The Impact of Global Volatility on Korean Financial Markets

Sang Hoon, Kang, Yun-Jung, Lee, Ki-Hong, Choi and Sungkyun, Park

Abstract**—**This study investigates the intertemporal relationship between global volatility (VIX) and Korean financial markets. We consider the impact of VIX changes on financial markets (equity and exchange rate markets). In doing it so, utilizing the VAR model, we suppose that equity returns have a negative relationship with the VIX, but exchange rates have a positive relationship with the VIX.

Keywords**—** Volatility Index, Korean financial markets, VAR model, Impulse response function

I. Introduction

THE volatility is one of the most important concepts in finance, appearing in a wide range of theories and applications in asset pricing, portfolio theory, risk management, derivatives, and econometrics. The market volatility index (VIX) of the Chicago Board Options Exchange (CBOE) is a popular indicator of future short-term volatility in U.S equity markets. This VIX is commonly referred to as an indicator of investor sentiment, namely 'investor fear gauge' in higher level of VIX [1-2].

During the 2008 global financial crisis, investors are fared of huge loss, which leads to the highest record of VIX. In the meanwhile, the global financial crisis has widely spread around the Asian financial markets. When the VIX reach the high historical record in 2008, investors withdraw investment funds from Korean financial markets. This effect leads to drop more than 30% value of equity market and result in the deprecation of Korean won.

Many empirical studies have focused on dynamics between the volatility index and the other financial time series. Skiadopoulos[3] found that the underlying stock market can forecast the future movement of Greek volatility index(GVIX), but the reverse relationship does not hold. Canbaş and Kandir[4] investigated the relation between investor sentiment and stock returns on the Istanbul Stock Exchange, employing vector autoregressive (VAR) analysis and Granger causality tests. They concluded that investor sentiment does not play a role on forecasting future stock returns. Lu, Wei and Chang[5] examined the dynamic relation between the volatility index(TVIX) and the market index(TAIEX) in Taiwan using the threshold conitergration model (TVECM). They suggested that the TVIX plays an important role on the investors' fear gauge indicator in the extreme higher regime. Kanas[6] employed a GARCH-M framework to revisit the risk-return relation for the S&P 100 index and detected the positive risk-return relation. Sarwar[7] found the significant negative relationships between VIX and BRIC stock market returns and strong asymmetric relation between innovations in VIX and daily stock returns.

Although many studies explored the return-volatility relation in financial market, their empirical results are still inconclusive and the role of VIX as an investor fear gauge in Korean financial markets has received little or no attention in empirical studies. We examine the return-volatility relation for Korean financial markets to determine whether a return-volatility association is significant for these markets, as well as the potential direction, and strength of the relation. In this context, we employ a vector autoregressive(VAR) process to examine the relation between VIX index and financial time series.

The rest of this paper is organized as follows. Section 2 discusses the VAR technique. Section 3 provides the descriptive statistics of sample data. Section 4 provides the empirical results, and several conclusions are discussed in Section 5.

II. Methodology

This section discusses the VAR model to examine the relation between return-volatility and interprets the shock of volatility to financial asset returns using impulse response functions.

We consider three variables: volatility index returns (VIX_t), foreign exchange rate returns (KRW_t) and equity returns $(Korea_t)$ in the Korean financial market. Note that the estimated VARs include 2 lags, as chosen by the Akaike criterion. The three pair variables of VAR model are collected in the vector Z_t. Consider the following a VAR(2) process:

$$Z_t = C + B_1 Z_{t-1} + B_2 Z_{t-2} + \varepsilon_t,\ \varepsilon_t \sim N(0, \Omega) \quad (1)$$

where Z_t contains 3×1 variables, Z_{t-i}, $i=1,2$ are lagged dependent variables, and ε_t represents 3×1 residuals from the VAR(2) model.

Once the VAR process is estimated, we then employ impulse response function (IRF). The IRF shows impulse response of a variable in the VAR system to the time path of its own shock as well as that of the shock to another variable in the system. Plotting the IRF is a practical way of visually inspecting the

Sang Hoon, Kang is with the Department of Business Administration, Pusan National University, Busan, 609-735, South Korea(corresponding author's phone: +82-51-510-2558 ; e-mail: sanghoonkang@pusan.ac.kr).

Yun-Jung, Lee is with the Creative Human Resource Development Program for IT Convergence, Pusan National University, Busan, 609-735, South Korea (e-mail: leeyj01@pusan.ac.kr).

Ki-Hong, Choi is with the Department of Economics, Pusan National University, Busan, 609-735, South Korea(e-mail: stoltz@nate.com)

Sungkyun, Park is with the Department of Physics, Pusan National University, Busan, 609-735, South Korea (e-mail: psk@pusan.ac.kr).

dynamic relationship among the three variables in the VAR system.

