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Dynamic Stock Market Integration in Northeast Asian Stock Markets: The Case of China, Japan, and Korea

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Abstract This study examines the relationship between the Northeast Asian and U.S. markets with particular attention placed on the global financial crisis period. For this purpose, the paper employs dynamic approaches including DCC-MGARCH, BEKK and Risk Decomposition models to ensure the robustness of empirical findings. The results are as follows. First, The Northeast Asian stock market remains relatively independent from the U.S. market movements during the sample period. Second, the regional market shows an increasing trend of joint integration with the U.S. market. Third, an increased integration is found to be only unique to the crisis period. We find no evidence to support the findings of previous empirical studies which suggest the increased level of integration since the GFC.

Keywords Northeast Asian Stock Markets, DCC-MGARCH, BEKK, Risk Decomposition Model, Integration, GFC

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Ⅰ. Introduction

In this paper, we investigate the dynamic pattern of integration between the Northeast Asian and U.S. markets, with particular attention placed on the global financial crisis period. Recently, the three main countries in the Northeast Asia－China, Japan, and Korea have recognized the importance of integrated regional market and established a Three Nations Economic Cooperation Secretariat in Korea. The China-Japan-Korea FTA has been under negotiation since 2012, and China and Korea have initialed FTA in February, 2015 which took effect in December, 2015. The tenth round of negotiations for a trilateral free trade agreement (FTA) was completed in April, 2016. The planned FTA could have enormous impact, as the combined GDPs of China, Japan, and Korea represent 20 percent of the world total. Similarly, their combined imports and exports account for 17.5 percent of global trade.

Despite the importance of the Northeast Asian economies, empirical examination of stock market integration has been mainly limited to developed markets and studies regarding stock market integration in Northeast Asian region are still in its preliminary stages and lack detailed analysis at this point of time. This paper fills the gap in this line of research by investigating the pattern of integration between the Northeast Asian three countries by using various models to ensure the robustness of empirical findings. We apply Dynamic Conditional Correlation Multivariate Generalized Autoregressive Conditional Heteroscedasticity (DCC-MGARCH), BEKK and Risk Decomposition models to reflect a time-varying integration process and to measure a risk shift of independent stock market during the integration process. This paper contributes to the existing literature in several ways. First, we consider the dynamic pattern of market inter-

dependence by reflecting time-varying characteristics of conditional correlations between stock markets during the sample period. By accounting for the time-varying volatility behavior of data series, DCC is able to detect changes in conditional correlations over time when the state of the economy changes.[1] Second, we use a risk decomposition model to examine the time-varying evolution of stock market linkages by computing the U.S. and regional markets' contribution to a particular nation's stock market. The decomposition methodology provides benefits by recognizing hedges and diversification benefits with portfolios. Third, we consider the impact of the global financial crisis on the integration pattern of Northeast Asian stock markets. The comprehensive analysis of stock market movement in this region can provide an important issue with significant policy implications. Finally, we extend the sample data to avoid reaching the erroneous conclusion based on a relatively short investigation period after the GFC. The evidence of increased level of market integration after the GFC in the previous studies may not be convincing as it stands because the sample data for the post-crisis period was not sufficient enough to fully reflect the effect of crisis on the level of market integration.

The sequence of this paper is as follows. The next section briefly reviews the literature. In Section 3, the empirical framework is discussed. Section 4 presents the empirical results. The last section gives the summary and conclusions.

