0.105	-0.148	0.530***	0.036	93.84
	(0.458)	(0.000)	(0.102)	(0.222)	(0.365)	(0.218)	(0.000)	(0.166)	
8	0.014	0.851***	0.809*	-0.331	-0.326**	-0.284**	0.608***	0.083**	90.90
	(0.115)	(0.000)	(0.085)	(0.305)	(0.034)	(0.026)	(0.006)	(0.025)	
9	0.020*	0.681***	0.505	-0.223	-0.399**	-0.253*	0.508*	0.322***	85.00
	(0.075)	(0.000)	(0.336)	(0.458)	(0.046)	(0.068)	(0.067)	(0.000)	
10	0.027**	0.655***	0.407	-0.267	-0.43**	-0.219	0.406*	0.320***	82.65
	(0.011)	(0.000)	(0.489)	(0.484)	(0.011)	(0.128)	(0.085)	(0.000)	
10-1	0.048***	0.685	1.000	-0.338	-0.773**	-0.444*	0.261	0.538***	66.61
	(0.008)	(0.024)	(0.522)	(0.488)	(0.010)	(0.050)	(0.203)	(0.000)	

Panel C: Zero

Port.	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	β_{csk}	β_{mkt}	γ_{mt}	R^2
1	-0.024*	0.670***	-0.035	0.347	0.517**	0.367*	-1.080***	-1.600*	75.80
	(0.058)	(0.001)	(0.956)	(0.390)	(0.021)	(0.068)	(0.000)	(0.078)	
2	-0.022	0.595***	0.037	0.303	0.595**	0.431**	-1.312***	-1.709*	72.48
	(0.117)	(0.008)	(0.939)	(0.363)	(0.023)	(0.034)	(0.000)	(0.081)	
3	-0.021*	0.905***	0.186	0.115	0.385**	-0.051	-0.609***	-2.130***	84.68
	(0.050)	(0.000)	(0.566)	(0.631)	(0.045)	(0.729)	(0.002)	(0.000)	
4	-0.014**	0.863***	0.476**	-0.196	0.205*	-0.097	0.301***	-0.310	96.42
	(0.024)	(0.000)	(0.026)	(0.168)	(0.054)	(0.250)	(0.000)	(0.326)	
5	-0.010**	0.880***	0.533**	-0.236	0.115	-0.176**	0.540***	0.010	96.56
	(0.031)	(0.000)	(0.031)	(0.155)	(0.123)	(0.041)	(0.000)	(0.974)	
6	-0.004	0.857***	0.668**	-0.357*	0.017	-0.164**	0.548***	0.275	96.16
	(0.303)	(0.000)	(0.028)	(0.089)	(0.833)	(0.041)	(0.000)	(0.455)	
7	0.005	0.872***	0.604*	-0.386	-0.138	-0.176	0.690***	0.166	93.72
	(0.358)	(0.000)	(0.060)	(0.141)	(0.182)	(0.134)	(0.000)	(0.770)	
8	0.016*	0.751***	0.817**	-0.453	-0.38***	-0.332**	0.985***	0.748	90.33
	(0.069)	(0.000)	(0.046)	(0.124)	(0.003)	(0.012)	(0.000)	(0.263)	
9	0.026	0.384	0.360	-0.619*	-0.656**	-0.462**	1.951***	2.40**	73.00
	(0.113)	(0.116)	(0.492)	(0.099)	(0.036)	(0.045)	(0.000)	(0.032)	
10	0.033*	0.349*	0.283	-0.670	-0.683**	-0.424*	1.844***	2.449**	70.46
	(0.070)	(0.089)	(0.585)	(0.105)	(0.042)	(0.060)	(0.000)	(0.013)	
10-1	0.057**	0.663	1.000	-1.018	-1.201**	-0.791**	2.925***	4.049**	41.05
	(0.047)	(0.393)	(0.735)	(0.130)	(0.022)	(0.043)	(0.000)	(0.017)	

