

# The Effect of Market Volatility on Liquidity and Stock Returns in the Korean Stock Market

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# The Effect of Market Volatility on Liquidity and Stock Returns in the Korean Stock Market

This study analyzes the effect of market volatility on stock returns using data from the Korean stock market from January 1, 2004 to December 31, 2014. We show that unexpected increases in market volatility accompany decreases in both stock returns and liquidity and the effect of volatility shock on stock returns is greater for stocks with more domestic or foreign institutional trading. Individual investors mitigate the negative effect of volatility shock on stock returns. The interaction effect of market volatility and liquidity on stock returns is stronger for stocks with more foreign institutional trading. We also document some evidence of asymmetric effects of market volatility on stock returns that are related to whether trades are buyer or seller-initiated.

**Keywords:** Market volatility, VIX, Price impact, Bid-ask spread, Liquidity, Stock returns, Investor type, Financial crisis

**JEL Classification:** G10, G32, G34

## I. Introduction

This paper analyzes the effects of market volatility on stock liquidity and returns using data from the Korean stock market. In particular, we analyze whether changes in stock returns and liquidity that result from unexpected changes in market volatility are related to trading volume accounted for by individual, domestic institutional, and foreign institutional investors. Our main thesis is that the effects of market volatility on liquidity and stock returns are likely to vary with the proportion of trades that are initiated by each type of investors because the information content of a trade is likely to differ across these investors.

Prior research shows that unexpected increases in market volatility decrease stock returns in the aggregate (i.e., market returns). For instance, French, Schwert, and Stambaugh (1987) find a negative relation between market returns and unexpected increases in market volatility. Similarly, Haugen, Talmor, and Torous (1991) show that increases in market volatility give rise to a subsequent decline in stock prices and higher future returns. Although the relation between market volatility and stock market returns in the aggregate is well documented, there is little evidence regarding how individual stock returns are related to market volatility. We provide such evidence in this study. To the extent that individual stock return sensitivity to market volatility is a priced factor in the cross-section of expected returns, the results of our study should help better understand the role of market volatility in asset pricing.

Prior research suggests that market uncertainty reduces liquidity for at least two reasons. Gorton and Metrick (2010) argue that liquidity suppliers provide less liquidity in times of high uncertainty because they face greater adverse selection problems during such times. Nagel (2012) shows that liquidity suppliers provide less liquidity during times of market turmoil because they require higher returns during such periods. Chung and Chuwonganant (2014) show that market volatility exerts a market-wide impact on liquidity, which generates co-movements in individual asset liquidity. Built on these findings, we analyze the effect of market uncertainty on individual stock liquidity and shed

further light on how market uncertainty exerts an impact on stock returns through its effect on stock liquidity.

Bali, Peng, Shen, and Tang (2014) show that both contemporaneous and future stock returns increase with unexpected increases in liquidity. The authors interpret this finding as that the stock market underreacts to stock-level liquidity shocks. Our study differs from their study in that we consider liquidity to be an important channel through which market uncertainty affects stock returns, while theirs focuses primarily on the effect of liquidity shocks on stock returns without considering the role of market uncertainty. The focal point of our empirical analysis is to explore whether volatility shocks prompt liquidity shocks and also whether this effect helps better understand changes in stock returns that are associated with market volatility shocks.

Chung and Chuwonganant (2016) analyze the effects of market volatility on stock liquidity and returns using the US data. Prior research shows that the information content of trading differs across the type of traders. For instance, Park and Chung (2007) find evidence that foreign institutional (local institutional) investors have faster access to or processing power of new information than local institutional (local individual) investors. The present study extends Chung and Chuwonganant (2016) using data from the Korean stock market, which provides information regarding whether each trade is initiated by individual, domestic institutional, or foreign institutional traders. Because both the information content of a trade and the adverse selection risk of a trade to liquidity providers are likely to differ significantly across these different types of traders, the effects of market volatility on liquidity and stock returns are also likely to vary with the proportion of trades that are initiated by each type of traders. Our study contributes to the literature by providing evidence consistent with this conjecture.

Using the KOSPI 200 volatility index as a measure of market volatility and the price impact of a trade as well as the quoted bid-ask spread as measures of individual stock liquidity, we show that unexpected increases in market volatility accompany decreases in both liquidity and contemporaneous monthly stock returns. We also show that decreases in individual stock returns that are

associated with increases in market volatility are larger for stocks with greater concurrent decreases in liquidity. These results suggest that liquidity providers play an important role in determining the effect of market uncertainty on individual stock returns in the Korean stock market.

We show that the negative effect of an increase in volatility shock on stock returns is greater for stocks with more domestic or foreign institutional trading, whereas individual traders mitigate the negative effect of an increase in volatility shock on stock returns. We interpret the latter result as evidence that individual traders are noise traders who do not fully comprehend the pricing implication of volatility shock. We also show that although the interaction effect of market volatility and liquidity on stock returns is stronger for stocks with more foreign institutional trading, the interaction effect does not vary with the extent of domestic investor trading.

We conjecture that the effect of market volatility on liquidity and stock returns may be particularly strong during times of financial crisis because investors are believed to be more risk averse during such times. To examine whether the effects of market volatility on liquidity and stock returns vary with market environments, we conduct regression analysis using data during the pre-crisis period (2004-2006), the crisis period (2007-2009), and the post-crisis period (2010-2014), separately. The results show that an increase in market volatility generally results in a decrease in stock returns in all three sub-periods.

Consistent with our expectation, however, we find that the negative effect of an increase in volatility shock on stock returns is greater for stocks with more foreign institutional trading during only the crisis period. In a similar vein, we find that the interaction effect of market volatility and liquidity on stock returns is stronger for stocks with larger foreign or domestic institutional trading only during the crisis period. The effects of liquidity shock on stock returns are positive and significant during both the crisis period and the non-crisis period, while the negative effect of an increase in volatility shock on stock returns is greater for stocks with more institutional trading during only the crisis period.

Finally, we show that the relation between stock returns and volatility shock is qualitatively similar, regardless of whether we use volatility shock in Korea, the

US, or Europe. We interpret this result as evidence of an integrated global market in which volatility shocks are highly correlated across markets because they are likely to arise largely from a common set of state variables and economic fundamentals.

This study contributes to the literature in several dimensions. First, it adds to a growing literature that uses market volatility index as a measure of market uncertainty. Pan and Singleton (2008) and Longstaff, Pan, Pedersen, and Singleton (2010) examine whether the Chicago Board Options Exchange (CBOE) market volatility index (VIX) can explain sovereign credit spreads. Graham and Harvey (2010) examine the relation between VIX and equity risk premium. Bao, Pan, and Wang (2011) analyze the relation between VIX and bond market liquidity. Nagel (2012) explores whether the expected return from liquidity provision increases with VIX. Our study extends this literature by analyzing the effect of market volatility on the cross-section of liquidity and returns in the Korean stock market.

Prior research examines the effect of market uncertainty on stock returns without considering the role of liquidity. The present study helps better understand the effect of market uncertainty on stock returns by investigating how the effect of market volatility on liquidity could magnify the impact of market uncertainty on stock returns. Another important contribution is to show that the extent to which market uncertainty affects liquidity and stock returns depends on the proportion of trades that are executed by different types of trades.

The rest of the paper is organized as follows. Section 2 explains data sources and variable measurement methods and provides summary statistics. Section 3 analyzes the impact of unexpected changes in market volatility on the liquidity and return of individual securities. Section 4 analyzes whether the effects of volatility and liquidity shocks on stock returns vary with the intensity of trading by different types of traders. Section 5 explores whether the effects of market volatility on stock returns vary with market environments. Section 6 investigates the effects of volatility shock in the US and European stock markets on Korean stock returns. Section 7 provides a brief summary of the paper and concluding remarks.

## II. Data Sources and Variable Description

Our initial study sample includes stocks listed on the Korea Exchange (KRX), an electronic order-driven market, from January 1, 2004 to December 31, 2014. We exclude financial firms from the study sample. We collect daily returns, number of shares outstanding, return volatility, book value of equity, and trading volume from FnGuide. We exclude stock-month observations with missing trading volume or stock return, stocks with a price lower than 1000 Korean won (KRW), which is equivalent to about one US dollar, stocks with fewer than 12 trading days within a month, and stocks with fewer than 24 trading months.

We obtain the Korean Trade and Quote (TAQ) data from the Korean Exchange (KRX). In order to minimize data errors, we exclude the following quotes and trades from the study sample: (1) quotes if either the ask or the bid is less than or equal to zero; (2) quotes if either the bid-ask spread is greater than 20% of share price or less than zero; (3) trades if price or volume is less than or equal to zero; (4) trade price,  $P_t$ , if  $\left| \frac{P_t - P_{t-1}}{P_{t-1}} \right| > 0.5$ ; (5) ask quote, ASK, if  $\left| \frac{ASK_t - ASK_{t-1}}{ASK_{t-1}} \right| > 0.5$ ; (6) bid quote, BID, if  $\left| \frac{BID_t - BID_{t-1}}{BID_{t-1}} \right| > 0.5$ ; (7) before-the-open and after-the-close trades and quotes.<sup>1)</sup>

We calculate the quoted spread (SPREAD) using the following formula:  $SPREAD_{i,t} = (ASK_{i,t} - BID_{i,t}) / M_{i,t}$ , where  $ASK_{i,t}$  is the best ask price of stock  $i$  at time  $t$ ,  $BID_{i,t}$  is the best bid price of stock  $i$  at time  $t$ , and  $M_{i,t}$  is the quote midpoint  $(ASK_{i,t} + BID_{i,t}) / 2$  of stock  $i$  at time  $t$ . We then calculate the daily time-weighted mean quoted spread and the monthly equal-weighted mean value of the daily quoted spread. We calculate the daily Amihud (2002) illiquidity measure using the following formula:  $AMIHU_{i,t} = [ |RET_{i,t}| / TRV_{i,t} ] * 10^9$ , where  $RET_{i,t}$  is stock  $i$ 's return on day  $t$  and  $TRV_{i,t}$

1) The regular trading hour of the Korea Exchange is from 9:00 AM to 3:00 PM.



is stock  $i$ 's trading volume (in KRW) on day  $t$ . To reduce outliers, we winsorize the data at 99.8% and require that the number of trading days within a month is at least 12 days. For each stock, we then calculate the monthly mean value of the Amihud measure.