Ⅱ. Literature Review

There have been numerous studies on market integration and inter-

1) See Engle (2002) for a detailed discussion.

dependence. Using data from seven major European countries from 1970 to 1990, Longin and Solnik (1995) find that cross-country stock market correlations increase over time. Karolyi and Stulz (1996) find evidence to support that correlations are high when there are significant markets movements. Palac-McMiken (1997) uses the monthly ASEAN market indices (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) between 1987 and 1995 and finds that with the exception of Indonesia, all the markets are linked with each other. He argues that there is still room for diversification across these markets despite evidence of interdependence among ASEAN stock markets. Masih and Masih (1999) find high levels of interdependence amongst markets in Thailand, Malaysia, the U.S., Japan, Hong Kong, and Singapore from 1992 to 1997. Johnson and Soenen (2002) study the equity market integration between the Japanese stock market and the other twelve equity markets in Asia. They find that the equity markets of Australia, China, Hong Kong, Malaysia, New Zealand, and Singapore are highly integrated with the stock market in Japan. They also find evidence to suggest that a higher import share as well as a greater differential in inflation rates, real interest rates, and GDP growth rates all have negative effects on stock market co-movements between country pairs. More recent papers have tried to capture the benefits of correlation coefficients within a GARCH framework which explicitly deals with volatility issues. Lucey and Voronkova (2008) use dynamic conditional correlation (DCC) derived from multivariate GARCH framework to make inferences about short-term interdependence between Russian equity market and developed markets.

Another line of studies have applied cointegration methods to investigate the financial market integration. These studies focus on the long-run equilibrium relations among a group of national equity markets. If these markets are cointegrated, they will not deviate very far from each other over a

relatively long period. Chowdhury (1994) studies this relationship among 4 Newly Industrialized Economies (NIEs), Japan and the U.S., using daily data from 1986 to 1990. He finds that the U.S. market leads the four markets (Hong Kong, South Korea, Singapore, and Taiwan) and that there is significant link between the stock markets of Hong Kong and Singapore and those of Japan and the United States. He also finds that the U.S. market is not influenced by the four Asian markets. Ng (2002) examines the linkage among the ASEAN five countries in the 1990s. The results of his study indicate that there is no evidence of co-integrating relationship across the ASEAN stock markets, although individual countries do show a trend toward stronger linkage with each other. An and Brown (2010) examines the long-run relationships of the weekly and monthly index returns of the U.S., Brazil, Russia, India, and China stock markets. Their findings show that there is a co-integrating relationship between the U.S. and China while there is no cointegration between the U.S. and the other emerging markets. Based on these results they argue that investors would have better diversification investing in Brazil, Russia, or India rather than in China. Though, as Barrett (1996) pointed out, cointegration does not necessarily mean an integrating relationship since two time series can be coincidently cointegrated without implying economic integration.

Agroup of papers use asset pricing models. Barari (2004) uses a risk decomposition model to investigate the degree of integration for the Latin American countries. De Jong and De Roon (2005) develop a factor asset pricing model and find that emerging stock markets have become less segmented from world stock markets and that integration with the world significantly reduces the cost of capital. Hunter (2006) uses a multivariate GARCH-in-Mean asset-pricing model on three Latin American markets: Argentina, Chile andMexico. Tai (2007) also estimates a dynamic interna-

tional CAPM using a parsimonious multivariate GARCH-in-Mean (MGARCH-M) approach and shows that emerging Asian stock markets become integrated after they liberalize their equity markets.

Several studies have investigated the effect of structural changes in the economy on the dynamic linkage of stock returns. Fujii (2005) reports that the causal linkages among several emerging stock markets vary considerably during the time of rapid growth and major upheaval from 1990 in Asia and Latin America. Westermann (2004) empirically shows that the introduction of the Euro shifts the linkage across the Euro zone stock markets, and Kim, Moshirian, and Wu (2005) find that increased stability and higher levels of integration have emerged in the post-euro era. For the transition economies, Chelley-Steeley (2005) finds a movement towards increased equity market integration by analyzing a smooth transition. Lucey and Voronkova (2007) also apply a series of cointegration testing methods on the relationship between Russian and other equity markets over the period of 1995～2004. They obtain mixed results about the number of cointegration relationships after the 1998 Russian equity market crisis.