Panel D: Roll effective spread

Port.	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	β_{csk}	β_{mkt}	γ_{mt}	R^2
1	-0.027**	0.473***	0.569	0.020	0.541**	0.376*	-0.514	-0.024	75.32
	(0.035)	(0.000)	(0.316)	(0.947)	(0.011)	(0.055)	(0.434)	(0.314)	
2	-0.025*	0.481***	0.729	-0.131	0.579***	0.375**	-0.171	-0.052*	74.04
	(0.052)	(0.000)	(0.195)	(0.602)	(0.008)	(0.021)	(0.834)	(0.097)	
3	-0.024**	0.663***	1.000**	-0.338	0.407**	-0.053	0.261	-0.038*	84.22
	(0.016)	(0.000)	(0.032)	(0.117)	(0.017)	(0.685)	(0.596)	(0.057)	
4	-0.014**	0.828***	0.594**	-0.261*	0.209**	-0.097	0.425**	-0.005	96.41
	(0.018)	(0.000)	(0.024)	(0.082)	(0.032)	(0.270)	(0.029)	(0.514)	
5	-0.01**	0.826***	0.502**	-0.185	0.139*	-0.138	0.228	0.015**	96.71
	(0.043)	(0.000)	(0.024)	(0.253)	(0.061)	(0.107)	(0.131)	(0.015)	
6	-0.004	0.882***	0.560*	-0.293	0.016	-0.160*	0.402**	0.006	96.17
	(0.363)	(0.000)	(0.053)	(0.147)	(0.837)	(0.056)	(0.043)	(0.373)	
7	0.006	0.853***	0.522	-0.317	-0.123	-0.150	0.410	0.013	93.82
	(0.319)	(0.000)	(0.222)	(0.251)	(0.284)	(0.178)	(0.242)	(0.353)	
8	0.017**	0.817***	0.5223	-0.277	-0.387***	-0.318**	0.576	0.018	90.40
	(0.046)	(0.000)	(0.326)	(0.378)	(0.005)	(0.013)	(0.209)	(0.323)	
9	0.030**	0.578***	-0.595	-0.0377	-0.649***	-0.406**	0.532	0.064*	74.51
	(0.035)	(0.000)	(0.439)	(0.926)	(0.007)	(0.040)	(0.574)	(0.069)	
10	0.037**	0.534***	-0.697	-0.066	-0.670***	-0.359*	0.328	0.069**	72.50
	(0.018)	(0.001)	(0.392)	(0.888)	(0.007)	(0.058)	(0.718)	(0.036)	
10-1	0.064**	0.663	1.000	-0.338	-1.212***	-0.736**	0.261	0.094*	42.24
	(0.016)	(0.824)	(0.306)	(0.895)	(0.004)	(0.039)	(0.584)	(0.091)	

Table 8 Liquidity timing ability: Bank-related mutual funds and nonbank-related mutual funds.

This table demonstrates the liquidity timing ability model in the view of the bank-mutual fund relationship. The model is tested at an aggregate level using four major liquidity measures. The other variables denotations are shown in Table 6. *p*-values obtained by Newey and West (1987) procedure are shown in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Bank-related mutual funds

	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	β_{csk}	β_{mkt}	γ_{mt}	R^2
Amihud	-0.015***	0.702***	0.462**	-0.247**	0.035	-0.206***	0.280***	0.010***	98.06
	(0.000)	(0.000)	(0.011)	(0.043)	(0.375)	(0.000)	(0.000)	(0.007)	
AdjILLIQ	-0.015***	0.696***	0.496***	-0.253**	0.035	-0.203***	0.267***	0.018***	98.07
	(0.000)	(0.000)	(0.006)	(0.037)	(0.392)	(0.000)	(0.000)	(0.009)	
Zero	-0.014***	0.706***	0.435***	-0.253**	0.014	-0.222***	0.346***	-0.011	98.01
	(0.000)	(0.000)	(0.006)	(0.022)	(0.743)	(0.000)	(0.000)	(0.953)	
Roll	-0.014***	0.684***	0.429**	-0.237*	0.023	-0.208***	0.234**	0.005	98.04
	(0.000)	(0.000)	(0.021)	(0.052)	(0.549)	(0.000)	(0.016)	(0.160)	

