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Liquidity and Skewness Risk in Stock Market: Does Measurement of Liquidity Matter?

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Abstract

Purpose: This study aims to explore the relationship between stock liquidity and skewness risk—tail risk (stock price crash risk) in an emerging market, in which problems on liquidity are more severe than in developed markets. **Research design, data, and methodology**: Based on the Thai market stock exchange over the period of 2000 to 2019, our sample include 13,462 firm-period observations. We employ a panel regression models regarding to five liquidity measures. These five liquidity measures cover three dimensions of liquidity namely the volume-based, price-based, and transaction cost-based measures for the liquidity-tail risk relationship. **Results**: We find a positively significant relationship between stock liquidity and tail risk in all cases. The finding here shows that the higher the stock liquidity, the larger the tail risk is. **Conclusion**: As the prior studies show inconclusive effect of stock liquidity on stock price crash risk, we demonstrate that mixed results found in prior studies are probably driven from the type of liquidity measure. The stock liquidity-tail risk association is present in the Stock Exchange of Thailand. The results remain the same regardless of the definition of tail risk and liquidity factors. An endogeneity issue is addressed by employing the two-stage least squares regression.

Keywords : Stock Price Crash Risk, Liquidity Measure, Emerging Market, Non-Normal Distribution, Skewness Risk, Tail Risk

JEL Classification Code: G01, G10, G11

1. Introduction

Even though the relationship between stock volatility and liquidity are widely documented (Bali et al., 2014; Chung & Chuwonganant, 2018), it is not true for the relationship between stock liquidity and tail risk (hence, stock price crash risk). The results of stock liquidity-tail risk relationship in developed markets remain inconclusive, depending on measurement of stock liquidity. Thus, we question that mixed findings are potentially driven by different liquidity measures. Moreover, studies of the relationship in emerging markets are scant, where stocks are less frequently traded than in developed market. Thus, we scrutinize the role of stock liquidity on crash risk in an emerging market (hence, Thailand) for the following reasons. First, an agency problem between managers and shareholders seems to be worse in emerging markets than advanced markets that allows managers in emerging

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markets to hoard bad news easier (Bédard et al., 2004; Larcker et al., 2007; Xie et al., 2003). Based on prior study, stock returns in Thailand clearly are skewed (Wattanatorn & Nathaphan, 2022; Wattanatorn & Padungsaksawasdi, 2022). Second, liquidity is found to be an important role in stock returns particularly in the Thai market (Wattanatorn et al., 2020; Wattanatorn & Tansupswatdikul, 2019). To fill the gap in prior literature, the objective of this paper is to investigate the liquidity-tail risk (crash risk) relationship in the Thai equity market by employing several types of liquidity measures.

We contribute to prior literature by examining the relationship between stock liquidity and crash risk based on five illiquidity measures covering three aspects (volume-, price-, and transaction-based) and employing Thailand as the sample setting for a representative of emerging markets. We find consistent results for the positive stock liquidity-crash risk association, which is insensitive to types of liquidity and crash risk measures. Among these five measures, the zero-return liquidity measure shows the strongest, while the Lui's liquidity measure shows the weakest relationship. Instrumental-variable regressions alleviate endogeneity concern, confirming that our results are robust.

2. Literature Review

2.1. Stock Price Crash Risk Measure

Stock price crash risk is a dramatic decline in stock prices, causing negative return skewness. A plummet decline in stock prices is due to asymmetric information between manager and outside shareholder. Managers have an incentive to delay any bad information of the firm. One important reason is that managers try to withhold this bad news because of their job security (Jin and Myers, 2006; Kothari et al., 2009). Ultimately, an accumulation of bad news has reached to the limit, the firm subsequently makes a public announcement. Thus, a crash in stock prices is inevitable (Chang et al., 2017; Habib et al., 2018). Prior literature in stock price crash risk is widely studied in developed markets (Chen et al., 2001; Jin and Myer, 2006; Hutton et al., 2009; Kim et al., 2011; Francis et al., 2016; Kim et al., 2014; Cohen et al., 2014). Only few studies provide evidence in emerging markets (Vo, 2020; Huang et al., 2021; Wattanatorn and Padungsaksawasdi, 2022). In addition, none deeply focuses on the role of stock liquidity in emerging markets despite an important role of liquidity. Therefore, this study aims to explore the impact of stock liquidity by employing several measurement of stock liquidity. Therefore, this study fills this gap.