In the Korean TAQ data, each trade is flagged to identify whether it is initiated by a domestic individual investor, a domestic institutional investor, or a foreign institutional investor. Using this information, we calculate, for each stock in each month, the proportion of trades that are initiated by domestic institutional investors (PINST), foreign institutional investors (PFORE), and domestic individual investors (PINDI). The Korean TAQ data also enable us to identify whether each trade is buyer- or seller-initiated using order sequence number and trade direction, which does not require the Lee and Ready (1991) algorithm. Specifically, we consider a trade to be buyer (seller)-initiated if a buy (sell) order is matched with existing sell (buy) orders using order sequence number and trade direction. We then calculate, for each stock in each month, the proportion of trades that are initiated by domestic institutional investors' sell orders (PSINST), foreign institutional investors' sell orders (PSFORE), domestic individual investors' sell orders (PSINDI), domestic institutional investors' buy orders (PBINST), foreign institutional investors' buy orders (PBFFORE), and domestic individual investors' buy orders (PBINDI).

We collect the KOSPI 200 volatility index (VIXKO hereafter) from Bloomberg. Following Chung and Chuwonganant (2016), we measure unexpected changes in market volatility ( $\Delta VIXKO_t$ ) and unexpected changes in individual stock liquidity ( $\Delta AMIHU_{i,t}$  and  $\Delta SPREAD_{i,t}$ ) as follows:

$$\Delta VIXKO_t = (VIXKO_t - \text{AVGVIXKO}_{t-12,t-1}) / \text{AVGVIXKO}_{t-12,t-1} \quad (1)$$

$$\Delta AMIHU_{i,t} = -(AMIHU_{i,t} - \text{AVGAMIHU}_{i|t-12,t-1}) / \text{AVGAMIHU}_{i|t-12,t-1} \quad (2)$$

$$\Delta SPREAD_{i,t} = -(SPREAD_{i,t} - \text{AVGSPREAD}_{i|t-12,t-1}) / \text{AVGSPREAD}_{i|t-12,t-1}; \quad (3)$$

where subscript  $i$  denotes stock  $i$  and subscript  $t$  denotes month  $t$ .  $VIXKO_t$  is the mean value of daily VIXKO in month  $t$  and  $\text{AVGVIXKO}_{t-12,t-1}$  is the mean value of VIXKO in the past 12 months. A negative  $\Delta VIXKO$  means a

decline in VIXKO relative to the past 12-month average.  $AMIHUD_{i,t}$  is the mean value of the daily Amihud measure (AMIHUD) for stock  $i$  in month  $t$ .  $AVGAMIHUD_{i|t-12,t-1}$  is the mean value of AMIHUD in the past 12 months. A negative  $\Delta AMIHUD$  means a decline in liquidity relative to the past 12-month average.  $SPREAD_{i,t}$  is the mean value of the daily quoted percentage spread for stock  $i$  in month  $t$ .  $AVGSPREAD_{i|t-12,t-1}$  is the mean value of SPREAD in the past 12 months. A negative  $\Delta SPREAD$  means an increase in spread (a decrease in liquidity) relative to the past 12-month average.

Table 1. Descriptive Statistics

Variables	Mean	Standard deviation	Percentile				
			5	25	50	75	95
$\Delta VIXKO$	-0.027	0.296	-0.355	-0.212	-0.093	0.048	0.647
$\Delta AMIHUD$	-0.145	3.320	-2.006	-0.402	0.168	0.548	0.877
$\Delta SPREAD$	0.014	0.346	-0.596	-0.149	0.054	0.234	0.490
RET	0.015	0.152	-0.192	-0.070	-0.002	0.078	0.279
TRV (billion won)	4.133	19.077	0.010	0.087	0.375	1.735	16.690
PINDI	0.810	0.227	0.290	0.716	0.920	0.972	0.998
PINST	0.126	0.176	0.000	0.003	0.032	0.195	0.525
PFORE	0.064	0.079	0.000	0.011	0.036	0.083	0.233
PSINDI	0.417	0.124	0.151	0.358	0.450	0.505	0.568
PSINST	0.064	0.096	0.000	0.001	0.013	0.094	0.282
PSFORE	0.034	0.044	0.000	0.005	0.019	0.043	0.127
PBINDI	0.393	0.126	0.132	0.326	0.423	0.478	0.556
PBINST	0.062	0.093	0.000	0.000	0.011	0.093	0.271
PBFORE	0.030	0.043	0.000	0.003	0.014	0.037	0.122

Note:  $\Delta VIXKO$ ,  $\Delta AMIHUD$ , and  $\Delta SPREAD$  stand for unexpected changes in market volatility, the Amihud illiquidity measure, and the percentage quoted bid-ask spread; RET and TRV are return and trading volume (in KRW); PINST, PFORE and PINDI are proportion of trades that are initiated by domestic institutional investors, foreign institutional investors, and domestic individual investors; PSINDI, PSFORE, and PSINST are proportion of trades that are initiated by domestic institutional investors' sell orders, foreign institutional investors' sell orders, domestic individual investors' sell orders; PBINST, PBFORE, and PBINDI are proportion of trades that are initiated by domestic institutional investors' buy orders, foreign institutional investors' buy orders, and domestic individual investors' buy orders.

Table 1 shows the descriptive statistics of the key variables for our study sample of 1,598 KRX stocks. The mean value of  $\Delta VIXKO$ ,  $\Delta AMIHU$ , and  $\Delta SPREAD$  is -0.027, -0.145, and 0.014, respectively. The mean monthly stock return is 0.015 and the mean trading volume is around 4.1 billion KRW. The majority of trades are initiated by domestic individual investors: On average, 81.0% of trades are initiated by individual investors, 12.6% are initiated by domestic institutional investors, and 6.4% are initiated by foreign institutional investors. Not surprisingly, the fraction of trades that are buyer-initiated is approximately equal to the fraction of trades that are seller-initiated for all three types of investors.

Table 2 shows the pairwise correlation matrix of the key variables. The results indicate that unexpected changes in market volatility ( $\Delta VIXKO$ ) are negatively correlated with unexpected changes in the Amihud measure ( $\Delta AMIHU$ ) and the bid-ask spread ( $\Delta SPREAD$ ), with a correlation coefficient of -0.099 and -0.375, respectively. As expected, unexpected changes in the Amihud measure are positively related to unexpected changes in the bid-ask spread. The changes in market volatility are positively related to idiosyncratic risk ( $\Delta IVO$ ), the coefficient of variation of the Amihud illiquidity measure ( $CVAMIHU$ ), the maximum daily return ( $MAXRET$ ), and negatively related to firm size ( $LOG(MVE)$ ),  $\log LOG(BM)$ , and Beta.

Table 2. Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) $\Delta VIXKO$	1												
(2) $\Delta AMIHU$	-0.099*	1											
(3) $\Delta SPREAD$	-0.375*	0.216*	1										
(4) $\Delta IVO$	0.171*	0.034*	0.022*	1									
(5) $\Delta TRV$	-0.001	0.002	0.011*	0.016*	1								
(6) $\text{LOG(MVE)}$	-0.006*	0.035*	0.037*	-0.022*	-0.002	1							
(7) $\text{CVAMIHU}$	0.060*	-0.065*	-0.050*	0.080*	0.004	-0.238*	1						
(8) $\text{STDTO}$	-0.003	-0.026*	0.027*	-0.025*	-0.003	-0.083*	-0.022*	1					
(9) $\text{LOG(BM)}$	-0.007*	-0.010*	-0.050*	0.035*	-0.003	-0.302*	0.182*	-0.158*	1				
(10) $\text{COSKEWNESS}$	-0.022*	-0.005	-0.003	-0.018*	-0.003	-0.025*	-0.013*	0.011*	-0.022*	1			
(11) $\text{BETA}$	-0.009*	-0.004	-0.003	-0.016*	-0.007*	0.044*	-0.091*	-0.003	-0.003	0.181*	1		
(12) $\text{RET}(-12,-2)$	-0.004	0.009*	0.043*	-0.014*	0.019*	0.030*	-0.012*	0.265*	-0.080*	-0.026*	0.001	1	
(13) $\text{MAXRET}$	0.143*	0.038*	0.122*	0.107*	0.007*	-0.151*	-0.053*	0.141*	-0.172*	0.006*	0.036*	0.033*	1

NOTE: This table shows the pair-wise correlation coefficient between the variables.  $\Delta VIXKO$ ,  $\Delta AMIHU$ , and  $\Delta SPREAD$  stand for unexpected changes in market volatility, the Amihud illiquidity measure, and the percentage quoted bid-ask spread;  $\Delta IVO$  and  $\Delta TRV$  are unexpected changes in idiosyncratic volatility and trading volume;  $\text{LOG(MVE}_{i,t-1})$  is the logarithm of market value of equity for stock  $i$ , month  $t - 1$ ;  $\text{CVAMIHU}_{i,t}$  is the coefficient of variation of the Amihud illiquidity measure;  $\text{STDTO}$  is the standard deviation of monthly volume turnover during the last 12 months;  $\text{LOG(BM)}$  is the logarithm of book-to-market value of equity ratio;  $\text{COSKEWNESS}$  is the co-skewness measure;  $\text{BETA}_{i,t}$  is the systematic risk,  $\text{RET}(-12,-2)$  is the momentum, calculated by cumulative return during month  $t - 12$  and month  $t - 2$ ;  $\text{MAXRET}$  is the maximum daily return. \* indicates significance at 1% level, respectively.