III. Data

This study considers daily data sets: CBOE VIX(VIX), Korea-MSCI(Korea), and Korea Won(KRW). The daily data covers the period from January 2nd, 2004, to December 30th, 2013. All sample data are obtained the database of Informax. Figure 1 shows the dynamics of the VIX index. The VIX index illustrates tranquil regime with low volatility in 2004-2007, global financial crisis regime with extremely high volatility in 2008-2009 and then recovery regime with stabilized volatility in 2009-2013. We apply the logarithmic difference return series computed by $R_{i,t} = \ln(P_{i,t}/P_{i,t}) \times 100$, where $R_{i,t}$ denotes the continuously compounded returns i at time t, and $P_{i,t}$ denotes index series the i at time t.

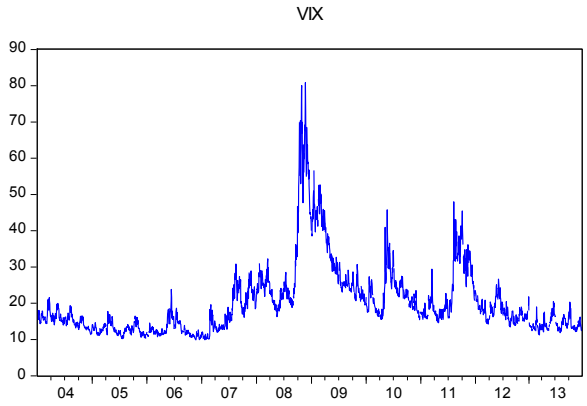

Fig. 1 The dynamics of VIX

Table 1 summarizes the descriptive statistics and unit root tests for all sample series. Panel A contains basic statistics for all sample series. VIX exhibited the highest standard deviations, which means greatest prices changes. Except in the case of VIX, the skewness (Skew.) was negative for all sample returns, which suggested that extremely negative returns were likely for the stock and foreign exchange markets, respectively. Excess kurtosis (Kurt.) coefficients had significant values, indicating that outliers may have occurred with a probability higher than that of a normal distribution. Accordingly, the Jarque-Bera (J-B) test rejected the null hypothesis of normality for all sample returns at the 1% significance level.

Panel B presents the test for the presence of a unit root in the VIX and four return series using the Augumented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. Both the ADF and PP unit root tests have the same null hypothesis, namely, that a time series contains a unit root. As shown in Panel B, large negative values for the ADF and PP test statistics rejected the null hypothesis of a unit root at the l% significance level, indicating that all sample returns were stationary.

TABLE I
DESCRIPTIVE STATISTICS AND UNIT ROOT TESTS

	VIX	Korea	KRW
Panel A: Descriptive statistics			
Mean	-0.0119	0.0393	-0.0049
Std. Dev.	6.7392	2.0233	0.8108
Skewness	0.7005	-0.2795	-0.6549
Kurtosis	7.3102	20.414	52.510
Jarque-Bera	2127.7	31709.7	255322
probability	[0.0000]	[0.0000]	[0.0000]
Panel B: Unit root tests			
ADF	-33.201***	-49.280***	-13.717***
PP	-63.646***	-49.306***	-49.006***

Notes: The Jarque-Bera (J-B) value corresponds to the test statistic for the null hypothesis of normality in the sample return distributions. *** represents significance at 1%.

IV. Empirical Results

In this section, we investigate the impact of global volatility on Korean equity and FX markets using a VAR model. Table 2 summarizes the estimated results of the VAR(2) model in Korean equity and FX markets.

TABLE II
ESTIMATIONS OF VAR(2) MODEL

	VIX	KOREA	KRW
VIX(-1)	**-0.140609**	**-0.098360**	**0.022141**
	(0.02043)	(0.00592)	(0.00244)
	[-6.88183]	[-16.6164]	[9.06779]
VIX(-2)	**-0.060259**	**-0.026462**	0.001053
	(0.02148)	(0.00622)	(0.00257)
	[-2.80593]	[-4.25307]	[0.41026]
KOREA(-1)	**0.200356**	**-0.190623**	**0.038746**
	(0.09746)	(0.02823)	(0.01165)
	[2.05584]	[-6.75130]	[3.32675]
KOREA(-2)	0.127006	-0.008900	**-0.038232**
	(0.09367)	(0.02714)	(0.01119)
	[1.35593]	[-0.32798]	[-3.41538]
KRW(-1)	**0.578484**	**-0.415535**	**0.067847**
	(0.23532)	(0.06818)	(0.02812)
	[2.45827]	[-6.09496]	[2.41253]
KRW(-2)	0.209399	-0.079193	**-0.105042**
	(0.23646)	(0.06851)	(0.02826)
	[0.88555]	[-1.15598]	[-3.71712]
C	-0.022349	0.042817	-0.004779
	(0.13381)	(0.03877)	(0.01599)
	[-0.16702]	[1.10445]	[-0.29884]

Notes: [.] indicates the t-statistics.