3. Research Methods

3.1. Data

All data are from Refinitiv Eikon, excepting for one-month T-bill from the Thai Bond Market Association. The sample period starts from February 2001 to December 2019. After removing insufficient and winsorizing data at the 1% of both tails, the final sample consists of 602 firms, yielding 13,462 firm-period observations.

3.2. Stock Price Crash Risk Measure

We employ two popular measures of stock price crash risk, namely the negative skewness measure ($NSKEW_{i,t}$) and the down-to-up volatility ($DUVOL_{i,t}$) suggested by Chen et al. (2001).

$$NSKEW_{i,t} = \frac{-[n(n-1)^{3/2}\sum_{\tau=1}^{T} w_{i,\tau}^3]}{[(n-1)(n-2)(\sum_{\tau=1}^{T} w_{i,\tau}^2)^{3/2}]} \quad (1)$$

$$DUVOL_{i,t} = log\left[\frac{(n_d-1)\sum_{\tau=DOWN}^{T}\sigma_{i,\tau}}{(n_u-1)\sum_{\tau=UP}^{T}\sigma_{i,\tau}}\right] \quad (2)$$

$w_{i,\tau}$ is the summation of the third moments of demeaned daily return of firm i. τ is the τth period of six months and n is the number of days in a particular six months period τ. $\sigma_{i,\tau}$ is the standard deviation of firm i daily return. $DOWN$ (UP) days are daily returns, which is less (more) than the six months average of firm i during a period of six months τ. n_d (n_u) is the number of $DOWN$ (UP) days.

3.3. Illiquidity Measures

In this study, we select five widely well-known illiquidity measures calculated from volume, price, and transaction cost as follows.

3.3.1. Volume-based Measures

3.3.1.1. Adjusted Amihud illiquidity ratio (Kang & Zhang, 2014)

$$AdjILLIQ_{i,t} = \left[ln\left(\frac{1}{T}\sum_{d=1}^{T}\frac{|R_{t,d}^i|}{V_{t,d}^i}\right)\right] \times (1 + Zerovol_{i,t}) \quad (3)$$

$$Zerovol_{i,t} = \frac{number\ of\ days\ with\ zero\ trading\ volume\ in\ month}{T} \quad (4)$$

where $R_{t,d}^i$ and $V_{t,d}^i$ are return and trading volume in million baht of stock i on day d in month t, respectively. T is the total number of trading days in month t. $Zerovol_{i,t}$

is the number of zero trading volume days in month t divided by the number of total trading days in month t. ln is natural logarithm.

3.3.1.2. Lui (2006)' s illiquidity measure

$$LM6 = \left[Number\ of days\ with\ zero\ trading\ volume\ in\ prior\ 6 - month + \frac{1/(6 - month\ turnover)}{11{,}000} \right] * \frac{21 \times 6}{Total\ number\ of\ trading\ day\ in\ prior\ x\ months} \quad (5)$$

where $6 - month\ turnover$ is the turnover ratio of stock i in prior six months.

3.3.2. Price-based Measure

3.3.2.1 Pastor and Stambaugh (2003)'s gamma

$$r^e_{i,t+1} = \theta + \emptyset r_{i,t} + \gamma sign(r^e_{i,t}) * Vol_{i,t} + \varepsilon_{i,t+1} \quad (6)$$

where $r^e_{i,t+1}$ and $Vol_{i,t}$ is the value-weighted excess return and trading value in million baht on stock i and on days $t+1$ and t, respectively. γ represents liquidity of stock.

3.3.3. Transaction Cost Measure

3.3.3.1. Zero return (Lesmond et al., 1999)

$$zero_{i,t} = \frac{number\ of\ days\ with\ zero\ return\ in\ month\ t}{T} \quad (7)$$

$zero_{i,t}$ is the average number of days with zero return for the stock i in month t.

3.3.3.2. Effective spread (Roll, 1984)

$$Effective\ spread_{i,t} = 2\sqrt{-cov_{i,t}} \quad (8)$$

cov_i is the first order serial covariance of price changes of stock i between two consecutive months.

3.4. Empirical Model

The baseline regression model is

$$CrashRisk_{i,t} = \alpha + \beta_i LIQ_{i,t-1} + \sum_{j=1}^{m} \beta_j Control\ variable_{j,t-1} + \text{Industry}_{\text{Fixed Effect}} + \text{Year}_{\text{Fixed Effect}} + \varepsilon_{i,t} \quad (9)$$

when $CrashRisk_{i,t}$ is $NSKEW_{i,t}$ or $DUVOL_{i,t}$. LIQ is a stock's illiquidity measure defined in prior section. $Control\ variable$ are described in Table 1.