### III. Empirical Model and Regression Results

To investigate the effects of market volatility and liquidity shocks on stock returns after controlling for the variables that are associated with stock returns, we estimate the following regression model using the pooled time series and cross-sectional data for the sample of the KRX stocks from January 2004 to December 2014:

$$\begin{aligned}
 \text{RET}_{i,t} \text{ or } \text{RET}_{i,t+1} = & \beta_0 + \beta_1 \Delta \text{VIXKO}_t + \beta_2 (\Delta \text{AMIHU}_{i,t} \text{ or } \Delta \text{SPREAD}_{i,t}) \\
 & + \beta_3 \Delta \text{VIXKO}_t * (\Delta \text{AMIHU}_{i,t} \text{ or } \Delta \text{SPREAD}_{i,t}) \\
 & + \beta_4 \Delta \text{IVO}_{i,t} + \beta_5 \Delta \text{TRV}_{i,t} + \beta_6 \text{BETA}_{i,t} \\
 & + \beta_7 \text{LOG}(\text{MVE}_{i,t-1}) + \beta_8 \text{CVAMIHU}_{i,t} + \beta_9 \text{MAXRET}_{i,t} \\
 & + \beta_{10} \text{RET}(-12,-2)_{i,t} + \beta_{11} \text{STDTO}_{i,t} + \beta_{12} \text{LOG}(\text{BM}_{i,t}) \\
 & + \beta_{13} \text{COSKEWNESS}_{i,t} + \varepsilon_{i,t}; \tag{4}
 \end{aligned}$$

where subscript  $i$ ,  $t$ , and  $t + 1$  stands for stock  $i$ , month  $t$ , and month  $t + 1$ , respectively, and  $\varepsilon_{i,t}$  is the error term. Bali, Peng, Shen, and Tang (2014) find that liquidity shocks are related to both contemporaneous returns and future returns in the same direction and interpret the results as evidence that the stock market underreacts to stock-level liquidity shocks. To examine whether the stock market underreacts to uncertainty shocks as well, we use the contemporaneous monthly return ( $\text{RET}_{i,t}$ ) or the one-month ahead return ( $\text{RET}_{i,t+1}$ ) as the dependent variable. As defined above,  $\Delta \text{VIXKO}_t$ ,  $\Delta \text{AMIHU}_{i,t}$ , and  $\Delta \text{SPREAD}_{i,t}$  stand for unexpected changes in market volatility, the Amihud illiquidity measure, and the percentage quoted bid-ask spread.

To assess whether unexpected changes in market volatility exert an impact on stock returns that is beyond the effect on stock returns of unexpected changes in the idiosyncratic volatility and trading volume of individual securities, we include unexpected changes in idiosyncratic volatility and trading volume ( $\Delta \text{IVO}_{i,t}$  and  $\Delta \text{TRV}_{i,t}$ ) in the regression. We include a number of additional control variables in the regression.  $\text{BETA}_{i,t}$  is the systematic risk,  $\text{LOG}(\text{MVE}_{i,t-1})$  is the logarithm of market value of equity for stock  $i$ , month

$t-1$ ,  $CVAMIHUD_{i,t}$  is the coefficient of variation of the Amihud illiquidity measure,  $MAXRET_{i,t}$  is the maximum daily return,  $RET(-12,-2)_{i,t}$  is the momentum, calculated by cumulative return during month  $t-12$  and month  $t-2$ ,  $STDTO_{i,t}$  is the standard deviation of monthly volume turnover during the last 12 months,  $LOG(BM_{i,t})$  is the logarithm of book-to-market value of equity ratio,  $COSKEWNESS_{i,t}$  is the co-skewness measure. Appendix provides the detailed description of these variables. We estimate regression model (4) with clustered standard errors by stock and time and show the results in Panel A of Table 3. <sup>2)</sup>

The first two column results show that contemporaneous stock returns are significantly and negatively related to volatility shock, indicating that an increase in market volatility results in a decrease in contemporaneous stock returns. The negative relation between volatility shocks and contemporaneous stock returns is consistent with the positive relation between expected risk premiums and volatility (French, Schwert, and Stambaugh, 1987). That is, as investors require a higher return due to an unexpected increase in market volatility, share price (which is the present value of future cash flows discounted at the required rate of return) declines, resulting in a decrease in stock returns. The results also show that contemporaneous stock returns are significantly and positively related to liquidity shock, regardless of whether we measure liquidity shock by  $\Delta AMIHUD$  or  $\Delta SPREAD$ , indicating that an increase in individual stock liquidity results in an increase in contemporaneous stock returns.

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2) For robustness check, we also estimate regression model (4) with firm fixed effects and standard errors clustered by firm. We find that although the results for contemporaneous returns are qualitatively similar,  $t$ -values for the coefficients on  $\Delta VIXKO$ ,  $\Delta AMIHUD$ ,  $\Delta VIXKO * \Delta AMIHUD$ ,  $\Delta SPREAD$ ,  $\Delta VIXKO * \Delta SPREAD$  are much larger than those provided in Table 3.

Table 3. Regression Results for the Effects of Market Volatility on Stock Liquidity and Returns

## Panel A. Effects of market volatility shock on stock returns

Variables	(1)	(2)	(3)	(4)
	RET(t)	RET(t)	RET(t+1)	RET(t+1)
$\Delta$ VIXKO	-0.0560** (-2.41)	-0.0407* (-1.81)	0.0154 (0.82)	0.0191 (0.97)
$\Delta$ AMIHU	0.0078*** (3.56)		0.0023 (1.54)	
$\Delta$ VIXKO* $\Delta$ AMIHU	0.0177* (1.74)		0.0009 (0.21)	
$\Delta$ SPREAD		0.0553*** (8.71)		0.0150* (1.88)
$\Delta$ VIXKO* $\Delta$ SPREAD		0.0536 (1.28)		0.0022 (0.13)
$\Delta$ IVO	0.0670*** (5.52)	0.0762*** (10.16)	-0.0117*** (-3.72)	-0.0117*** (-3.68)
$\Delta$ TRV	0.0011 (1.59)	0.0010 (1.54)	-0.0001 (-1.06)	-0.0001 (-0.98)
$\text{LOG(MVE)}_{i,t-1}$	-0.0018** (-2.05)	-0.0021** (-2.35)	-0.0016* (-1.81)	-0.0017** (-1.99)
CVAMIHU	0.0181*** (4.38)	0.0151*** (3.84)	-0.0027 (-0.74)	-0.0036 (-0.91)
STDTO	0.0067 (1.44)	0.0060* (1.70)	-0.0046* (-1.73)	-0.0039 (-1.43)
LOG(BM)	0.0170*** (6.82)	0.0169*** (6.86)	0.0199*** (7.79)	0.0198*** (7.52)
COSKEWNESS	-0.0288 (-1.05)	-0.0208 (-0.76)	0.0153 (0.79)	0.0123 (0.63)
BETA	0.0011 (0.36)	0.0001 (0.03)	-0.0022 (-1.22)	-0.0020 (-1.08)
RET(-12,-2)	0.0014 (0.88)	0.0009 (0.55)	-0.0004 (-0.21)	-0.0002 (-0.10)
MAXRET	-0.0011** (-1.99)	-0.0017*** (-3.10)	0.0007 (1.57)	0.0007* (1.66)
Constant	0.0457* (1.80)	0.0590** (2.35)	0.0541** (2.17)	0.0584** (2.29)
Number of observations	131,668	127,120	130,488	126,041
R-squared	0.12	0.13	0.01	0.01
Clustered standard errors by stock and time	Yes	Yes	Yes	Yes

Note: \*\*\*, \*\*, and \* denote significance at the 1%, 5% and 10%, respectively. Numbers in columns represent t-statistics.

## Panel B. Effects of market volatility shock on stock liquidity

Variables	(1) $\Delta$ AMIHUD	(2) $\Delta$ SPREAD
$\Delta$ VIXKO	-1.2359*** (-7.79)	-0.4740*** (-9.49)
$\Delta$ IVO	0.3377*** (2.87)	0.0489*** (5.85)
$\Delta$ TRV	0.0022 (1.45)	0.0010 (1.53)
$\text{LOG}(\text{MVE})_{i,t-1}$	0.0473*** (3.05)	0.0113*** (3.23)
CVAMIHUD	-0.4831*** (-5.02)	-0.0111 (-1.21)
STDTO	-0.4585 (-1.21)	-0.0181*** (-2.65)
$\text{LOG}(\text{BM})$	0.0142 (0.45)	0.0002 (0.04)
COSKEWNESS	-0.0146 (-0.08)	-0.0324 (-0.66)
BETA	-0.0491*** (-3.11)	-0.0073** (-2.17)
$\text{RET}(-12,-2)$	0.1267*** (3.15)	0.0225*** (4.24)
MAXRET	0.0489*** (7.94)	0.0151*** (15.44)
Constant	-1.1303** (-2.41)	-0.3660*** (-3.81)
Number of observations	131,668	127,120
R-squared	0.07	0.19
Clustered standard errors by stock and time	Yes	Yes

Note: \*\*\*, \*\*, and \* denote significance at the 1%, 5% and 10%, respectively. Numbers in parentheses represent t-statistics

The positive relation between liquidity shocks and contemporaneous stock returns is consistent with the positive relation between expected returns and illiquidity (i.e., investors demand a premium for less liquid stocks) (Amihud and Mendelson, 1986).



The regression coefficient on the interaction term between volatility shock and liquidity shock is positive and significant when we measure liquidity by AMIHUD. This result indicates that the negative effect of an increase in market volatility on stock returns is greater for stocks with a larger concurrent increase in illiquidity as measured by the price impact of a trade (i.e., the adverse selection component of the spread). However, the regression coefficient on the interaction term between volatility shock and liquidity shock is insignificant when we measure liquidity by SPREAD. These results suggest that the negative effect of market volatility on stock returns increases with only a concurrent increase in the adverse selection cost.

The results show that the coefficients on idiosyncratic volatility shock ( $\Delta IVO$ ) (i.e., unexpected change in the idiosyncratic volatility of individual securities) are positive and significant, indicating that contemporaneous stock returns increase with unexpected increases in the idiosyncratic volatility of individual securities. Contemporaneous stock returns are positively and significantly related to CVAMIHUD and LOG(BM), but negatively and significantly related to LOG(MVE) and MAXRET, which is consistent with the finding of Bali, Peng, Shen, and Tang (2014).

Column (3) and Column (4) in Table 3 show that one-month ahead stock returns ( $RET_{i,t+1}$ ) are not significantly related to volatility shock, indicating that the market does not underreact to volatility shock.<sup>3)</sup> The results also show that one-month ahead stock returns are not significantly related to liquidity shock measured by unexpected changes in the price impact of a trade (the Amihud measure). We find, however, that one-month ahead stock returns are significantly and positively related to liquidity shock measured by unexpected changes in the quoted bid-ask spread. These results suggest that the market tends to underreact to unexpected changes in the total trading cost (i.e., the spread), but not to unexpected changes in the adverse selection component of

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3) We find that the coefficients on  $\Delta VIXKO$  in the regressions for one-month ahead stock returns are positive and significant when we estimate regression model (4) with firm fixed effects and standard errors clustered by firm. Hence, we have mixed results regarding whether or not the market underreacts to volatility shocks, which depends on the estimation method.

the spread (i.e., the price impact of a trade).<sup>4)</sup> The regression coefficients on the interaction term between volatility shock and liquidity shock are not significantly different from zero, regardless of whether we use the Amihud measure or the quoted spread. This result indicates that the negative effect of an increase in market volatility on one-month ahead stock returns does not vary with liquidity shock in the current month.