In Table 2, the past values of VIX returns have a negative impact on the current values of equity returns. This means that an increase in VIX results in price falls of stock markets, implying that VIX play a role on 'fear gauge' on the Korean equity market. On the other hand, In the FX markets (in Table 2), the past values of VIX have a positive impact on the KRW. This evidence concludes that an increase in VIX results in the depreciation of Korean currency. These findings provide an

important implication on implementing financial policies. In the Korean financial market, the increase of VIX (risk) forces foreign investors to withdraw investment, which negatively affects the prices of Korean equity markets and then lead to the depreciation of the Korean currency.

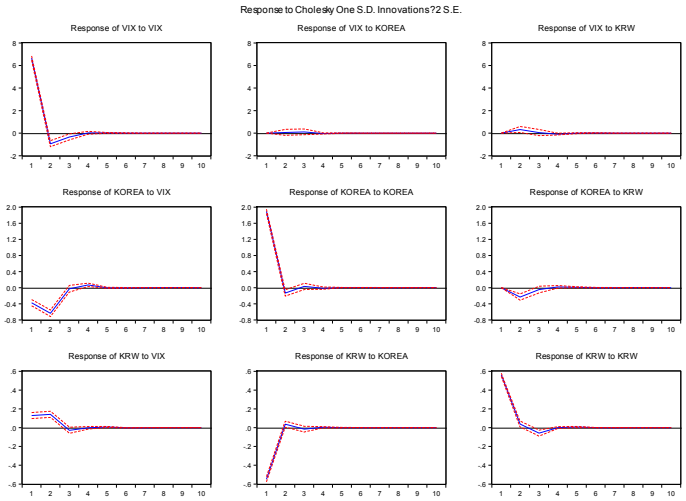

Fig. 2 Impulse response function

Figure 2 illustrates the shock of VIX on the equity and FX returns, respectively. As shown in Figure 2, the initial impact of VIX index on the equity market is negative and significant which is effective up to 2 time-lags. This evidence indicates that the VIX is considered as a signal of fear gauge in the Korean equity market. Furthermore, the impact of VIX index on the KRW rate returns is negative and significant, implying that a higher level of VIX index deteriorates the KRW depreciation. This finding suggested currency responds more similarity to changes of global volatility.

This study provides several implications on investment portfolio theory. First, this negative relationship delivers the insight on the risk-return trade-off in equity markets. Second, the negative or positive relationship is related to hedge the exchange rate risk. Third, these evidences result in the predictability of equity prices and exchange rates, which gives an opportunity for portfolio investors to earn the abnormal returns in Korean financial markets.

V. Conclusion

We examine the return-volatility relation to determine whether a return-volatility association is significant for Korean equity and FX markets. In this context, we employ a VAR(2) process to examine the relation between VIX index and financial time series.

Our empirical results provide two important impactions on the relation between VIX and financial time series. First, the VIX returns have a negative impact on both equity returns, implying that VIX play a role on a 'fear gauge' indicator on equity markets. Second, the VIX returns have a positive impact on the KRW. This evidence indicates that a higher level of VIX index deteriorates the depreciation of KRW.

A limitation of this paper is that we neglected the different regimes of VIX. In general, risk aversion investors desire to hedge a higher level of VIX and prefer a lower level of VIX. These investors might have distant behaviors depending on the level of the fear gauge, therefore different dynamic relationship between return-volatility in different regime of VIX. We suggest that future research follow the regime switching literature to investigate the different dynamic relation in regimes.

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References

[1] R. E. Whaley, "The investor fear gauge", *Journal of Portfolio Management*, vol. 26, pp. 12-17, 2000. http://dx.doi.org/10.3905/jpm.2000.319728

[2] R. E. Whaley, "Understanding VIX," *Journal of Portfolio Management*, Vol. 35, pp. 98-105, 2009. http://dx.doi.org/10.3905/JPM.2009.35.3.098

[3] G. Skiadopoulos, "The Greek implied volatility index: Construction and Properties," *Applied Financial Economics*, vol. 14, pp. 1187-1196, 2004. http://dx.doi.org/10.1080/0960310042000280438

[4] S. Canbaş, and S. Y. Kandir, 'Investor sentiment and stock returns: Evidence from Turkey,' *Emerging Markets Finance & Trade*, vol. 45, No. 4, pp. 36-52, 2009. http://dx.doi.org/10.2753/REE1540-496X450403

[5] Y.-C. Lu, Y.-C. Wei, and C.-W. Chang, "Nonlinear dynamics between the investor fear gauge and market index in the emerging Taiwan equity market," *Emerging Markets Finance & Trade*, vol. 48, pp. 171-191, 2012. http://dx.doi.org/10.2753/REE1540-496X4801S111

[6] A. Kanas, "Modelling the risk-return relation for the S&P 100: The role of VIX," *Economic Modelling*, vol. 29, pp. 795-809. 2012. http://dx.doi.org/10.1016/j.econmod.2011.10.010

[7] Sarwar, G., 2012, 'Is VIX an investor fear gauge in BRIC equity markets?,' *Journal of Multinational Financial Management*, vol. 22, pp. 55-65, 2012. http://dx.doi.org/10.1016/j.mulfin.2012.01.003