Ⅲ. Methodologies

1. Dynamic Conditional Correlation

This study uses Dynamic Conditional Correlation (DCC) Multivariate EGARCH (DCC-MEGARCH) model to investigate market interdependence. EGARCH model is used to consider the problem of asymmetric volatility in market return. The asymmetric volatility is a market pattern

that volatility is higher during market downturns than during upswings. Factors that cause asymmetric volatility include the effects of leverage in the markets, volatility feedback and different perceptions of risk and return relationship at different market levels. The existence of asymmetric volatility has been widely documented by several studies (i.e., Schwert, 1989; Bekaert and Wu, 2000; Engle and Mistry, 2014).[2] While the GARCH model imposes the nonnegative constraints on the parameters, EGARCH models the log of the conditional variance so that there are no restrictions on these parameters.

$$R_{i,t} = \beta_{i,0} + \sum_{j=1}^{4} \beta_{i,j} R_{j,t-1} + \epsilon_{i,t} \; I, j = 1,\ 2,\ 3,\ 4 \tag{1}$$

$$\sigma_{i,t}^2 = \exp\left\{\alpha_{i,0} + \sum_{j=1}^{4} \alpha_{i,j} f_j(Z_{j,t-1}) + \gamma_i \ln(\sigma_{i,t-1})\right\} \tag{2}$$

If γ_1 is significant, it implies that the bad news cause a higher volatility than that caused by the good news.

$$f_j(Z_{j,t-1}) = |Z_{j,t-1}| - E(|Z_{j,t-1}|) + \delta_j Z_{j,t-1} \tag{3}$$

$$\rho_{ij}(UC) = \frac{\sigma_{ij}}{\sigma_i \sigma_j} = \frac{\sum_{t=1}^{n} R_{i,t} R_{j,t}}{\sqrt{\sum_{t=1}^{n} R_{i,t}^2 \sum_{t=1}^{n} R_{j,t}^2}} \tag{4}$$

$$\rho_{ij,t}(DCC) = \frac{E_{t-1(Z_{i,t} Z_{j,t})}}{\sqrt{E_{t-1}\left(Z_{i,t}^2\right) E_{t-1}\left(Z_{j,t}^2\right)}} \tag{5}$$

$$= \frac{\sum_{s=1}^{t-1} \lambda^s Z_{i,t-s} Z_{j,t-s}}{\sqrt{\left(\sum_{s=1}^{t-1} \lambda^s Z_{i,t-s}^2\right)\left(\sum_{s=1}^{t-1} \lambda^s Z_{j,t-s}^2\right)}},\ \lambda = \gamma_i$$

2) There are several other models that allow for volatility asymmetry. These models include Quadratic GARCH, the GJR GARCH, Threshold GARCH, Power GARCH, and etc. Cappiello, Engle and Sheppard (2006) report the results of various GARCH-type models. They find that various models show generally significant asymmetric terms for the equity returns and generally insignificant asymmetric terms for bond returns. In this paper, we tried both EGARCH and GJR GRACH models and find that there is no fundamental difference between models in terms of capturing asymmetric volatility. We decided to proceed with the EGARCH results.

$R_{i,t}$: i^{th} return at time t

$\sigma_{i,t}^2$: conditional variance

$\epsilon_{i,t}$: innovation

$z_{i,t}$: standardized innovation, $(z_{i,t} = \epsilon_{i,t}/\sigma_{i,t})$

2. Risk Decomposition Model

This paper uses the risk decomposition methodology suggested by Akdogan (1996, 1997) and Barari (2004). Consider the following return-generating model of the i^{th} country,

$$R_i = a_i + b_{ri}q_r + b_{wi}R_w + e_i \tag{6}$$

Where R_i and R_w are returns on the i^{th} country index and on a benchmark index, respectively. q_r is orthogonal to R_w and is obtained as residuals from the following regression:

$$R_r = a_r + b_{wr}R_w + q_r \tag{7}$$

In the equations (6) and (7) above, R_i is the rate of return on the i^{th} country, R_r and R_w are the rates of return on the benchmark regional and world portfolios respectively. We break down the rate of return on the i^{th} country into three components: (1) a component that is perfectly correlated with the rate of return on the regional market, (2) a component of the international market rate of return that is uncorrelated with the rate of return on the regional market, and (3) a third component that is uncorrelated with either the first or the second component. The variance of R_i can be decomposed by dividing both sides by var (R_i). We express the risk arguments on the right-hand side of equation (6) as fractions of total risk of investing in the i^{th} country portfolio down into

the following components.