Table 1: Variables description

Variable	Description
NSKEW	Negative skewness of the firm daily mean returns.
DUVOL	The logarithm of the ratio of down to up volatility of the firm daily mean returns.
SIGMA	The standard deviation of firm daily mean returns.
RET	The firm daily mean return.
DTURN	The average monthly stock turnover in period t minus the average monthly stock turnover
SIZE	The logarithm of market capitalization
MB	The ratio of market value of equity to the book value of equity
LEV	The ratio of the difference between total asset and shareholder's equity to total asset
ROA	The return on asset
AdjILLIQ	The Adjusted-illiquidity ratio (Kang & Zhang, 2014)
Zero	The zero-return illiquidity measure (Lesmond et al., 1999)
Roll	The Roll effective spread (Roll, 1984)
LM6	The Lui's liquidity measure (Lui, 2006)
Gamma	The Pastor and Stambaugh's gamma (Pastor & Stambaugh, 2003)

4. Results and Discussion

4.1. Baseline Regression

For interpretation, we follow prior literature by multiplying -1 to all coefficients of illiquidity measures. Thus, when looking at estimated coefficients in the results, for ease, we multiply -1 in order to show the relationship between stock liquidity and tail risk (stock price crash risk). Table 2 clearly demonstrates a negative relationship between stock illiquidity and crash risk in both crash risk measures. However, the effect of liquidity measure on $NSKEW$ is generally greater than that of $DUVOL$. All coefficients of liquidity measures are also significant. Among different types of liquidity measure, the zero-return illiquidity measure shows the strongest effect with 0.851% increase in crash risk, while the Lui's liquidity measure shows the least effect (0.0286%). Additionally, control variables are largely significant, which are in line with prior literature.

4.2. Endogeneity

In order to alleviate the endogeneity biases, we apply the two-stage least squares instrumental variable (2SLS). The industry median of liquidity measures is selected as an instrumental variable given two major advantages. First, firm's liquidity is co-related with industry-wide liquidity, providing similar information (Chordia et al., 2000) . Second, although the management actions could influence crash risk, subsequently affecting stock's liquidity, it is less likely that they can influence the entire industry. The first stage regression is shown

$$\widehat{LIQ_{i,t-1}} = \alpha_i + LIQ_{median,t-1} + \gamma_i \sum_{i=1}^{k} CONTROL_{i,t-1} + \vartheta_{t-1} \quad (10)$$

Then we repeat the procedure in section 3 for the second stage least square regression and the results are shown in Table 3. The findings are largely similar to Table 2, confirming the negative liquidity-crash risk relationship.

5. Conclusion

This paper fills the gap in prior literature on mixed findings of the relationship between stock liquidity and tail risk (stock price crash risk simply defined as a negative skewness in return). We perform tests based on the three different dimensions of liquidity measurement namely volume based measures, price based measures, and transaction cost based measures. We show that mixed results found in prior literature are potentially driven from types of liquidity measure. The liquidity-tail risk association is existent in the Stock Exchange of Thailand, in which problem of liquidity is more concerned than in that of advanced economies. The higher the stock liquidity, the larger the tail risk is. The results are robust in terms of measurement of crash risk and liquidity factors. An endogeneity issue is addressed by employing two-stage least squares regression.

Table 2: Main results.

	$NSKEW$	$DUVOL$	$NSKEW$	$DUVOL$	$NSKEW$	$DUVOL$	$NSKEW$	$DUVOL$	$NSKEW$	$DUVOL$
$AdjAmihud_{t-1}$	-0.0116***	-0.0051***								
	(-2.66)	(-3.75)								
$Zero_{t-1}$			-0.8510***	-0.3510***						
			(-7.43)	(-7.20)						
$Roll_{t-1}$					-1.7900**	-0.4730*				
					(-2.03)	(-1.96)				
$LM6_{t-1}$							-0.0286***	-0.0128***		
							(-6.06)	(-8.14)		
$Gamma_{t-1}$									-0.1820**	-0.0694*
									(-2.06)	(-1.88)
$NSKEW_{t-1}$	0.0739***	0.0322***	0.0618***	0.0273***	0.0783***	0.0340***	0.0688***	0.0299***	0.0777***	0.0338***
	(4.73)	(6.95)	(3.80)	(5.37)	(5.05)	(7.41)	(4.44)	(6.54)	(5.11)	(7.60)
$SIGMA_{t-1}$	0.0020	0.0030**	0.0004	0.0024**	0.0014	0.0030**	0.0021	0.0030**	0.0028	0.0033**
	(1.01)	(2.09)	(0.27)	(2.03)	(0.71)	(2.16)	(1.12)	(2.22)	(1.50)	(2.44)
RET_{t-1}	0.2400**	0.1170***	0.2590***	0.1250***	0.2410**	0.1170***	0.2250**	0.1110***	0.2330**	0.1150***
	(2.52)	(3.06)	(3.10)	(3.69)	(2.51)	(3.01)	(2.50)	(3.02)	(2.45)	(2.97)
$DTURN_{t-1}$	0.0212***	0.0082***	0.0125***	0.0046***	0.0230***	0.0090***	0.0156***	0.0057***	0.0233***	0.0091***
	(4.17)	(4.45)	(2.65)	(2.71)	(4.34)	(4.74)	(3.24)	(3.07)	(4.48)	(4.85)