Our empirical model (regression model (4)) implicitly assumes that increases in market volatility result in concurrent decreases in stock liquidity. To shed some light on the empirical validity of this assumption, we analyze the relation between stock liquidity and market volatility by regressing our measures of liquidity shock (i.e.,  $\Delta\text{AMIHU}$  and  $\Delta\text{SPREAD}$ ) on volatility shock ( $\Delta\text{VIXKO}$ ) and the control variables we used in regression model (4). The results (see Panel B in Table 3) show that the coefficients on  $\Delta\text{VIXKO}$  are negative and significant, regardless of whether we use  $\Delta\text{AMIHU}$  or  $\Delta\text{SPREAD}$  as a measure of liquidity shock, which confirms the validity of our assumption.

#### **IV. Results Using the Proportion of Trades that are Initiated by Different Types of Investors**

Prior research shows that the information content of trading differs across different types of traders. For instance, Park and Chung (2007) show that returns of stocks with high foreign institutional ownership in Korea lead returns of stocks with low foreign institutional ownership. Likewise, returns of stocks with high local institutional ownership lead returns of stocks with low local institutional ownership. Based on these results, the authors conclude that foreign institutional (local institutional) investors have faster access to or processing power of new information than local institutional (local individual) investors. This section examines whether the effect of market volatility on

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4) A decrease in liquidity should result in high future returns in an efficient market (Acharya and Pedersen, 2005). We find that one-month ahead stock returns are significantly and positively related to liquidity shock measured by unexpected changes in both the Amihud measure and the quoted bid-ask spread when we estimate regression model (4) with firm fixed effects and standard errors clustered by firm.

contemporaneous stock returns varies with the proportion of trades that are initiated by domestic institutional investors (PINST), foreign institutional investors (PFORE), and domestic individual investors (PINDI), respectively, across stocks and over time. For this, we estimate the following regression model:

$$\begin{aligned}
 RET_{i,t} = & \beta_0 + \beta_1 \Delta VIXKO_t + \beta_2 (\Delta AMIHU_{i,t} \text{ or } \Delta SPREAD_{i,t}) \\
 & + \beta_3 \Delta VIXKO_t * (\Delta AMIHU_{i,t} \text{ or } \Delta SPREAD_{i,t}) \\
 & + \beta_4 \Delta VIXKO_t * (PINST_{i,t} \text{ or } PFORE_{i,t} \text{ or } PINDI_{i,t}) \\
 & + \beta_5 \Delta VIXKO_t * (\Delta AMIHU_{i,t} \text{ or } \Delta SPREAD_{i,t}) * (PINST_{i,t} \text{ or } PFORE_{i,t} \text{ or } PINDI_{i,t}) \\
 & + \text{control variables} + \varepsilon_{i,t}; \tag{5}
 \end{aligned}$$

Panel A in Table 4 shows the results when we use  $\Delta AMIHU$  and Panel B shows the results when we use  $\Delta SPREAD$  as a measure of liquidity shock. The results show that the regression coefficient on the interaction term between volatility shock and PINST is negative and significant when we use  $\Delta SPREAD$  as a measure of liquidity shock. Similarly, the coefficient on the interaction term between volatility shock and PFORE is negative and significant when we use  $\Delta SPREAD$  as a measure of liquidity shock. These results indicate that the negative effect of an increase in volatility shock on stock returns is greater for stocks with more domestic or foreign institutional trading, which suggests that domestic and foreign institutional investors are sensitive to volatility shock. Surprisingly, we find that the coefficient on the interaction term between volatility shock and PINDI is positive and significant when we use  $\Delta SPREAD$  as a measure of liquidity shock, suggesting that individual traders mitigate the negative effect of an increase in volatility shock on stock returns. One possible interpretation of this result is that individual traders are noise traders who do not fully understand the pricing implication of volatility shock.

Table 4. Results Using the Proportion of Trades that are Initiated by Different Types of Investors

Panel A. Regression results using  $\Delta AMIHU$ D

Variables	(1) RET(t)	(2) RET(t)	(3) RET(t)
$\Delta VIXKO$	-0.0537** (-2.20)	-0.0511** (-2.11)	-0.0649*** (-3.08)
$\Delta AMIHU$ D	0.0077*** (3.51)	0.0077*** (3.53)	0.0077*** (3.50)
$\Delta VIXKO * \Delta AMIHU$ D	0.0154* (1.77)	0.0138 (1.35)	0.0563** (2.13)
$\Delta VIXKO * PINST$	-0.0103 (-0.42)		
$\Delta VIXKO * PFORE$		-0.0563 (-0.93)	
$\Delta VIXKO * PINDI$			0.0128 (0.69)
$\Delta VIXKO * \Delta AMIHU * PINST$	0.0463 (1.33)		
$\Delta VIXKO * \Delta AMIHU * PFORE$		0.0995** (2.44)	
$\Delta VIXKO * \Delta AMIHU * PINDI$			-0.0424** (-2.00)
CONTROL	YES	YES	YES

Panel B. Regression results using  $\Delta SPREAD$

Variables	(1) RET(t)	(2) RET(t)	(3) RET(t)
$\Delta VIXKO$	-0.0339 (-1.44)	-0.0304 (-1.34)	-0.0772*** (-3.42)
$\Delta SPREAD$	0.0558*** (8.71)	0.0562*** (8.92)	0.0561*** (8.80)
$\Delta VIXKO * \Delta SPREAD$	0.0551 (1.51)	0.0473 (1.13)	0.0746 (0.89)
$\Delta VIXKO * PINST$	-0.0495** (-2.08)		
$\Delta VIXKO * PFORE$		-0.1435** (-2.33)	
$\Delta VIXKO * PINDI$			0.0462** (2.49)
$\Delta VIXKO * \Delta SPREAD * PINST$	-0.0038 (-0.05)		
$\Delta VIXKO * \Delta SPREAD * PFORE$		0.1496** (2.34)	
$\Delta VIXKO * \Delta SPREAD * PINDI$			-0.0226 (-0.43)
CONTROL	YES	YES	YES

Note: \*\*\*, \*\*, and \* denote significance at the 1%, 5% and 10%, respectively. Numbers in parentheses represent t-statistics.

The coefficients on  $\Delta VIXKO * \Delta AMIHU * PFORE$  and  $\Delta VIXKO * \Delta SPREAD * PFORE$  are positive and significant, indicating that the interaction effect of market volatility and liquidity on stock returns is stronger for stocks with larger foreign institutional trading. However, the coefficients on  $\Delta VIXKO * \Delta AMIHU * PINST$  and  $\Delta VIXKO * \Delta SPREAD * PINST$  are not significantly different from zero, indicating that the interaction effect of market volatility and liquidity on stock returns does not depend on domestic institutional trading. The coefficient on  $\Delta VIXKO * \Delta AMIHU * PINDI$  is negative and significant when we use  $\Delta AMIHU$  as a measure of liquidity shock, which suggests that the interaction effect of market volatility and liquidity on stock returns is weaker for stocks with larger individual trading.

Brennan et al. (2012) show that sell-order liquidity is priced more strongly than buy-order liquidity in the cross-section of equity returns. Chiyachantana et al. (2004) report asymmetries in price impacts between institutional buy and sell orders. The authors show that institutional buys exert a larger price impact than institutional sells in bull markets, whereas institutional buys exert a smaller price impact than institutional sells in bear markets. To examine whether the effect of volatility shock on stock returns is different between buyer- and seller-initiated trades, we estimate regression model (5) using the percentage of trades that are buyer- and seller-initiated separately.

Panel A in Table 5 shows the results using the percentage of trades that are buyer-initiated for each type of traders and Panel B shows the results using the percentage of trades that are seller-initiated for each type of traders. In both panels, the first three columns show the results when we measure liquidity shock by  $\Delta AMIHU$  and the next three columns show the results when we measure liquidity shock by  $\Delta SPREAD$ . The results show that the coefficients on  $\Delta VIXKO$ ,  $\Delta AMIHU$ ,  $\Delta SPREAD$ ,  $\Delta VIXKO * \Delta AMIHU$ , and  $\Delta VIXKO * \Delta SPREAD$  in both panels of Table 5 are qualitatively similar to those in Table 4, which indicates that separating trades into buyer- or seller-initiated trades does not change our main results. We find that the coefficients on the interaction term between volatility shock and the percentage trades that are initiated by individual investors are positive and significant only for seller-initiated trades,

suggesting that individual traders mitigate the negative effect of an increase in volatility shock on stock returns only for these trades.

The regression coefficients on the interaction term between volatility shock and the percentage of trades that are initiated by domestic or foreign institutional investors are negative and significant only for buyer-initiated trades and when we use  $\Delta\text{SPREAD}$  as a measure of liquidity shock. This result indicates that the negative effect of an increase in volatility shock on stock returns is greater for stocks with more domestic or foreign institutional buy trading.

