

Global Economic Crisis and East Asian Stock Markets*

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(Abstract)

This paper investigates the impact of global economic crisis on the stock markets of four East Asian countries including Japan, China, Korea, and Taiwan using their daily rate of returns on the market indices for the period from July 15, 2004 to July 31, 2010. The main results are summarized as follow. First, there were significant changes in the stock return patterns after the crisis in the U.S. and East Asian countries by observing decrease in mean return, increase in volatility, increase in skewness, and increase in kurtosis. Second, the impact of the crisis triggered by collapse of Lehman Brothers was more severe to the Japanese stock market as compared to the Korea, Taiwan, and China. In addition, the crisis continued to affect stock markets of the U.S. and Japan for 6 months whereas Korea, Taiwan, and China were no longer affected by the crisis beyond 3 months. Third, Taiwan and Korea made a quicker recovery from the crisis relative to the U.S and Japan. Fourth, the stock return and volatility in the U.S. market have a significant impact on market return and volatility of Japan, China, Korean, and Taiwan during the period of global economic crisis. In the country level, the Japanese market is the most sensitive to return changes in the U.S. market while the largest volatility spillover is observed for the Chinese market. These results confirm close economic linkages between the U.S. and East Asian countries and the argument of Longin (1995) that the linkages between the stock markets rapidly increase in turbulence.

Key words: global economic crisis, East Asian stock markets, impact of crisis, recovery from crisis, spillover effects

1. Introduction

Serious financial turmoil, which was triggered by the sub-prime mortgage crisis in the U.S., erupted in September 2008. The contagion spread quickly to the entire U.S. financial sector and then to financial markets overseas. The crisis rapidly escalated into the economic crisis of all the nations in the world. As a result, the world economy faced its worst crisis since the Great Depression of 1930s. There seems to be a consensus that the crisis could be ascribed to the U.S. sub-prime mortgage lending. During the last decade, a large number of people, previously considered as bad credit risks, were offered mortgages. Because house prices were rising and it seemed like they would continually increase. However, the bursting of the U.S. housing bubble caused the values of securities tied to U.S. real estate pricing to plummet, damaging financial institutions seriously.

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When financial turmoil started in the summer of 2007, Asian economies were well positioned to avoid its worst effects since their direct exposures to impaired assets were limited. However, as the global financial crisis intensified dramatically when Lehman Brothers collapsed in September 2008, capital flows shifted away from risky assets in the emerging markets. Moreover, the collapse of financial markets were matched up by the decline of the real economy. As a result, the world headed for a period of the worst economic downturn since the Second World War. In particular, during this financial and real economic turmoil the global stock markets were severely affected.

This paper investigates the impact of global economic crisis on the stock markets of East Asian countries (including Japan, China, Korea, and Taiwan) using their daily rate of returns on the market indices for the period from July 15, 2004 to July 31, 2010. To examine the impact of global economic crisis and its recovery the period of study is divided into two parts: crisis period from September 15, 2008 to July 31, 2010 and normal period from July 15, 2004 to June 30, 2007. In addition, this paper examines the spillover effect from the U.S. stock market to the East Asian stock markets during the crisis period.

Specifically, the following issues are investigated in this study. First, this paper examines which countries were severely affected by the global economic crisis and fast recovered from the crisis. Second, this paper investigates whether there were any systematic changes in stock return patterns after the crisis. Third, assuming that innovations in the U.S. equity market are exogenous, this paper investigates how the U.S. market innovations impact the equity markets of East Asian countries during global economic crisis.

The rest of the paper is organized as follows. The next section provides literature review. Section 3 describes the data and methodology used in this study. Section 4 presents empirical results, which are divided into four parts; 1) daily return patterns before and after crisis, 2) impact of crisis, 3) recovery from crisis, and 4) spillover effect from the U.S. market during the crisis period. Finally, discussions and concluding remarks are presented in the last section.

2. Literature Review

As the barriers to the capital flow across national boundaries have gradually removed, the global financial markets have been moving toward a comprehensive regional integration. The globalization of financial markets accelerates transnational capital flows and provides investment diversification service to international investors. Therefore, understanding the relationship across the multinational financial markets provides strong references to government policy and investor decision-making. Over the past years many scholars have committed to investigate an interactive relationship between the international financial markets.