$\boldsymbol{SIZE_{t-1}}$	0.0565***	0.0144***	0.0820***	0.0247***	0.0525***	0.0120**	0.0715***	0.0211***	0.0491***	0.0112**
	(3.82)	(3.30)	(5.88)	(5.56)	(3.18)	(2.44)	(5.36)	(5.19)	(3.09)	(2.35)
$\boldsymbol{MB_{t-1}}$	-0.1020***	-0.0379***	-0.1010***	-0.0374***	-0.0958***	-0.0350***	-0.0996***	-0.0370***	-0.0941***	-0.0346***
	(-7.47)	(-5.67)	(-6.59)	(-4.98)	(-6.36)	(-4.98)	(-6.72)	(-5.16)	(-6.30)	(-4.96)
$\boldsymbol{LEV_{t-1}}$	-0.1760**	-0.0917***	-0.0655	-0.0457*	-0.1610*	-0.0851***	-0.1170	-0.0653**	-0.1600*	-0.0848***
	(-2.10)	(-3.20)	(-0.84)	(-1.75)	(-1.92)	(-2.98)	(-1.47)	(-2.46)	(-1.90)	(-2.97)
$\boldsymbol{ROA_{t-1}}$	-0.0004	0.0001	-0.0003	0.0001	-0.0005	0.0001	-0.0006	-0.0000	-0.0005	0.0001
	(-0.81)	(0.33)	(-0.66)	(0.48)	(-0.79)	(0.27)	(-1.13)	(-0.02)	(-0.86)	(0.25)
$\boldsymbol{\alpha}$	-1.1840***	-0.2200**	-2.0620***	-0.5780***	-1.1120***	-0.1730	-1.6520***	-0.4310***	-1.0260***	-0.1500
	(-3.48)	(-2.13)	(-6.38)	(-5.17)	(-2.91)	(-1.46)	(-5.55)	(-4.48)	(-2.83)	(-1.36)
$\boldsymbol{Adj.R^2}$	7.680%	6.660%	8.610%	7.550%	7.460%	6.380%	8.080%	7.140%	7.420%	6.360%

Note: we multiply all coefficients of illiquidity measures by -1. *, **, and *** are statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 3: Two-stage least squares estimation

	$\boldsymbol{NSKEW}$	$\boldsymbol{NSKEW}$	$\boldsymbol{NSKEW}$	$\boldsymbol{NSKEW}$	$\boldsymbol{NSKEW}$
$\widehat{AdjAmihud}_{t-1}$	-0.1490***				
	(-2.50)				
$\widehat{Zero}_{t-1}$		-1.0860***			
		(-4.28)			
$\widehat{Roll}_{t-1}$			-0.0707*		
			(-1.72)		
$\widehat{LM6}_{t-1}$				-0.0819*	
				(-1.94)	
$Gamma_{t-1}$					-0.1477*
					(-1.84)
$NSKEW_{t-1}$	0.0706***	0.0500***	0.0775***	0.0498**	0.0695***
	(4.41)	(2.78)	(5.11)	(2.30)	(4.22)
$SIGMA_{t-1}$	0.0019	-0.0011	-0.0013	0.0007	0.0018
	(0.92)	(-0.63)	(-0.21)	(0.28)	(1.03)
RET_{t-1}	0.2370***	0.2900***	0.2620**	0.2190***	0.2420***
	(2.60)	(3.81)	(2.52)	(2.75)	(2.69)
$DTURN_{t-1}$	0.0193***	0.0076	0.0222***	0.0026	0.0214***
	(3.19)	(1.36)	(3.83)	(0.23)	(4.35)
$SIZE_{t-1}$	0.0648***	0.1020***	0.0612**	0.1120***	0.0542***
	(3.18)	(5.99)	(2.23)	(3.53)	(3.10)
MB_{t-1}	-0.1080***	-0.0969***	-0.0996***	-0.1090***	-0.0953***
	(-8.07)	(-5.71)	(-5.58)	(-5.74)	(-4.65)
LEV_{t-1}	-0.1920**	0.0002	-0.1540*	-0.0384	-0.1760**
	(-2.27)	(0.00)	(-1.83)	(-0.35)	(-2.09)
ROA_{t-1}	-0.0003	-0.0001	-0.0001	-0.0007	-0.0008
	(-0.58)	(-0.13)	(-0.10)	(-1.21)	(-1.28)
α	-1.3740***	-2.8030***	-1.3540*	-2.7200***	-1.1370***
	(-2.89)	(-5.68)	(-1.94)	(-3.16)	(-2.94)
$Adj.R^2$	8.10%	9.79%	6.99%	6.54%	1.65%