Table 5. Results Using the Proportion of Buyer-initiated and Seller-initiated Trades

Panel A. Regression results using the percentage of trades that are buyer-initiated for each trader type

Variables	Results using $\Delta AMIHUD$		Results using $\Delta SPREAD$			
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta VIXKO$	RET(t) -0.0520** (-2.12)	RET(t) -0.0515** (-2.08)	RET(t) -0.0404* (-1.82)	RET(t) -0.0327 (-1.37)	RET(t) -0.0321 (-1.38)	RET(t) -0.0457** (-2.02)
$\Delta AMIHUD$ or $\Delta SPREAD$	0.0078*** (3.54)	0.0078*** (3.55)	0.0077*** (3.50)	0.0555*** (8.68)	0.0559*** (8.84)	0.0562*** (8.84)
$\Delta VIXKO * \Delta AMIHUD$	0.0171* (1.90)	0.0177* (1.75)	0.0573*** (3.66)			
$\Delta VIXKO * \Delta SPREAD$				0.0643* (1.72)	0.0573 (1.37)	0.1380** (2.05)
$\Delta VIXKO * PBINST$	-0.0532 (-0.89)			-0.1251** (-2.27)		
$\Delta VIXKO * PBF0RE$		-0.1546 (-1.27)			-0.2973*** (-2.74)	
$\Delta VIXKO * PBINDI$						0.0157 (0.36)
$\Delta VIXKO * \Delta AMIHUD * PBINST$	0.0309 (0.46)		-0.0367 (-0.92)			
$\Delta VIXKO * \Delta AMIHUD * PBF0RE$		0.0143 (0.17)				
$\Delta VIXKO * \Delta AMIHUD * PBINDI$			-0.0896*** (-4.80)			
$\Delta VIXKO * \Delta SPREAD * PBINST$				-0.2149* (-1.71)		
$\Delta VIXKO * \Delta SPREAD * PBF0RE$					-0.1427 (-1.23)	
$\Delta VIXKO * \Delta SPREAD * PBINDI$						-0.1915** (-2.44)
CONTROL	YES	YES	YES	YES	YES	YES

Note: \*\*\*, \*\*, and \* denote significance at the 1%, 5% and 10%, respectively. Numbers in parentheses represent t-statistics.

Panel B. Regression results using the percentage of trades that are seller-initiated for each trader type

Variables	Results using $\Delta AMIHUD$			Results using $\Delta SPREAD$		
	(1) RET(t)	(2) RET(t)	(3) RET(t)	(4) RET(t)	(5) RET(t)	(6) RET(t)
$\Delta VIXKO$	-0.0559** (-2.32)	-0.0527** (-2.24)	-0.0927*** (-3.35)	-0.0364 (-1.60)	-0.0328 (-1.49)	-0.0998*** (-3.49)
$\Delta AMIHUD$ or $\Delta SPREAD$	0.0076*** (3.48)	0.0077*** (3.55)	0.0078*** (3.54)	0.0563*** (8.80)	0.0560*** (8.89)	0.0558*** (8.79)
$\Delta VIXKO * \Delta AMIHUD$	0.0142 (1.62)	0.0125 (1.16)	0.0210 (0.61)			
$\Delta VIXKO * \Delta SPREAD$				0.0459 (1.23)	0.0424 (0.99)	-0.0317 (-0.42)
$\Delta VIXKO * PSINST$	0.0156 (0.39)			-0.0561 (-1.30)		
$\Delta VIXKO * PSFORE$		-0.0466 (-0.37)			-0.1847 (-1.43)	
$\Delta VIXKO * PSINDI$			0.0896* (1.87)			0.1430*** (3.32)
$\Delta VIXKO * \Delta AMIHUD * PSINST$	0.1343** (2.29)					
$\Delta VIXKO * \Delta AMIHUD * PSFORE$		0.2055*** (3.12)				
$\Delta VIXKO * \Delta AMIHUD * PSINDI$			-0.0062 (-0.10)			
$\Delta VIXKO * \Delta SPREAD * PSINST$				0.2257 (1.40)		
$\Delta VIXKO * \Delta SPREAD * PSFORE$					0.3927*** (2.69)	
$\Delta VIXKO * \Delta SPREAD * PSINDI$						0.1995** (2.28)
CONTROL	YES	YES	YES	YES	YES	YES

Note: \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10%, respectively. Numbers in parentheses represent t-statistics.



## V. Does the Effect of Market Volatility on Stock Returns Vary with Market Environments?

The effect of market volatility on liquidity and stock returns may vary with market environments. In particular, we conjecture that the effect of market volatility on liquidity and stock returns could be particularly strong during times of financial crisis because investors are believed to be more risk averse during such times. To test this conjecture, we estimate regression model (5) using data during the pre-crisis period (2004-2006), the crisis period (2007-2009), and the post-crisis period (2010-2014), separately. Panel A in Table 6 shows the results using  $\Delta AMIHU$  and Panel B shows the results using  $\Delta SPREAD$  as a measure of liquidity shock.

Panel A shows that the effect of liquidity shock on stock returns is positive and significant during both the crisis period and the post-crisis period, but not significant during the pre-crisis period. The results also show that the coefficients on the interaction term between volatility shock and liquidity shock are positive and significant during only the crisis period, which indicates that the negative effect of an increase in market volatility on stock returns is greater for stocks with a larger concurrent decrease in liquidity only during the crisis period. These results suggest that the volatility-shock-induced liquidity change plays a more important role in asset pricing during the crisis period than during the non-crisis period.

Table 6. The Effects of Market Volatility on Stock Returns in Different Market Environments

Panel A. Regression results using  $\Delta AMIHUD$ 

Variables	Pre-crisis period (2004–2006)			Crisis period (2007–2009)			Post-crisis period (2010–2014)		
	(1) RET(t)	(2) RET(t)	(3) RET(t)	(4) RET(t)	(5) RET(t)	(6) RET(t)	(7) RET(t)	(8) RET(t)	(9) RET(t)
$\Delta VIXKO$	-0.1016*	-0.0966*	-0.1048**	-0.0457	-0.0404	-0.0917**	-0.0426	-0.0424	-0.0600**
	(-1.68)	(-1.66)	(-2.18)	(-1.36)	(-1.29)	(-2.52)	(-1.16)	(-1.15)	(-2.19)
$\Delta AMIHUD$	0.0021	0.0022	0.0021	0.0104***	0.0106***	0.0104***	0.0147***	0.0145***	0.0147***
	(1.26)	(1.26)	(1.25)	(3.06)	(3.08)	(3.04)	(3.39)	(3.19)	(3.36)
$\Delta VIXKO * \Delta AMIHUD$	0.0046	0.0044	0.0299	0.0252**	0.0244**	0.0783***	0.0070	0.0030	-0.0090
	(0.46)	(0.46)	(0.57)	(2.42)	(2.02)	(3.52)	(1.13)	(0.28)	(-0.27)
$\Delta VIXKO * PINST$	0.0108			-0.0450			-0.0232		
	(0.13)			(-1.26)			(-0.63)		
$\Delta VIXKO * PFORE$		-0.0830			-0.1976**			-0.0348	
		(-0.59)			(-2.40)			(-0.40)	
$\Delta VIXKO * PINDI$			0.0055			0.0496*			0.0183
			(0.08)			(1.92)			(0.64)
$\Delta VIXKO * \Delta AMIHUD * PINST$	0.0254			0.0654**			-0.0329		
	(0.43)			(2.19)			(-0.65)		
$\Delta VIXKO * \Delta AMIHUD * PFORE$		0.0954			0.1227***			0.0209	
		(0.75)			(3.36)			(0.28)	
$\Delta VIXKO * \Delta AMIHUD * PINDI$			-0.0256			-0.0543***			0.0160
			(-0.48)			(-3.55)			(0.45)
CONTROL	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table shows the regression results using data during the pre-crisis period (2004-2006), the crisis period (2007-2009), and the post-crisis period (2010-2014), separately. Panel A shows the results using  $\Delta AMIHUD$  as a measure of liquidity shock. \*\*\*, \*\*, and \* denote significance at the 1%, 5% and 10%, respectively. Numbers in parentheses represent t-statistics.

Panel B. Regression results using  $\Delta$ SPREAD

Variables	Pre-crisis period (2004–2006)		Crisis period (2007–2009)		Post-crisis period (2010–2014)				
	(1) RET(t)	(2) RET(t)	(3) RET(t)	(4) RET(t)	(5) RET(t)	(6) RET(t)	(7) RET(t)	(8) RET(t)	(9) RET(t)
$\Delta$ VIXKO	-0.0716 (-1.14)	-0.0686 (-1.13)	-0.1143*** (-2.65)	-0.0290 (-0.87)	-0.0229 (-0.74)	-0.1009*** (-2.75)	-0.0372 (-0.96)	-0.0378 (-0.99)	-0.0582** (-2.16)
$\Delta$ SPREAD	0.0382*** (3.35)	0.0387*** (3.38)	0.0384*** (3.35)	0.0533*** (3.22)	0.0544*** (3.33)	0.0540*** (3.30)	0.0543*** (9.25)	0.0534*** (9.24)	0.0542*** (9.22)
$\Delta$ VIXKO* $\Delta$ SPREAD	0.0550 (0.86)	0.0421 (0.64)	0.0880 (0.64)	0.0737 (1.63)	0.0656 (1.33)	0.0718 (0.68)	0.0296 (1.15)	0.0223 (0.86)	0.0995*** (2.62)
$\Delta$ VIXKO*PINST	-0.0424 (-0.52)			-0.0803*** (-2.69)			-0.0279 (-0.81)		
$\Delta$ VIXKO*PFORE		-0.1607 (-1.07)			-0.2671*** (-2.81)			-0.0374 (-0.44)	
$\Delta$ VIXKO*PINDI			0.0460 (0.68)			0.0765*** (3.09)			0.0221 (0.80)
$\Delta$ VIXKO* $\Delta$ SPREAD*PINST	-0.0030 (-0.02)			-0.0356 (-0.41)			0.0798 (1.29)		
$\Delta$ VIXKO* $\Delta$ SPREAD*PFORE		0.3255 (1.18)			0.1266 (1.54)			0.1610 (1.20)	
$\Delta$ VIXKO* $\Delta$ SPREAD*PINDI			-0.0401 (-0.29)			-0.0009 (-0.01)			-0.0755 (-1.48)
CONTROL	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table shows the regression results using data during the pre-crisis period (2004–2006), the crisis period (2007–2009), and the post-crisis period (2010–2014), separately. Panel B shows the results using  $\Delta$ SPREAD as a measure of liquidity shock. \*\*\*, \*\*, and \* denote significance at the 1%, 5% and 10%, respectively. Numbers in parentheses represent t-statistics.

We find that the coefficients on the interaction term between volatility shock and PFORE are negative and significant during only the crisis period, suggesting that the negative effect of an increase in volatility shock on stock returns is greater for stocks with more foreign institutional trading during only the crisis period. Such effect does not present during the non-crisis period. The coefficients on the interaction term between volatility shock and PINDI are positive and significant during only the crisis period, which suggests that individual traders mitigate the negative effect of an increase in volatility shock on stock returns only during the crisis period.