Panel B: Nonbank-related mutual funds

	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	β_{csk}	β_{mkt}	γ_{mt}	R^2
Amihud	-0.011***	0.763***	0.254	-0.096	-0.010	-0.143***	0.382***	0.009	97.73
	(0.001)	(0.000)	(0.348)	(0.563)	(0.837)	(0.006)	(0.000)	(0.210)	
AdjILLIQ	-0.011***	0.760***	0.265	-0.102	-0.018	-0.146***	0.397***	0.010	97.71
	(0.001)	(0.000)	(0.323)	(0.539)	(0.736)	(0.006)	(0.000)	(0.362)	
Zero	-0.010***	0.752***	0.256	-0.113	-0.027	-0.154***	0.444***	0.068	97.69
	(0.003)	(0.000)	(0.231)	(0.414)	(0.655)	(0.003)	(0.000)	(0.802)	
Roll	-0.010***	0.741***	0.220	-0.081	-0.019	-0.141***	0.309**	0.006	97.73
	(0.003)	(0.000)	(0.416)	(0.625)	(0.726)	(0.009)	(0.010)	(0.192)	

Table 9 Robustness.

This table provide a robustness check for the results. We employ the 48-month lag for the liquidity timing ability factor. The other variables denotations are in Table 6. *p*-values obtained by Newey and West (1987) procedure are shown in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Amihud illiquidity measure

Port.	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	β_{csk}	β_{mkt}	γ_{mt}	R^2
1	-0.020*	0.420***	0.285	0.027	0.368*	0.279*	-0.353	-0.106***	79.52
	(0.067)	(0.000)	(0.565)	(0.921)	(0.055)	(0.081)	(0.104)	(0.000)	
2	-0.016	0.339***	0.314	-0.058	0.377*	0.294**	-0.354	-0.142***	80.60
	(0.138)	(0.000)	(0.492)	(0.789)	(0.052)	(0.030)	(0.135)	(0.000)	
3	-0.018*	0.553***	0.734*	-0.272	0.293*	-0.087	0.021	-0.087***	86.06
	(0.063)	(0.000)	(0.068)	(0.174)	(0.094)	(0.524)	(0.889)	(0.000)	
4	-0.013**	0.812***	0.559**	-0.251*	0.195**	-0.100	0.384***	-0.011	96.43
	(0.020)	(0.000)	(0.035)	(0.096)	(0.042)	(0.241)	(0.000)	(0.351)	
5	-0.011**	0.873***	0.581**	-0.219	0.160**	-0.142	0.397***	0.022**	96.71
	(0.015)	(0.000)	(0.012)	(0.180)	(0.023)	(0.103)	(0.000)	(0.043)	
6	-0.005	0.896***	0.636**	-0.295	0.063	-0.133*	0.357***	0.028***	96.36
	(0.201)	(0.000)	(0.022)	(0.135)	(0.457)	(0.097)	(0.000)	(0.000)	
7	0.005	0.898***	0.574	-0.352	-0.120	-0.165	0.606***	0.012	93.75
	(0.425)	(0.000)	(0.174)	(0.237)	(0.303)	(0.180)	(0.000)	(0.443)	
8	0.014	0.870***	0.654	-0.308	-0.329**	-0.299**	0.682***	0.043*	90.75
	(0.117)	(0.000)	(0.187)	(0.343)	(0.034)	(0.019)	(0.001)	(0.050)	
9	0.019*	0.753***	-0.081	-0.127	-0.398*	-0.304**	0.753***	0.176***	83.11
	(0.096)	(0.000)	(0.897)	(0.685)	(0.054)	(0.038)	(0.001)	(0.000)	
10	0.025**	0.724***	-0.163	-0.167	-0.417**	-0.261*	0.612***	0.181***	81.58
	(0.018)	(0.000)	(0.809)	(0.668)	(0.021)	(0.072)	(0.006)	(0.000)	
10-1	0.046**	0.304***	1.000	-0.338	-0.785**	-0.540**	0.966**	0.287***	61.35
	(0.008)	(0.271)	(0.522)	(0.488)	(0.010)	(0.050)	(0.203)	(0.000)	