$$a_i = b_{ir}^2 \mathrm{var}(q_r)/\mathrm{var}(R_i),\ b_i = b_{iw}^2 \mathrm{var}(R_w)/\mathrm{var}(R_i),\ c_i = \mathrm{var}(e_i)/\mathrm{var}(R_i),$$
$$1 = a_i + b_i + c_i$$

where a_i, b_i, and c_i represent the regional systematic risk, U.S. systematic risk, and unsystematic risk, respectively.

Ⅳ. Empirical Results

1. Data and Sample Statistics

We use weekly close price indices of Korea Stock Composite (KOSPI), Shanghai Composite, and Nikkei 225 from January 1, 2000 to December 31, 2012 as the basis for our data. Returns are calculated as continuously compounding rates of returns.[3] We use the S &P 500 return as a U.S. benchmark against which we compare the individual markets due to it being one of the strongest representatives of the U.S. financial market. Regional market return was measured by using equally weighted portfolio return of the regional countries excluding home market. All data was collected from Yahoo Finance (finance.yahoo.com). <Table 1> reports basic descriptive statistics for the data. Korea displays the highest mean return and it is also rather volatile, with 33% higher standard deviation than that of United States. The Komogorov-Smirnov D tests reject the hypothesis of normality and left-skewness is found in all markets except

3) If the U.S. market to be the main "driver" of movements in the other equity market, then it is possible to have the non-synchronization problem. For instance, Thursday trading U.S. market would have an impact on the Asian financial markets at their opening on Friday morning. We investigate this issue and find that US Fri-Fri, Asia Mon-Mon case shows the highest correlation coefficient. However, the correlation patterns are almost the same regardless of the time gap adjustment. Furthermore, we have non-convergence problems for some models used in this study for the data adjusted for the time gap even if the similar results are obtained in most cases.

China. For Japan, stock market underperforms the United State. The best performance among three markets is achieved by Korea (0.11%) and the lowest is Japan (-0.12%).

<Table 1> Descriptive Statistics of Weekly Returns, 2000~2012

Return	Mean	Max	Min	Std. Dev.	Skewness	Kurtosis	Komogorov -Smirnov D (P Value)
Korea	0.11	17.03	-22.93	4.01	-0.61	6.81	0.0749*** (<0.01)
U.S.	-0.04	11.36	-29.95	2.92	-1.97	23.06	0.0829*** (<0.01)
China	0.09	13.94	-14.90	3.63	0.05	4.69	0.0521*** (<0.01)
Japan	-0.12	0.08	-36.26	3.44	-2.13	24.03	0.0562*** (<0.01)

Description: ***, **, and * represent the levels of significance of 1%, 5% and 10% respectively.

<Table 2> Unit Root Tests

Country	ADF (P Value)		PP (P Value)	
	Levels	First Difference	Levels	First Difference
Korea	-0.795	-24.411*** (<0.01)	-0.826	-24.409*** (<0.01)
China	-1.305	-22.155*** (<0.01)	-1.606	-22.629*** (<0.01)
Japan	-2.146	-25.275*** (<0.01)	-2.151	-25.238*** (<0.01)
U.S.	-2.362	-25.937*** (<0.01)	-2.255	-25.954*** (<0.01)

Description: ADF is the augmented Dickey-Fuller test and PP is the Phillips-Perron test.
***, **, and * represent the levels of significance of 1%, 5% and 10% respectively.

To check the presence of unit root, two standard unit root test procedures are applied. One is the augmented Dickey-Fuller (ADF) test and the other is the Phillips-Perron (PP) test. The null hypothesis in each test is that each of the index series contains a unit root. <Table 2>

reports the results. According to the <Table 2>, all indices are nonstationary and I (1). Their first differences are stationary. We perform these tests with different numbers of lag and without trend and they make no difference to the conclusion.