The cross-national analysis of stock markets is an important issue because it may have significant implications for the question of possible diversification gains from international

investments and the development of international asset pricing theory. Earlier studies, such as those conducted by Levy and Sarnat (1970), Joy, Panton, Reilly, and Martin (1976), and Hillard (1979), were concerned principally with the contemporaneous and/or lagged correlations in the rates of return across equity markets in developed countries. Recent research into this topic has generally been more concerned with the transmission mechanisms of stock returns and variances across international equity markets (see Eun and Shim (1989), Becker, Finnerty, and Gupta (1990), and Hamao, Masulis, and Ng (1990)).

However, due largely to the higher importance of the financial markets of the developed countries to the global markets and due partly to the ease of availability of data, extant research regarding relationships among international capital markets has focused, primarily, on the financial markets of developed countries. Despite the growing importance of emerging capital markets, researchers have paid relatively less attention to these markets (see Park and Fatemi (1993), Wei, Liu, Yang, and Chaung (1995), and Ghoshi, Saidi, and Johnson (1999)). In particular, East Asian capital markets, spurred by the phenomenal economic growth, have attracted a great deal of attention from investors in the global markets (see Cheng and Glascock (2005) and Ng (2000)).

3. Data and Methodology

3.1. Data

The data utilized consist of daily rates of return, measured in terms of the local currency unit, on the market indices of the U.S. and four East Asian countries including Japan, China, Korea, and Taiwan. The indices chosen to represent each stock market of the five countries are as follows: S&P500 for the U.S., Nikkei225 for Japan, Shanghai Composite Index for China, KOSPI for Korea, and TWII for Taiwan.

To examine the impact of global economic crisis and its recovery and compare the results with the data during the normal period, this paper covers the period from July 15, 2004 to July 31, 2010. The global financial crisis begins in earnest from the collapse of Lehman Brothers on September 15, 2008. Thus the period after September 15, 2008 is selected as crisis period. For comparison purpose, the period from July 15, 2004 to June 30, 2007 is assumed as normal period. Because even before the collapse of Lehman Brothers the global financial markets were affected by sub-prime mortgage crisis started in 2007, this paper assumes that the normal period ends on June 31, 2007. The data source is FnGuide.

3.2 Research Methodology

This paper utilizes the extended GARCH (Generalized Autoregressive Conditional Heteroskedastic) model as the method of investigation. Engle (1982) first proposes the ARCH (Autoregressive Conditional Heteroskedasticity) model and provides a new way of thinking

for the resolution of an alternative to the standard time-series treatments. On the basis of the ARCH model Bollerslev (1986) carries out a direct linear extension and forms a wider range of GARCH model. The GARCH model is considered the methodology of choice for examining the transmission mechanisms of the conditional first and second moments in stock prices across international stock markets.

This paper adopts GARCH(1,1) model by the results of AIC(Akaike's Information Criterion) and SBC(Schwartz Bayesian Criterion) tests. In addition, considering the autocorrelation of conditional mean determined by Ljung-Box statistics, MA(1) process is included in the GARCH model. As a result, the following MA(1)-GARCH(1,1) model is utilized in this paper.

$$R_t^i = \alpha + \varepsilon_t + \theta\varepsilon_{t-1}, \varepsilon_t | \Omega_{t-1} \sim N(0, h_t)$$

$$h_t = a + b\varepsilon_{t-1}^2 + ch_{t-1}$$

In this equation R_t^i is daily rates of return on stock market i , and h_t represents conditional variance of R_t^i at day t .

As a second stage of modeling, this paper employs the following model to measure the spillover effects of mean and variance between stock markets.

$$R_t^i = \alpha + \beta R_t^j + \varepsilon_t + \theta\varepsilon_{t-1}, \varepsilon_t | \Omega_{t-1} \sim N(0, h_t)$$

$$h_t = a + b\varepsilon_{t-1}^2 + ch_{t-1} + \delta\varepsilon_{t-1}^j$$

In this equation R_t^i and R_t^j are daily rates of return on stock markets i and j , respectively. And the volatility shock, ε_{t-1}^j and ε_{t-1}^k , which are estimated from MA(1)-GARCH(1,1) model of stock markets i and j are added to the equation. Therefore, the coefficients, β and δ , measure the transmission effects of mean and variance, respectively. In other words, the significance of these coefficients indicates that information occurring at stock market j influence the return and volatility at stock market i .