Panel B: Adjusted illiquidity measure

Port.	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	β_{csk}	β_{mkt}	γ_{mt}	R^2
1	-0.020**	0.511***	-0.140	0.083	0.343*	0.225	-0.108	-0.217***	81.66
	(0.047)	(0.000)	(0.754)	(0.762)	(0.057)	(0.108)	(0.608)	(0.000)	
2	-0.017	0.445***	-0.177	0.019	0.372**	0.246*	-0.132	-0.266***	82.56
	(0.111)	(0.000)	(0.643)	(0.933)	(0.043)	(0.069)	(0.616)	(0.000)	
3	-0.019*	0.613***	0.458	-0.224	0.299*	-0.108	0.121	-0.154***	86.32
	(0.052)	(0.000)	(0.179)	(0.259)	(0.085)	(0.442)	(0.483)	(0.000)	
4	-0.013**	0.823***	0.503**	-0.246	0.188*	-0.110	0.425***	-0.026	96.47
	(0.022)	(0.000)	(0.047)	(0.102)	(0.054)	(0.196)	(0.000)	(0.117)	
5	-0.011**	0.860***	0.639**	-0.232	0.154**	-0.141	0.389***	0.035**	96.69
	(0.022)	(0.000)	(0.010)	(0.167)	(0.039)	(0.113)	(0.000)	(0.036)	
6	-0.005	0.876***	0.728***	-0.310	0.062	-0.126	0.322***	0.051***	96.39
	(0.237)	(0.000)	(0.008)	(0.114)	(0.495)	(0.125)	(0.001)	(0.000)	
7	0.004	0.880***	0.658	-0.358	-0.105	-0.148	0.530***	0.036	93.84
	(0.458)	(0.000)	(0.102)	(0.222)	(0.365)	(0.218)	(0.000)	(0.166)	
8	0.014	0.836***	0.809*	-0.331	-0.326**	-0.284**	0.608***	0.083**	90.90
	(0.115)	(0.000)	(0.085)	(0.305)	(0.034)	(0.026)	(0.006)	(0.025)	
9	0.020*	0.626***	0.505	-0.223	-0.399**	-0.253*	0.508*	0.322***	85.00
	(0.075)	(0.000)	(0.336)	(0.458)	(0.046)	(0.068)	(0.067)	(0.000)	
10	0.027**	0.600***	0.407	-0.267	-0.43**	-0.219	0.406*	0.320***	82.65
	(0.011)	(0.000)	(0.489)	(0.484)	(0.011)	(0.128)	(0.085)	(0.000)	
10-1	0.048***	0.685	1.000	-0.338	-0.773**	-0.444*	0.261	0.538***	66.61
	(0.008)	(0.271)	(0.522)	(0.488)	(0.010)	(0.050)	(0.203)	(0.000)	

Panel C: Zero

Port.	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	β_{csk}	β_{mkt}	γ_{mt}	R^2
1	-0.024*	0.667***	-0.035	0.347	0.517**	0.367*	-1.080***	-1.600*	75.80
	(0.058)	(0.001)	(0.956)	(0.390)	(0.021)	(0.068)	(0.000)	(0.078)	
2	-0.022	0.592***	0.0376	0.303	0.595**	0.431**	-1.312***	-1.709*	72.48
	(0.117)	(0.008)	(0.939)	(0.363)	(0.023)	(0.034)	(0.000)	(0.081)	
3	-0.021*	0.901***	0.186	0.115	0.385**	-0.051	-0.609***	-2.130***	84.68
	(0.050)	(0.000)	(0.566)	(0.631)	(0.045)	(0.729)	(0.002)	(0.000)	
4	-0.014**	0.863***	0.476**	-0.196	0.205*	-0.097	0.301***	-0.310	96.42
	(0.024)	(0.000)	(0.026)	(0.168)	(0.054)	(0.250)	(0.000)	(0.326)	
5	-0.010**	0.880***	0.533**	-0.236	0.115	-0.176**	0.540***	0.010	96.56
	(0.031)	(0.000)	(0.031)	(0.155)	(0.123)	(0.041)	(0.000)	(0.974)	
6	-0.004	0.857***	0.668**	-0.357*	0.017	-0.164**	0.548***	0.275	96.16
	(0.303)	(0.000)	(0.028)	(0.089)	(0.833)	(0.041)	(0.000)	(0.455)	
7	0.005	0.872***	0.604*	-0.386	-0.138	-0.176	0.690***	0.166	93.72
	(0.358)	(0.000)	(0.060)	(0.141)	(0.182)	(0.134)	(0.000)	(0.770)	
8	0.016*	0.752***	0.817**	-0.453	-0.387***	-0.332**	0.985***	0.748	90.33
	(0.069)	(0.000)	(0.046)	(0.124)	(0.003)	(0.012)	(0.000)	(0.263)	
9	0.026	0.388	0.360	-0.619*	-0.656**	-0.462**	1.951***	2.40**	73.00
	(0.113)	(0.110)	(0.492)	(0.099)	(0.036)	(0.045)	(0.000)	(0.032)	
10	0.033*	0.353*	0.283	-0.670	-0.683**	-0.424*	1.844***	2.449**	70.40
	(0.070)	(0.083)	(0.585)	(0.105)	(0.042)	(0.060)	(0.000)	(0.013)	
10-1	-0.024*	0.667***	-0.035	0.347	0.517**	0.367*	-1.080***	-1.600*	75.80
	(0.047)	(0.400)	(0.735)	(0.130)	(0.022)	(0.043)	(0.000)	(0.017)	