2. The Dynamic Conditional Correlation (DCC) Analysis

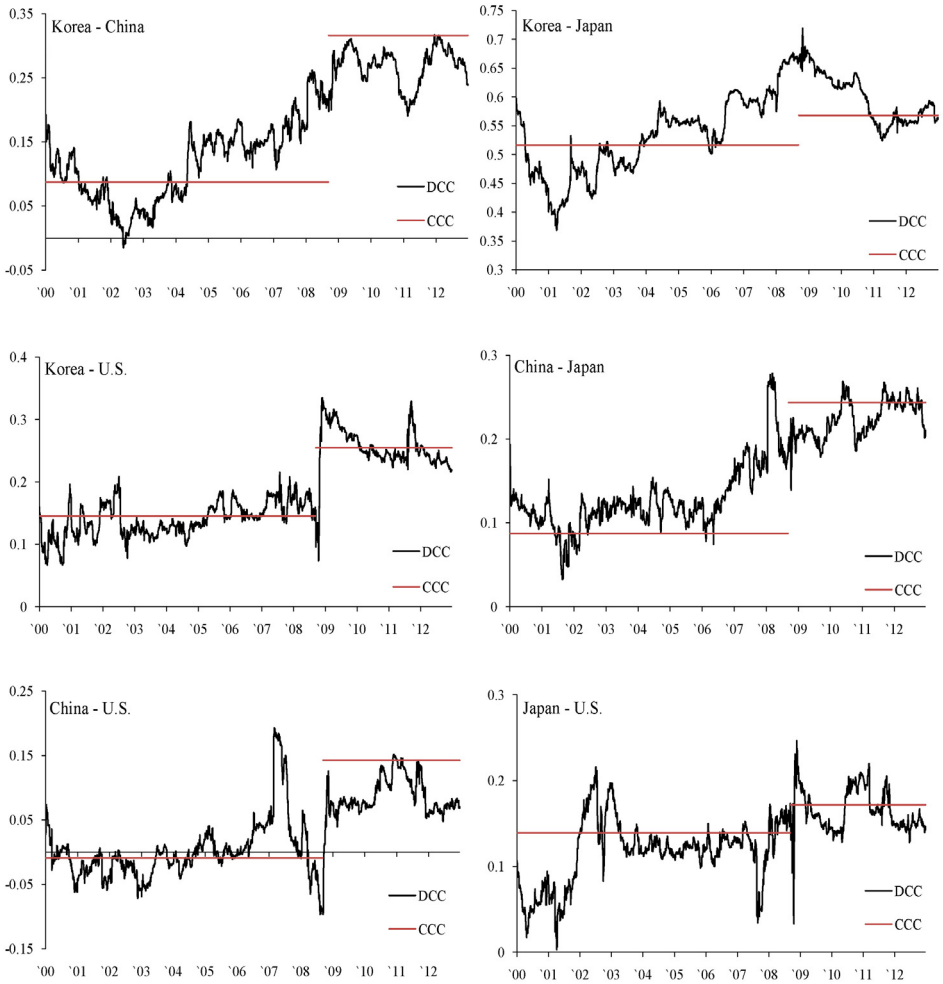
<Table 3> shows the unconditional correlation relationship between the chosen markets and the benchmark indices. The correlations over the sample period range from 0.111 for China and United States to 0.627 for Korea and Japan. The Korean and Japanese markets are more closely correlated with the U.S. market compared to the Chinese market. The conditional correlation coefficients estimated from DCC and CCC models are plotted in <Figure 1>. <Figure 1> shows a gradual increase of the correlation between the stock markets during the sample period. It is interesting to note that the correlation tends to peak in all countries with the occurrence of the global financial crisis. However, the increased correlations during the financial crisis period have been significantly decreased in the post-crisis era. It implies that the stock market movements have been shifting towards the market segmentation after the GFC.