4. Empirical Results

4.1 Daily Return Patterns Before and After Crisis

The descriptive statistics for the daily rates of return on the market indices of the four East Asian countries (i.e., Japan, China, Korea, and Taiwan) and the U.S. for the period before and after the global economic crisis are reported in Table 1. The period before the crisis covers three and half years from July 15, 2004 to the end of 2007 and the period after the crisis covers 22 months from September 1, 2008 to July 31, 2010.

Table 1. Daily Stock Return Patterns of East Asian Countries and the U.S. before and after the Crisis (%)

Country	Period	Mean	Std. Dev.	Skewness	Kurtosis
Japan	before	0.040	1.085	-0.260	1.369
	after	-0.040	2.350	-0.036	6.005
China	before	0.168	1.657	-0.368	3.018
	after	0.041	2.022	0.023	2.065
Korea	before	0.118	1.219	-0.443	2.357
	after	0.057	1.993	-0.316	6.566
Taiwan	before	0.055	1.065	-0.533	2.754
	after	0.035	1.735	-0.090	1.903
U.S.	before	0.035	0.767	-0.300	2.022
	after	-0.007	2.205	0.050	4.675

All the markets in the sample evidence decrease in daily mean returns after the 2008 global economic crisis. However, the emerging markets in the sample such as China, Korea, and Taiwan exhibit positive mean returns even after the crisis whereas the mean returns of the developed markets such as the U.S. and Japan are negative. Among four East Asian markets in the sample, Korea records the highest average after-crisis return of 0.057, and China and Taiwan are next in the order, with mean returns of 0.041 and 0.035, respectively. On the other hand, Japan records the average after-crisis return of -0.040, which is even lower than the U.S. mean return of -0.007.

In terms of market volatility, as measured by the standard deviation of daily stock market returns, all the markets in the sample evidence significant increase after the 2008 global economic crisis. Among four East Asian markets in the sample, Japan records the highest volatility of 2.350 after the crisis, followed by China, Korea, and Taiwan with standard deviations of 2.022, 1.993, and 1.735, respectively. The magnitude of increase in volatility is larger for the developed markets such as the U.S. and Japan than the emerging markets in the sample such as China, Korea, and Taiwan. For example, the volatility increased two to three times in the U.S. and Japan whereas it increased by 30-60% in Korea, China, and Taiwan.

Another interesting pattern observed in Table 1 is changes in skewness of daily stock market returns after the 2008 global economic crisis. All five stock markets in the sample show negative skewness before the crisis, indicating that the tail on the left side of stock return distribution is longer than the right side and the bulk of the daily returns lie to the right of the mean. However, skewness of daily stock market returns of these countries increases after the crisis and becomes even positive in some markets including China and the U.S. The positive skewness suggests that the tail on the right side of stock return distribution is longer than the left side and the bulk of the daily returns lie to the left of the mean.

In Table 1, we also observe that kurtosis of daily stock market returns significantly increases after the crisis in Japan, Korea, and the U.S. while it decreases in China and Taiwan. Higher kurtosis means more of the variance is the result of infrequent extreme deviations, as

opposed to frequent modestly sized deviations. Thus we know that the increased volatility of the daily returns after the crisis results from infrequent extreme deviations of stock returns from their mean.

Overall, we find that there were some systematic changes in stock return patterns after the crisis in the U.S. and East Asian countries. Specifically, we observe decrease in mean return, increase in volatility, increase in skewness, and increase in kurtosis.

4.2 Impact of Crisis

The global economic crisis had a significant impact on the stock markets in the world. Thus it is interesting to investigate how East Asian countries' markets were affected by the crisis. The global economic crisis has come in earnest since the collapse of Lehman Brothers on September 15, 2008. To measure the impact of the crisis triggered by the collapse of Lehman Brothers, this paper computes the stock market returns of four East Asian countries and the U.S. for 1 month, 3 months, and 6 months from the trading day before September 15, 2008 and reports the results in Table 2.