The coefficients on the three-way interaction terms [i.e.,  $\Delta VIXKO * \Delta AMIHUD * (PFORE \text{ or } PINST)$ ] are positive and significant during the crisis period, but are not significantly different from zero during the non-crisis period, indicating that the interaction effect of market volatility and liquidity on stock returns is stronger for stocks with larger foreign or domestic institutional trading only during the crisis period. In contrast, we find that the coefficients on  $\Delta VIXKO * \Delta AMIHUD * PINDI$  are negative and significant during the crisis period, but are not significantly different from zero during the non-crisis period, which indicates that the interaction effect of market volatility and liquidity on stock returns is weaker for stocks with larger individual trading during the crisis period.

Panel B shows that the effect of liquidity shocks (measured by unexpected changes in the Amihud price impact) on stock returns is positive and significant during both the crisis period and the non-crisis period. However, the coefficients on the interaction term between volatility shock and institutional trading (PINST and PFORE) are negative and significant during only the crisis period, which indicates that the negative effect of an increase in volatility shock on stock returns is greater for stocks with more institutional trading during only the crisis period. We find that the coefficients on the interaction term between volatility shock and PINDI are positive and significant during only the crisis period, suggesting that individual traders mitigate the negative effect of an increase in volatility shock on stock returns only during the crisis period. None of the coefficients on the three-way interaction terms are significantly different from zero even during the crisis period.

## VI. Results Using Measures of Volatility Shock in the US and Europe

In this section we analyze whether volatility shock in the global market places affects Korean stock returns. To conduct this analysis, we first measure volatility shock in the US market by  $\Delta VIXUS_t = (VIX_t - AVG VIX_{t-12,t-1})/AVG VIX_{t-12,t-1}$ , where  $VIX_t$  is the Chicago Board Options Exchange (CBOE) market volatility index in month  $t$  and  $AVG VIX_{t-12,t-1}$  is the mean value of the CBOE market volatility index in the past 12 months. Similarly, we measure volatility shock in the European market by  $\Delta VIXEU_t = (VIXEU_t - AVG VIXEU_{t-12,t-1})/AVG VIXEU_{t-12,t-1}$ , where  $VIXEU_t$  is the Euro STOXX50 volatility index in month  $t$  and  $AVG VIXEU_{t-12,t-1}$  is the mean value of the Euro volatility index in the past 12 months. We then reproduce Table 3 using  $\Delta VIXUS$  and  $\Delta VIXEU$  in lieu of  $\Delta VIXKO$ .

The first four columns in Table 7 show the results using volatility shock in the US market and the next four columns show the results using volatility shock in the European market. The results in column (1), column (2), column (5), and column (6) show that there is a significant and negative relation between contemporaneous stock returns in Korea and volatility shock, regardless of whether we use volatility shock in the US or European markets. In contrast, the results in column (3), column (4), column (7), and column (8) show that one-month ahead stock returns are not significantly related to volatility shock in the US or European markets. These results suggest that the Korean stock market does not underreact to volatility shock in the US or European markets.

The results in column (1), column (2), column (5), and column (6) show that there is a significant and positive relation between contemporaneous stock returns and both measures of liquidity shock (i.e.,  $\Delta AMIHU$  and  $\Delta SPREAD$ ). Similarly, the results in column (4), column (7), and column (8) show that one-month ahead stock returns are also significantly and positively related to liquidity shock. These results suggest that the Korean stock market underreacts to liquidity shock that is triggered by volatility shock in the US or European markets.

Column (1), column (2), column (5), and column (6) show that the

coefficients on the interaction term between volatility shock and both measures of liquidity shock are all positive and significant, regardless of whether we use volatility shock in the US or European markets. These results indicate that the negative effect of an increase in US or European market volatility on contemporaneous Korean stock returns is greater for stocks with a larger concurrent decrease in liquidity. In contrast, columns (3), (4), (7), and (8) show that the coefficients on the interaction term between volatility shock and both measures of liquidity shock are not significantly different from zero, regardless of whether we use volatility shock in the US or European markets. These results should not come as a surprise given the fact that one-month ahead stock returns in Korea are not significantly related to volatility shock in the US or European markets in the first place.

The results for control variables are similar to those reported in Table 3. Contemporaneous stock returns increase with  $\Delta IVO$ ,  $CVAMIHU$ , and  $LOG(BM)$ , but decrease with  $LOG(MVE)$  and  $MAXRET$ . We reproduce both panels in Table 4 using volatility shock in the US market and provide the results in Panel A of Table 8. Likewise, we reproduce both panels in Table 4 using volatility shock in the European market and provide the results in Panel B of Table 8. Again, we find that the results in Table 8 are qualitatively identical to those in Table 4.

On the whole, our results show that the relation between stock returns in Korea and volatility shock is qualitatively similar, regardless of whether we use volatility shock in Korea, the US, or Europe.<sup>5)</sup> We interpret these results as evidence of an integrated global market in which volatility shocks are highly correlated across markets because they are likely to arise largely from a common set of state variables and economic fundamentals.

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5) We conduct the regression analyses using the residuals of  $VIXKO$  after accounting for the global market volatilities ( $VIXUS$ ,  $VIXEU$ ) instead of  $VIXKO$  in regression model (4). We find that the coefficients of residuals of  $VKOSPI$  become insignificant, implying that the global market volatilities play a significant role in explaining stock market returns.

Table 7. Results Using Measures of Volatility Shock in the US and Europe

Variables	ΔVIXUS				ΔVIXEU			
	(1) RET(t)	(2) RET(t)	(3) RET(t+1)	(4) RET(t+1)	(5) RET(t)	(6) RET(t)	(7) RET(t+1)	(8) RET(t+1)
ΔVIXUS or ΔVIXEU	-0.0556** (-2.34)	-0.0468** (-2.05)	0.0182 (1.04)	0.0215 (1.17)	-0.0619** (-2.27)	-0.0520** (-2.00)	0.0228 (1.19)	0.0261 (1.29)
ΔAMIHUD	0.0073*** (3.66)	0.0022 (1.64)	0.0022 (1.64)	0.0076*** (3.58)	0.0076*** (3.58)	0.0023* (1.68)	0.0031 (0.88)	
(ΔVIXUS or ΔVIXEU)*ΔAMIHUD	0.0203*** (2.77)	0.0027 (0.72)	0.0027 (0.72)	0.0187** (2.31)	0.0187** (2.31)	0.0031 (0.88)		
ΔSPREAD		0.0493*** (6.95)		0.0148** (2.17)		0.0488*** (6.53)		0.0158** (2.21)
(ΔVIXUS or ΔVIXEU)*ΔSPREAD		0.0526* (1.73)		0.0081 (0.53)		0.0594** (2.10)		0.0075 (0.47)
ΔIVO	0.0687*** (6.01)	0.0776*** (10.84)	-0.0119*** (-3.96)	-0.0119*** (-3.93)	0.0679*** (5.87)	0.0776*** (10.99)	-0.0120*** (-3.91)	-0.0120*** (-3.90)
ΔTRV	0.0011 (1.59)	0.0010 (1.54)	-0.0001 (-1.06)	-0.0001 (-0.98)	0.0011 (1.59)	0.0010 (1.54)	-0.0001 (-1.05)	-0.0001 (-0.98)
LOG(MVE) <sub>t-1</sub>	-0.0019** (-2.23)	-0.0021** (-2.47)	-0.0016* (-1.86)	-0.0018** (-2.01)	-0.0018** (-2.16)	-0.0021** (-2.49)	-0.0016* (-1.89)	-0.0017** (-1.99)
CVAMIHUD	0.0177*** (4.23)	0.0155*** (3.91)	-0.0027 (-0.77)	-0.0037 (-0.98)	0.0172*** (4.03)	0.0154*** (3.84)	-0.0027 (-0.75)	-0.0037 (-0.97)
STDTO	0.0058 (1.37)	0.0058 (1.64)	-0.0045* (-1.69)	-0.0038 (-1.40)	0.0055 (1.35)	0.0060* (1.70)	-0.0045* (-1.70)	-0.0039 (-1.42)
LOG(BM)	0.0165*** (6.31)	0.0165*** (6.35)	0.0200*** (7.85)	0.0199*** (7.57)	0.0164*** (6.33)	0.0167*** (6.45)	0.0200*** (7.87)	0.0199*** (7.58)
COSKEWNESS	-0.0360 (-1.31)	-0.0272 (-0.98)	0.0171 (0.91)	0.0145 (0.76)	-0.0364 (-1.32)	-0.0278 (-1.01)	0.0176 (0.92)	0.0151 (0.79)
BETA	0.0015 (0.48)	0.0002 (0.07)	-0.0021 (-1.22)	-0.0020 (-1.09)	0.0016 (0.51)	0.0003 (0.10)	-0.0022 (-1.23)	-0.0020 (-1.11)
RET(-12,-2)	0.0011 (0.74)	0.0008 (0.49)	-0.0003 (-0.19)	-0.0002 (-0.08)	0.0011 (0.69)	0.0007 (0.44)	-0.0003 (-0.20)	-0.0002 (-0.08)
MAXRET	-0.0012** (-2.06)	-0.0016*** (-2.86)	0.0007 (1.56)	0.0007* (1.68)	-0.0012** (-2.11)	-0.0016*** (-2.83)	0.0006 (1.50)	0.0007 (1.57)
Number of observations	131,668	127,120	130,488	126,041	131,668	127,120	130,488	126,041
R-squared	0.13	0.14	0.01	0.01	0.13	0.14	0.01	0.01

Note: This table shows whether and how volatility shock in the global market places affects Korean stock returns. We reproduce Table 3 using ΔVIXUS and ΔVIXEU in lieu of ΔVIXKO. The first four columns show the results using volatility shock in the US market and the next four columns show the results using volatility shock in the European market.