For Korea, <Figure 1> shows positive relations with the U.S., China, and Japan markets. For China, the correlation pattern is similar to that of Korea for the pre-crisis period. Only exception can be found from the China-US relation. China has been independent from the movements of U.S. market for the pre-crisis period. Korea shows the highest correlation with the U.S. stock market while China shows the least. Japan shows the highest correlation with Korea. In all cases, the results show that Northeast Asian stock markets are more closely connected with the regional stock market than they are with the U.S. market.

<Table 3> Correlation Matrix for Equity Markets Returns

	Korea	China	Japan	US
Korea	1	0.1887	0.6275	0.5447
China	0.1887	1	0.2095	0.1118
Japan	0.6275	0.2095	1	0.5994
U.S.	0.5447	0.1118	0.5994	1

<Figure 1> Analysis of Dynamic Conditional Correlations between Markets



Description: CCC: Constant Conditional Correlation model of Bollerslev (1990).
DCC: Dynamic Conditional Correlation model of Engle (2002).

To investigate the effect of GFC on the level of correlation, we compare the pre-crisis correlation pattern with the post-crisis correlation pattern. As we can see in <Figure 1>, the correlations between the U.S. and Northeast Asian stock markets have increased since the GFC. The result suggests that the GFC strengthened the U.S. - the regional market ties. However, the correlations between Northeast Asian stock markets and the U.S. stock market have gradually decreased during the post-crisis period, implying that Northeast Asian stock markets are less influenced by the movements of the U.S. stock market during this period. To sum up, the 2008 GFC seems to influence the dynamics of contagion and integration process in this regional stock market. However, the effect of GFC on the regional integration is only temporary. There is no evidence to suggest that the crisis systematically influences the integration process of individual market in the region.

3. Alternative Specification-Diagonal BEKK Model

DCC-EGARCH is not the only model to estimate the dynamic integration process between markets. To model the correlation coefficient, it is possible to use an alternative procedure such as scalar or diagonal BEKK (e.g., Engle and Kroner, 1995). BEKK has someproblems, such as the curse of dimensionality. For instance, if there is a k-dimensional vector of financial variables (returns), the BEKK model has parameters increasing with order of k^2. As the number of parameters estimated by BEKK models is much more than that of DCC models, the summation of the error accumulated by each parameter of the BEKK model tends to be larger than that of the DCC model. Consequently, BEKK estimates can be more volatile than those obtained with the DCC model. However, we are only estimating four markets in this paper. Therefore, the dimensionality is

not likely to cause a serious problem while BEKK specification allows us to obtain a richer set of results.[4] The form of the diagonal BEKK model is as follows. The time-dependent conditional covariance matrix is parameterized as

$$H_t = C'C + \sum_{K=1}^{K} \sum_{i=1}^{q} A'_{Ki} \epsilon_{t-i} \epsilon'_{t-i} A_{Ki} + \sum_{K=1}^{K} \sum_{j=1}^{p} B'_{Kj} H_{t-j} B_{Kj} \quad (8)$$

$\boldsymbol{C}$ is the $n \times n$ upper triangular parameter matrix; $\boldsymbol{B}$ is the diagonal parameter matrix that shows the extent to which current levels of conditional variances are related to past conditional variances; $\boldsymbol{A}$ is the diagonal parameter matrix that measures the extent to which conditional variances are correlated with past squared errors. This formulation has the advantage over the general specification of the multivariate GARCH that conditional variance (H_t) is guaranteed to be positive for all t. The following equation presents the BEKK GARCH(1, 1), with K=1.

$$H_t = C'C + A'\epsilon_{t-1}\epsilon'_{t-1}A + B'H_{t-1}B \quad (8a)$$

where C is a 4×4 lower triangular matrix with intercept parameters, and A and B are 4×4 square matrices of parameters. Once again, we apply the BEKK GARCH model with diagonal restriction.