Table 2. Stock Market Returns since Collapse of Lehman Brothers (%)

Country	1 Month	3 Months	6 Months
Japan	-26.69	-39.41	-47.85
China	-3.04	-6.22	2.34
Korea	-7.75	-29.19	-27.19
Taiwan	-13.44	-30.06	-21.18
U.S.	-17.82	-30.44	-45.52

Japan records the lowest 1 month return of -25.69%, which is more severe than the return of -17.82% for the U.S. where the global economic crisis started. Relatively, Taiwan, Korea, and China exhibit less adverse impact, with 1 month returns of -13.44%, -7.75%, and -3.04%, respectively. This result indicates that the short-term impact of the crisis triggered by collapse of Lehman Brothers is more severe to developed markets. For 3 month return Japan remains the lowest one with -39.41%, and the U.S., Taiwan, and Korea form a next order with 3 month returns of -30.44%, -30.06%, and -29.19%, respectively. However, China exhibits 3 month returns of -6.22%, indicating less adverse impact of the crisis on its stock market.

It is interesting to observe that the 6 month returns of two developed markets of the U.S. and Japan are much lower than those of the emerging markets such as Korea, Taiwan, and China. While Japan and the U.S. record -47.85% and -45.52%, respectively, Korea and Taiwan exhibit -27.19% and -21.18%, respectively. In particular, the Chinese stock market show a positive 6 month return of 2.34%. These results imply that the global economic crisis continued to affect stock markets of developed countries for 6 months whereas the emerging stock markets were no longer affected by the crisis beyond 3 months. Actually, the U.S. and Japan experienced further drop in stock prices for the period between 3 and 6 months after the collapse of Lehman

Brothers whereas Taiwan and China recovered their stock prices during the same period.

As another way to examine the impact of the global economic crisis on the stock markets, this paper computes the stock market returns using the price changes between peak before the crisis and bottom after the crisis and reports the results in Table 3. Consistent with the result in Table 2, Japan records a large drop in stock market index from the peak of 18,261.98 on July May 19, 2007 to the bottom of 7,054.98 on March 10, 2009, resulting in -61.37% (or -95.11% in log return). China is ranked the first with return of -71.98% (or -127.24% in log return) from 6,092 on October 16, 2007 to 1,707 on November 4, 2008. Combined with the result in Table 2, this result for China indicates that the Chinese stock market began to plunge long before the collapse of Lehman Brothers. Korea and Taiwan recorded with the maximum losses of -54.54% and -58.31%, respectively, which are close to the U.S. maximum loss of -56.78%.

Table 3. Stock Market Returns Computed from Peak before Crisis to Bottom after Crisis

Country	Peak before Crisis		Bottom after Crisis		Return (%)	
	Date	Price	Date	Price	Plain	Log
Japan	2007-07-09	18,261.98	2009-03-10	7,054.98	-61.37	-95.11
China	2007-10-16	6,092.06	2008-11-04	1,706.70	-71.98	-127.24
Korea	2007-10-31	2,064.85	2008-10-24	938.75	-54.54	-78.83
Taiwan	2007-10-29	9,809.88	2008-11-20	4,089.93	-58.31	-87.49
U.S.	2007-10-09	1,565.15	2009-03-09	676.53	-56.78	-83.88

4.3 Recovery from Crisis

The stock markets have recovered from the global economic crisis, but the questions are which countries' markets recovered fast and how much they recovered from the crisis. In this investigation the method measuring the degree of recovery is an important issue. This paper compares the average market index in the month of July 2010 with index at the peak before the crisis and index at the bottom after the crisis. The results are shown in Table 4.

Table 4. Stock Market Recovery between July 2010 and Peak or Bottom around the Crisis

Country	from Bottom after Crisis	from Peak before Crisis
Japan	134.0%	51.8%
China	146.1%	40.9%
Korea	184.4%	83.8%
Taiwan	186.8%	77.9%
U.S.	159.6%	69.0%

When the average market index in the month of July 2010 is compared to the bottom after the crisis, among five countries in the sample, Taiwan and Korea exhibit relatively fast recovery with levels of 186.8% and 184.4%, respectively. However, this much recovery is still below the peak before the crisis. As compared to the peak before the crisis, the recovery levels

of Taiwan and Korea are 77.9%, and 83.8%, respectively. On the other hand, Japan records a slow recovery with 134.0% from the bottom after the crisis and 51.8% from the peak before the crisis. The U.S. shows the recovery level of 159.6% from the bottom after the crisis and 69.0% from the peak before the crisis. Interestingly, China exhibits the lowest recovery level of 40.9% from the peak before the crisis while 146.1% from the bottom after the crisis. As mentioned earlier, this result reflects that the Chinese stock market began to plummet long before the global economic crisis.