Panel D: Roll effective spread

Port.	α_{pt}	β_{0mp}	β_{smb}	β_{hml}	β_{mom}	β_{csk}	β_{mkt}	γ_{mt}	R^2
1	-0.027**	0.486***	0.569	0.020	0.541**	0.376*	-0.514	-0.024	75.32
	(0.035)	(0.000)	(0.316)	(0.947)	(0.011)	(0.055)	(0.434)	(0.314)	
2	-0.025*	0.510***	0.729	-0.131	0.579***	0.375**	-0.171	-0.052*	74.04
	(0.052)	(0.001)	(0.195)	(0.602)	(0.008)	(0.021)	(0.834)	(0.097)	
3	-0.024**	0.685***	1.000**	-0.338	0.407**	-0.053	0.261	-0.038*	84.22
	(0.016)	(0.000)	(0.032)	(0.117)	(0.017)	(0.685)	(0.596)	(0.057)	
4	-0.014**	0.831***	0.594**	-0.261*	0.209**	-0.097	0.425**	-0.005	96.41
	(0.018)	(0.000)	(0.024)	(0.082)	(0.032)	(0.270)	(0.029)	(0.514)	
5	-0.01**	0.817***	0.502**	-0.185	0.139*	-0.138	0.228	0.015**	96.71
	(0.043)	(0.000)	(0.024)	(0.253)	(0.061)	(0.107)	(0.131)	(0.015)	
6	-0.004	0.878***	0.560*	-0.293	0.016	-0.160*	0.402**	0.006	96.17
	(0.363)	(0.000)	(0.053)	(0.147)	(0.837)	(0.056)	(0.043)	(0.373)	
7	0.006	0.846***	0.522	-0.317	-0.123	-0.150	0.410	0.013	93.82
	(0.319)	(0.000)	(0.222)	(0.251)	(0.284)	(0.178)	(0.242)	(0.353)	
8	0.017**	0.800***	0.522	-0.277	-0.387***	-0.318**	0.576	0.018	90.40
	(0.046)	(0.000)	(0.326)	(0.378)	(0.005)	(0.013)	(0.209)	(0.323)	
9	0.030**	0.542***	-0.595	-0.037	-0.649***	-0.406**	0.532	0.064*	74.51
	(0.035)	(0.003)	(0.439)	(0.926)	(0.007)	(0.040)	(0.574)	(0.069)	
10	0.037**	0.496***	-0.697	-0.066	-0.670***	-0.359*	0.328	0.069**	72.50
	(0.018)	(0.006)	(0.392)	(0.888)	(0.007)	(0.058)	(0.718)	(0.036)	
10-1	-0.027**	0.486***	0.569	0.020	0.541**	0.376*	-0.514	-0.024	75.32
	(0.016)	(0.974)	(0.306)	(0.895)	(0.004)	(0.039)	(0.584)	(0.091)	