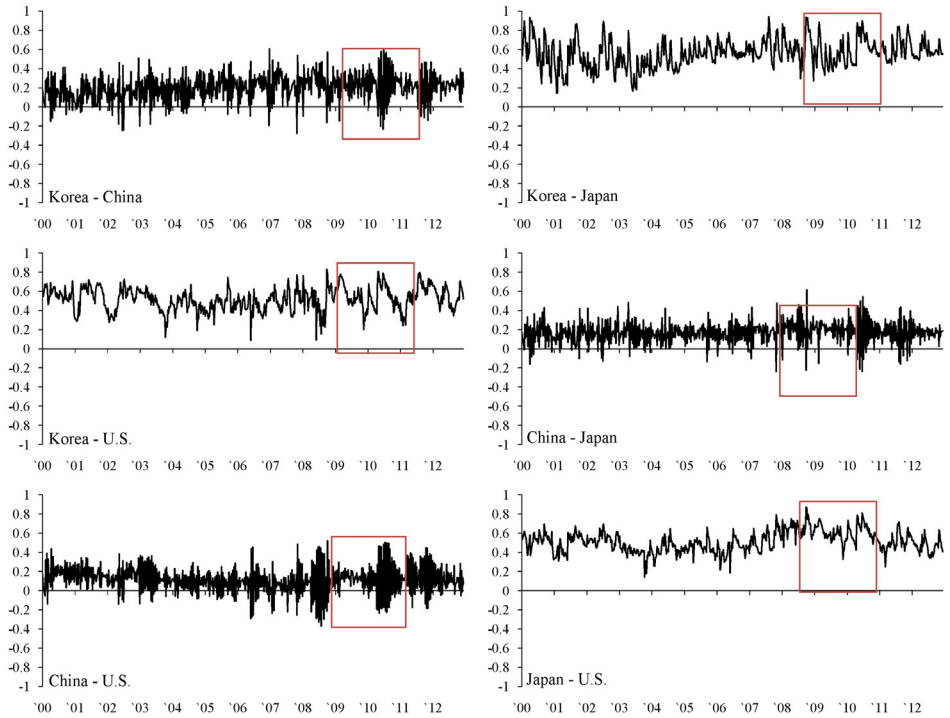
The conditional correlation coefficients estimated from the diagonal BEKK are plotted in <Figure 2>. The conditional correlations became unstable during the second half of 2008 and the year 2009, due to the global financial turbulence during that period. Some higher degree of conditional correlations can be spotted in this period, especially for the relationship with U.S. and local markets. However, unlike the DCC estimation results, the general impression is that there is no upwards trending

4) For a detailed discussion of BEKK model, see Baba, Engle, Kraft, and Kroner (1990).

of correlations between markets since the GFC. For instance, China has had some negative correlations with the other countries during this period. Furthermore, <Figure 2> shows a decreasing tendency of correlational coefficients between regional markets and U.S. market during the post-crisis period. The result is consistent with the result of DCC estimation.

The BEKK estimation results suggest that the stock market integration among Korea, Japan and U.S. is high with the values typical for any major stock markets in developed countries. However, Chinese market exhibits much lower degree of integration with the other countries. The result for China is likely to reflect the following main factors: 1) relatively short history of stock market in China, 2) slow financial reforms in China compared to the other regional countries.

<Figure 2> Analysis of BEKK Correlations between Stock Markets



Description: Time-varying Correlations estimated by BEKK-EGARCH.

These results highlight the potential diversification benefits to investors who held Chinese stocks at that time. This is likely to be due to the relatively independent movements of Chinese market from the U.S. market movements.