4.4 Spillover Effect from the U.S. during Crisis Period

Using the extended GARCH model where the U.S. market returns are included as exogenous variable, this paper analyzes the spillover effect from the U.S. to stock markets of four East Asian countries including Japan, China, Korea, and Taiwan for the period of global economic crisis. The results are shown in Tables 5

Table 5. Spillover Effects from the U.S. to East Asian Stock Markets

	Japan	China	Korea	Taiwan
α	-0.023	0.157	0.054	0.040
β	0.711**	0.324**	0.477	0.487**
θ	-0.149	-0.050	-0.159	-0.054
a	0.019	0.481	0.319	0.024
b	0.057	0.011	0.091	-0.077
c	0.731**	0.733*	0.877**	0.920**
δ	0.117**	0.210**	0.101**	0.123**
R ²	0.391	0.058	0.152	0.205

** , * indicate significance level at 0.01 and 0.05, respectively

As aforementioned, the coefficients, β and δ , measure the transmission mechanism of return and volatility, respectively. We observe that the coefficients β , are all significantly positive at the 1 percent level, implying that the stock returns on the U.S. market have a significant impact on market returns of Japan, China, Korean, and Taiwan during the period of global economic crisis. Among four countries, the Japanese market is the one most sensitive to the U.S. market with a coefficient of 0.711, and Taiwan, Korea, and China form a next order with coefficients of 0.487, 0.477, and 0.324, respectively. This result suggests that the return spillover effect from the U.S to East Asian markets exists during the period of global economic crisis.

In Table 5, we also observe that the coefficients, δ , are all significant positive at the 1 percent level for four East Asian markets, implying that a volatility surprise in the U.S. stock market affects the return volatility in the stock markets of Japan, China, Korea, and Taiwan during the crisis period. In the country level, China exhibits the largest coefficient, and Taiwan, Japan, and Korea form a next order with little difference.

5. Summary and Conclusion

This paper investigates the impact of global economic crisis on the stock markets of East Asian countries (including Japan, China, Korea, and Taiwan) using their daily rate of returns on the market indices for the period from July 15, 2004 to July 31, 2010. To examine the impact of global economic crisis and its recovery the period of study is divided into two parts: crisis period from September 15, 2008 to July 31, 2010 and normal period from July 15, 2004 to June 30, 2007. In addition, this paper examines the spillover effect from the U.S. stock market to the East Asian stock markets during the crisis period.

The main results are summarized as follow. First, there were significant changes in the stock return patterns after the crisis in the U.S. and East Asian countries by observing decrease in mean return, increase in volatility, increase in skewness, and increase in kurtosis. Second, the impact of the crisis triggered by collapse of Lehman Brothers was more severe to the Japanese stock market as compared to the Korea, Taiwan, and China. In addition, the crisis continued to affect stock markets of the U.S. and Japan for 6 months whereas Korea, Taiwan, and China were no longer affected by the crisis beyond 3 months. Third, Taiwan and Korea made a quicker recovery from the crisis relative to the U.S and Japan. Fourth, the stock return and volatility in the U.S. market have a significant impact on market return and volatility of Japan, China, Korean, and Taiwan during the period of global economic crisis. In the country level, the Japanese market is the most sensitive to return changes in the U.S. market while the largest volatility spillover is observed for the Chinese market.

In conclusion, the global economic crisis which started in the U.S. had significant impact on the East Asian stock markets. Among four East Asian countries Japan was greatly influenced by the crisis. The crisis continued to affect the Japanese stock market for 6 months whereas stock markets of China, Korea, and Taiwan were no longer affected by the crisis beyond 3 months. Also, Japan recorded a slower recovery from the recovery whereas China, Korea, and Taiwan made relatively quick recovery. These results confirm close economic linkages between the U.S. and East Asian countries and the argument of Longin (1995) that the linkages between the stock markets rapidly increase in turbulence.

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