Table 8. Results Using Measures of Volatility Shock in the US and Europe and the Proportion of Trades that are Initiated by Different Types of Investors

Panel A. Results using  $\Delta VIXUS$

Variables	(1) RET(t)	(2) RET(t)	(3) RET(t)	(4) RET(t)	(5) RET(t)	(6) RET(t)
$\Delta VIXUS$	-0.0524** (-2.10)	-0.0468* (-1.88)	-0.0736*** (-3.45)	-0.0404* (-1.71)	-0.0339 (-1.47)	-0.0843*** (-3.86)
$\Delta AMIHUD$	0.0073*** (3.60)	0.0073*** (3.61)	0.0072*** (3.59)			
$\Delta VIXUS * \Delta AMIHUD$	0.0183*** (2.62)	0.0183** (2.15)	0.0492*** (3.16)			
$\Delta SPREAD$				0.0498*** (7.14)	0.0504*** (7.23)	0.0502*** (7.23)
$\Delta VIXUS * \Delta SPREAD$				0.0536** (2.07)	0.0499 (1.61)	0.0704 (1.06)
$\Delta VIXUS * PINST$	-0.0164 (-0.67)			-0.0458** (-2.08)		
$\Delta VIXUS * PFORE$		-0.1219** (-2.12)			-0.1819*** (-3.26)	
$\Delta VIXUS * PNDI$			0.0240 (1.29)			0.0477*** (2.80)
$\Delta VIXUS * \Delta AMIHUD * PINST$	0.0395 (1.64)					
$\Delta VIXUS * \Delta AMIHUD * PFORE$		0.0581 (1.29)				
$\Delta VIXUS * \Delta AMIHUD * PNDI$						
$\Delta VIXUS * \Delta SPREAD * PINST$			-0.0316* (-1.93)			
$\Delta VIXUS * \Delta SPREAD * PFORE$				0.0010 (0.01)		
$\Delta VIXUS * \Delta SPREAD * PNDI$					0.0898* (1.66)	
CONTROL	YES	YES	YES	YES	YES	YES

Note: This table reports the results of using volatility shocks in the US market. We reproduce both panels in Table 4 using volatility shock in the US market and provide the results in Panel A.



Panel B. Results using  $\Delta VIXEU$ 

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	RET(t)	RET(t)	RET(t)	RET(t)	RET(t)	RET(t)
$\Delta VIXEU$	-0.0579** (-1.99)	-0.0510* (-1.73)	-0.0834*** (-3.71)	-0.0440 (-1.59)	-0.0360 (-1.33)	-0.0974*** (-4.33)
$\Delta AMIHU$	0.0075*** (3.50)	0.0076*** (3.46)	0.0075*** (3.46)			
$\Delta VIXEU * \Delta AMIHU$	0.0166** (2.05)	0.0167* (1.74)	0.0505*** (3.57)			
$\Delta SPREAD$				0.0493*** (6.67)	0.0499*** (6.76)	0.0497*** (6.74)
$\Delta VIXEU * \Delta SPREAD$				0.0605** (2.49)	0.0588** (2.00)	0.0755 (1.20)
$\Delta VIXEU * \Delta PINST$	-0.0194 (-0.61)			-0.0553** (-1.97)		
$\Delta VIXEU * \Delta PFORE$		-0.1449* (-1.90)			-0.2189*** (-3.48)	
$\Delta VIXEU * \Delta PINDI$			0.0290 (1.15)			0.0581*** (2.65)
$\Delta VIXEU * \Delta AMIHU * \Delta PINST$	0.0432* (1.86)					
$\Delta VIXEU * \Delta AMIHU * \Delta PFORE$		0.0629 (1.15)				
$\Delta VIXEU * \Delta AMIHU * \Delta PINDI$			-0.0346** (-1.97)			
$\Delta VIXEU * \Delta SPREAD * \Delta PINST$				0.0032 (0.04)		
$\Delta VIXEU * \Delta SPREAD * \Delta PFORE$					0.0529 (0.89)	
$\Delta VIXEU * \Delta SPREAD * \Delta PINDI$						-0.0163 (-0.36)
CONTROL	YES	YES	YES	YES	YES	YES

Note: This table reports the results of using volatility shocks in the European market. We reproduce both panels in Table 4 using volatility shock in the US market and provide the results in Panel B.

## VII. Summary and Concluding Remarks

This paper investigates the effects of market volatility on stock liquidity and returns in the Korean stock market. We show that unexpected changes in market volatility exert a significant impact on both the liquidity and returns of individual stocks. In particular, we show that volatility shock exerts a greater impact on stock returns when stock liquidity decreases more in response to an increase in market volatility. Put differently, a stock's price is more sensitive to unexpected changes in market volatility when its liquidity providers react more strongly to unexpected changes in market uncertainty. We also show that stock return sensitivity to unexpected changes in market volatility depend on the extent of trading by certain types of investors. Specifically, we show that stock returns decline more in response to unexpected increases in market volatility when there is more trading by foreign or domestic institutional investors. We also document some evidence of asymmetric effects of market volatility on stock returns that are related to whether trades are buyer- or seller-initiated.

Consistent with our expectation, we find evidence that the effect of market volatility on stock liquidity and returns varies with market environments. In particular, we show that market volatility and liquidity play a more important role in asset pricing during the crisis period than the non-crisis period. Finally, we show that stock returns in Korea react similarly to market volatility in Korea, the US, and Europe, which suggests an integrated global market in which volatility shocks are highly correlated across markets. In short, our study sheds additional light on the effects of market volatility on stock returns by underscoring the roles of liquidity providers, different types of traders, and market environments. We show that market volatility exerts a stronger impact on stock returns when liquidity providers are more reactive to market uncertainty, when there is more institutional trading, and during the crisis period.

A fruitful area of future research would be the equilibrium asset pricing implication of the cross-sectional variation in the sensitivity of stock

returns to market volatility. For instance, it would be interesting to find out whether stocks with returns that are more sensitive to changes in market volatility provide investors with higher average returns in the long run. In a similar vein, the results of our study suggest that stocks with greater institutional trading will have higher expected returns.

Liquidity suppliers in the Korean stock market are fundamentally different from traditional market makers (e.g., NYSE specialists and NASDAQ dealers) because they do not have an affirmative obligation to maintain a fair and orderly market. As a result, liquidity providers in the Korean stock market, including high-frequency traders, are likely to provide liquidity opportunistically based on their perceived adverse selection risks. To the extent that uncertainty shock exerts a greater impact on stock returns when it has a greater effect on stock liquidity, providing liquidity suppliers with an incentive to supply liquidity during times of high market uncertainty could reduce stock return volatility. In this respect, an important policy implication of our finding is that regulatory authorities may consider initiatives that could promote the robust supply of liquidity by market participants even during times of high uncertainty. For example, large liquidity suppliers, including major high-frequency traders, may be required to store order placement and cancelation records and make them available to relevant authorities upon request, incentivizing them to provide the stable and robust supply of liquidity based on certain regulatory policy guidelines and thereby reducing excessive swings in stock returns.

## References

- Acharya, V. V., Pedersen, L. H. (2005), "Asset Pricing with Liquidity Risk," *Journal of Financial Economics*, Vol. 77, pp. 375-410.
- Amihud, Y. (2002), "Illiquidity and Stock Returns: Cross-section and Time-series Effects," *Journal of Financial Markets*, Vol. 5, pp. 31-56.
- Amihud, Y., Mendelson, H. (1986), "Asset Pricing and the Bid-ask Spread," *Journal of Financial Economics*, Vol. 17, pp. 223-249.
- Ang, A. Hodrick, R. J., Xing, Y., Zhang, X. (2006), "The Cross-section of Volatility and Expected Returns," *Journal of Finance*, Vol. 61, pp. 259-299.
- Bali, T. G., Cakici, N., Whitelaw, R. (2011), "Maxing Out: Stocks as Lotteries and the Cross-section of Expected Returns," *Journal of Financial Economics*, Vol. 99, pp. 427-446.
- Bali, T. G., Peng, L., Shen, Y., Tang, Y. (2014), "Liquidity Shocks and Stock Market Reactions," *Review of Financial Studies*, Vol. 27, pp. 1434-1485.
- Bao J, Pan J, Wang J. (2011), "The Illiquidity of Corporate Bonds," *The Journal of Finance*, Vol. 66, pp. 911-946.
- Brennan, M. J., Chordia, T., Subrahmanyam, A., Tong, Q. (2012), "Sell-order Liquidity and the Cross-section of Expected Stock Returns," *Journal of Financial Economics*, Vol. 105, pp. 523-541.
- Chiyachantana, C. N., Jain, P. K., Jiang, C., Wood, R. A. (2004), "International Evidence on Institutional Trading Behavior and Price Impact," *Journal of Finance*, Vol. 59, pp. 869-898.
- Chordia, T., Subrahmanyam, A., Anshuman V. R. (2001), "Trading Activity and Expected Stock Returns," *Journal of Financial Economics*, Vol. 59, pp. 3-32.
- Chung, K. H., Chuwonganant, C. (2014), "Uncertainty, Market Structure, and Liquidity," *Journal of Financial Economics*, Vol. 113, pp. 476-499.

- Chung, K. H., Chuwonganant, C. (2016), "Market Uncertainty, Liquidity, and Stock Returns," University at Buffalo Working Paper, The State University of New York.
- Fama, E. F., French, K. R. (1992), "The Cross-section of Expected Stock Returns," *Journal of Finance*, Vol. 47, pp. 427-465.
- French, K. R., Schwert, G. W., Stambaugh, R. F. (1987), "Expected Stock Returns and Volatility," *Journal of Financial Economics*, Vol. 19, pp. 3-29.
- Gorton, G., Metrick, A. (2010), "Haircuts," *Federal Reserve Bank of St. Louis Review*, Vol. 92, pp. 507-519.
- Graham, J. R., Harvey, C. R. (2010), "The Equity Risk Premium in 2010," Social Science Research Network, <http://ssrn.com/abstract=1654026>, <http://dx.doi.org/10.2139/ssrn.1654026>.
- Harvey, C. R., Siddique, A. (2000), "Conditional Skewness in Asset Pricing Tests," *Journal of Finance*, Vol. 55, pp. 1263-1295.
- Haugen, R. A., Talmor, E., Torous, W. N. (1991), "The Effect of Volatility Changes on the Level of Stock Prices and Subsequent Expected Returns," *Journal of Finance*, Vol. 46, pp. 985-1007.
- Jegadeesh, N., Titman, S. (1993), "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency," *Journal of Finance*, Vol. 48, pp. 65-91.
- Lee, C. and Ready, M.J. (1991), "Inferring Trade Direction from Intraday Data," *Journal of Finance*, Vol. 46, pp. 733-746.
- Longstaff, F., Pan, J., Pedersen, L., Singleton, K. (2010), "How Sovereign is Sovereign Credit Risk?," *American Economic Journal: Macroeconomics*, Vol. 3, pp. 75-103.
- Nagel, S. (2012), "Evaporating Liquidity," *Review of Financial Studies*, Vol. 25, pp. 2005-2039.
- Pan, J., Singleton, K. (2008), "Default and Recovery Implicit in the Term Structure

of Sovereign CDS Spreads,” *Journal of Finance*, Vol. 63, pp. 2345-2384.