Note: we multiply all coefficients of illiquidity measures by -1. *, **, and *** are statistical significance at the 10%, 5%, and 1% levels, respectively.

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Appendixes

Appendix 1: Summarize the theoretical background on investor sentiment.

Author	Research Question	Sample	Finding
Chen et al. (2001)	To forecast skewness in the daily returns to individual stocks.	U.S. equity market between 1962 - 1998	Stocks with positive returns over the last 36 months and an increase in trading volume compared to trend over the previous 6 months have the greatest negative skewness
Jin et al. (2006)	This study proposes the hypothesis that information asymmetries between company insiders and external stakeholders may increase the probability of crash risk.	Stock returns from 40 stock markets during 1990 - 2001	Companies can abandon on the residual claim and inform outside investors of bad news, but doing so is expensive and rarely done. The exercise of this option results in a crash, or a significant, adverse residual return.

Author	Research Question	Sample	Finding
Hutton et al. (2009)	To study the relationship between opacity in financial reporting and crash risk.	U.S. equity market between 1991-2005	Stock price drops are more likely to happen at companies with opaque financial statements. However, this relationship was more obvious before the Sarbanes-Oxley Act was passed.
Kim et al. (2011)	To study the relationship between tax avoidance and crashes.	U.S. equity market between 1995 - 2008	Various tax avoidance strategies raise the risk of crashes.
Francis et al. (2016)	To study the relationship between real earning management (REM) and crashes.	U.S. equity market between 1989 – 2009	Companies that diverge from industry norms in actual operations are positively associated with future crash risk.
Kim et al. (2014)	To study the relationship between CSR and firm- specific stock price crash risk.	U.S. equity market between 1995 – 2009	Companies with higher CSR scores have a lower crash risk. When internal or external board monitoring is taking place, the function of CSR in lowering the risk of a stock price fall is extremely crucial.
Cohen et al. (2014)	To study the relationship between financial institutions and crash.	U.S. equity market between 1997 - 2009	Prior to the start of the crisis period in 2007, banks with more aggressive earnings management techniques showed significantly higher crash risk.
Chang et al. (2017)	To study the relationship between stock liquidity and crashes.	U.S. equity market between 1993 - 2010	The likelihood of a company's stock price crash in the future is determined to be positively and significantly correlated with its stock liquidity. The risk of a future stock price drop and its liquidity. The enterprises with a higher percentage of short-horizon investors, greater information asymmetry, and higher degrees of short-sale limits experience a stronger liquidity effect.
Xuan Vinh Vo (2020)	To study the relationship between foreign ownership and stock price crash risk.	Vietnam stock exchange between 2007-2015	The study shows a positive relationship between foreign ownership and stock price crash risk.
Huang et al. (2021)	To study the impact of the COVID-19 on the stock price crash risk of energy firms in China	China equity market includes 248 energy firms covered by the State Intellectual Prop- erty Office (SIPO) database and 3420 nonenergy firms during 2019 - 2020	The probability of stock price crashes at energy companies drastically decreased after COVID-19. The impact of COVID-19 on energy companies could be greatly reduced by CSR performance. And this research demonstrates that after COVID-19, the SOE has a lower serious crash risk.
Wattanatorn and Padungsaksawdi (2022)	To explore the role of systematic skewness and stock price crash risk	Thai stock exchange between 2000 – 2019	The study shows a negative relationship between systematic skewness and stock price crash risk.