Park, Y. K., Chung, K. H. (2007), “Foreign and Local Institutional Ownership and the Speed of Price Adjustment,” *Journal of Business Finance and Accounting*, Vol. 34, pp. 1569-1595.

Petkova, R., Akbas, F., Armstrong, W. (2011), “The Volatility of Liquidity and Expected Stock Returns,” Available at SSRN: <http://ssrn.com/abstract=1786991>

## Appendix. Variable Descriptions

Variable	Definition and Measurement
<i>Volatility shocks</i>	
$\Delta VIXUS_t$	U.S market uncertainty shock calculated as $(VIX_t - AVG VIX_{t-12,t-1}) / AVG VIX_{t-12,t-1}$ where $VIX_t$ is the CBOE(Chicago Board Options Exchange) market volatility index in month t and $AVG VIX_{t-12,t-1}$ is the mean value of the CBOE market volatility index in the past 12 months.
$\Delta VIXKO_t$	Korean market uncertainty shock calculated as $(VIXKO_t - AVG VIXKO_{t-12,t-1}) / AVG VIXKO_{t-12,t-1}$ where $VIXKO_t$ is the KOSPI 200 volatility index in month t and $AVG VIXKO_{t-12,t-1}$ is the mean value of the KOSPI 200 volatility index in the past 12 months.
$\Delta VIXEU_t$	Euro market uncertainty shock calculated as $(VIXEU_t - AVG VIXEU_{t-12,t-1}) / AVG VIXEU_{t-12,t-1}$ where $VIXEU_t$ is the Euro STOXX50 volatility index in month t and $AVG VIXEU_{t-12,t-1}$ is the mean value of the Euro volatility index in the past 12 months.
<i>Liquidity shocks</i>	
$\Delta AMIHUD_{i,t}$	$\Delta AMIHUD_{i,t} = (AMIHUD_{i,t} - AVG AMIHUD_{t-12,t-1}) / AVG AMIHUD_{t-12,t-1}$ where $AMIHUD$ is the Amihud illiquidity measure (Amihud (2002)) and $AVG AMIHUD_{t-12,t-1}$ is the mean value of the Amihud measure in the past 12 months.
$\Delta SPREAD_{i,t}$	$\Delta SPREAD_{i,t} = (SPREAD_{i,t} - AVG SPREAD_{t-12,t-1})$ where $SPREAD$ is the percentage quoted spread and $AVG SPREAD_{t-12,t-1}$ is the mean value of the percentage quoted spread in the past 12 months.
<i>Types of Traders</i>	
$PINST_{i,t}$	Proportion of trades that are initiated by domestic institutional investors for stock i in month t
$PFORE_{i,t}$	Proportion of trades that are initiated by foreign institutional investors for stock i in month t.
$PIND_{i,t}$	Proportion of trades that are initiated by individual investors for stock i in month t
$PSINST_{i,t}$	Proportion of trades that are initiated by domestic institutional investors' sell orders for stock i in month t
$PSFORE_{i,t}$	Proportion of trades that are initiated by foreign institutional investors' sell orders for stock i in month t.
$PSIND_{i,t}$	Proportion of trades that are initiated by individual investors' sell orders for stock i in month t
$PBINST_{i,t}$	Proportion of trades that are initiated by domestic institutional investors' buy orders for stock i in month t
$PBFORE_{i,t}$	Proportion of trades that are initiated by foreign institutional investors' buy orders for stock i in month t
$PBIND_{i,t}$	Proportion of trades that are initiated by individual investors' buy orders for stock i in month t

Variable	Definition and Measurement
<i>Control variables</i>	
$\Delta IVO_{i,t}$	The idiosyncratic volatility shock of stock $i$ in month $t$ . Following Ang, Hodrick, Xing and Zhang (2006), we estimate the regression model: $R_{i,d} - R_{F,d} = \alpha_i + \beta_i (R_{M,d} - R_{F,d}) + \gamma_i SMB_d + \delta_i HML_d + \epsilon_{i,t}$ where subscript $d$ denotes day, $R_i$ is the return on stock $i$ , $R_F$ is the yield on CD 91days, $R_M$ is the value-weighted market return.
$\Delta TRV_{i,t}$	Won trading volume shock for stock $i$ in month $t$ , calculated as $(TRV_{i,t} - AVGTRV_{i t-12,t-1}) / AVGTRV_{i t-12,t-1}$ where $TRV_{i,t}$ is the won trading volume of the stock in month $t$ and $AVGDVOL_{i t-12,t-1}$ is the mean value of stock $i$ 's dollar trading volume in the past 12 months.
$MVE_{i,t-1}$	The market value of equity of stock $i$ in the prior month calculated as the share price * number of outstanding shares. MVE is expressed won.
$CVAMIHU_{i,t}$	The coefficient of variation in the Amihud illiquidity of stock $i$ in month $t$ . Following Petkova, Akbas and Armstrong (2011), we calculate CVAMIHU as the standard deviation of the daily Amihud illiquidity measure divided by the average Amihud illiquidity measure for the month.
$MAXRET_{i,t}$	The maximum daily return over the past one month for stock $i$ (see Bali, Cakici, and Whitelaw (2011), Chung and Chuwonganant (2016))
$RET(-12,-2)_{i,t}$	The momentum of stock $i$ in month $t$ computed as the cumulative return of stock $i$ over the previous 12 months ending on month prior to month $t$ (Jegadeesh and Titman (1993)).
$STDTO_{i,t}$	The standard deviation of monthly turnover over the last 2 months for stock $i$ in month $t$ (Chordia, Subrahmanyam and Anshuman (2001)).
$BM_{i,t}$	The ratio of book value of equity to market value of stock $i$ in month $t$ . Book value of equity for the fiscal year ending in the previous year and market value of equity of stock $i$ in month $t-1$ .
BETA	The market beta of stock $i$ in month $t$ . We follow Fama and French (1992) by estimating the beta from the following regression model: $R_{i,t} - R_{F,t} = \alpha_i + \beta_i^1 (R_{M,t} - R_{F,t}) + \beta_i^2 (R_{M,t-1} - R_{F,t-1}) + \epsilon_{i,t}$ where subscripts $t$ and $t-1$ denote month $t$ and month $t-1$ , respectively. $R_i$ is the return on stock $i$ , $R_F$ is the yield on CD 91 days, and $R_M$ is the value-weighted market return. The market beta for stock $i$ (BETA) is the sum of the estimated regression coefficients $\beta_i^1 + \beta_i^2$ . We use monthly returns over the prior 60 months in the regression (at least 24 observations required).
COSKEWNESS	The co-skewness of stock $i$ in month $t$ . Following Harvey and Siddique (2000) and Chung and Chuwonganant (2016), we estimate co-skewness by carrying out the following regression model for each stock using the monthly returns over the past 60 month (at least 20 months available): $R_{i,t} - R_{i,t} = \alpha_i + \beta_i (R_{M,t} - R_{F,t}) + \gamma_i (R_{M,t} - R_{F,t})^2 + \epsilon_{i,t}$ where $R_{i,t}$ is the monthly return for stock $i$ , $R_{i,t}$ is yield on CD 91 days for the month, and $R_{M,t}$ is the value-weighted market return. The estimated regression coefficient $\gamma_i$ is the co-skewness measure of the stock.



<Abstract in Korean>

## 금융시장 불확실성이 국내 주식시장의 유동성과 주가수익률에 미치는 영향

이지은\*, 정기호\*\*

본고는 국내 금융시장의 불확실성 증대가 개별 주가수익률에 미치는 영향에 대해 2004년부터 2014년까지 자료를 이용하여 실증 분석하였다. 분석결과, 예상치 못한 금융시장의 불확실성 증대로 개별 주가수익률과 유동성이 감소하는 현상이 나타났다. 불확실성이 주가수익률에 미치는 부정적 효과는 국내 기관 및 외국인 투자자에 의해 확대되었으나, 국내 개인 투자자에 의해 축소되었다. 또한, 금융시장 불확실성과 유동성 간 상호작용이 주가수익률에 미치는 영향은 외국인 투자자에 의해 강화되었으며, 매도자 혹은 매수자 주도 거래 여부에 따라 불확실성이 주가수익률에 미치는 비대칭적 효과가 나타났다.

핵심 주제어: 금융시장 불확실성 (VIX), 가격충격, 매도매수호가 스프레드, 유동성, 주가수익률, 투자자유형, 금융위기

JEL Classification: G10, G32, G34

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## BOK 경제연구 발간목록

한국은행 경제연구원에서는 Working Paper인 『BOK 경제연구』를 수시로 발간하고 있습니다. 『BOK 경제연구』는 주요 경제 현상 및 정책 효과에 대한 직관적 설명 뿐 아니라 깊이 있는 이론 또는 실증 분석을 제공함으로써 엄밀한 논증에 초점을 두는 학술논문 형태의 연구이며 한국은행 직원 및 한국은행 연구용역사업의 연구 결과물이 수록되고 있습니다. 『BOK 경제연구』는 한국은행 경제연구원 홈페이지(<http://imer.bok.or.kr>)에서 다운로드하여 보실 수 있습니다.

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4	서비스업 발전을 통한 내외수 균형성장: 기대효과 및 리스크	김승원 · 황광명
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3	직간접 무역연계성을 통한 해외충격의 우리나라 수출입 파급효과 분석	최문정 · 김근영
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19	Who Are the First Users of a Newly-Emerging International Currency? A Demand-Side Study of Chinese Renminbi Internationalization	Hyoung-kyu Chey · Geun-Young Kim · Dong Hyun Lee
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3	FTA의 물가 안정화 효과 분석	곽노선 · 임호성
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10	유가가 손익분기인플레이션에 미치는 영향	김진용 · 김준철 · 임형준
11	인구구조변화가 인플레이션의 장기 추세에 미치는 영향	강환구
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14	Improving Forecast Accuracy of Financial Vulnerability: Partial Least Squares Factor Model Approach	Hyeongwoo Kim · Kyunghwan Ko
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