It should be also noted that a trend of market integration is not evident for these local markets. The results of the current analysis are inconsistent with previous studies that have reported the increased integration since the financial crisis. On the contrary, the evidence in this paper suggests that an increased integration is only unique to the crisis period. We also find that the pattern of stock market integration can be different under the various volatility conditions across different regional markets. It seems that stock markets are not integrated or segmented in a fixed pattern but change dynamically over time.[5)]

4. Risk Decomposition Analysis

We further investigate the dynamic integration process by using the risk decomposition analysis. <Table 4> provides the estimated historical integration scores for the three countries in the region. We divide the sample period into two sub-periods; pre-crisis and post-crisis periods. For the pre-crisis period, the value of B score is higher than the value of A score except China. Since the A and B represent the regional systematic risk and U.S. systematic risk, respectively, the result suggests that integration with U.S. is dominant over regional integration for Japan and Korea. B score for China is close to zero, indicating China receives very little influence from the U.S. market before the GFC. During the post-crisis period, all three countries in the region have shown a tendency to shift towards a more integration with U.S. as the B scores increase sharply. The value

5) See Barari (2004) and Phylaktis and Ravazzolo (2005) for this view.

of post B score is higher than the value of pre B score for all three countries. However, average B score for the post crisis period is mainly due to the high B scores for the crisis period, indicating that the increased integration is only temporary for the crisis period. Similar evidence is found by the analysis of country specific risk. The pattern of country specific risk is identified by analyzing C scores. According to <Figure 3>, the unsystematic risk levels are in the order of Japan, Korea, and China. The unsystematic risk constitutes the biggest proportion of overall risk in all three countries during the entire sample period. In particular, China's unsystematic risk constitutes 95% of the total risk. For Korea, the country-specific risk exhibits a peak around the global financial crisis period. We also find that country-specific risk for Japan shows a downward trend up to 2008 and it suddenly shows a sharp increase in 2009. High level of country specific risk in the region implies that a portfolio created through

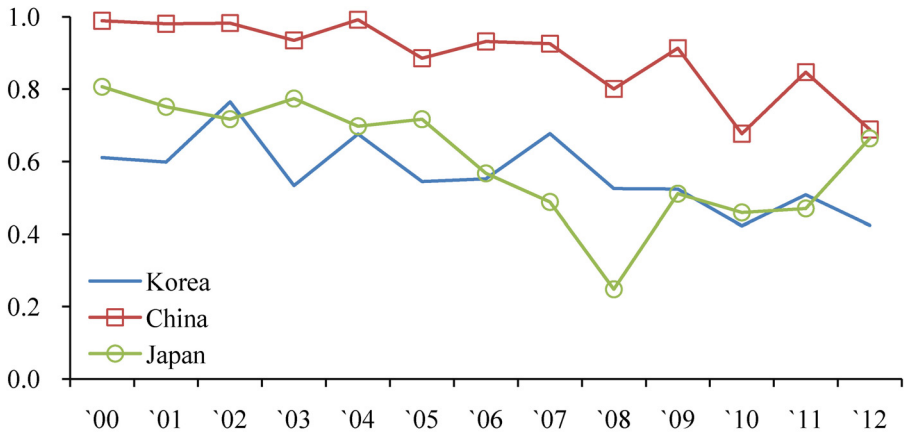
<Table 4> Integration Scores

	KOREA			CHINA			JAPAN		
	A	B	C	A	B	C	A	B	C
2000	0.24890	0.14005	0.61104	0.00966	0.00145	0.98890	0.19310	0.00027	0.80663
2001	0.00652	0.39487	0.59861	0.00382	0.01553	0.98065	0.03466	0.21408	0.75126
2002	0.01237	0.22267	0.76496	0.01671	0.00070	0.98260	0.10769	0.17546	0.71686
2003	0.09889	0.36756	0.53355	0.06111	0.00403	0.93486	0.06492	0.16088	0.77421
2004	0.09513	0.22871	0.67616	0.00801	0.00001	0.99198	0.10134	0.20128	0.69738
2005	0.20254	0.25261	0.54485	0.09996	0.01466	0.88538	0.13995	0.14321	0.71684
2006	0.09867	0.34935	0.55198	0.02703	0.04119	0.93178	0.12177	0.31096	0.56727
2007	0.04611	0.27649	0.67740	0.03950	0.03464	0.92586	0.14351	0.36823	0.48827
2008	0.12887	0.34583	0.52529	0.14946	0.04990	0.80064	0.13773	0.61457	0.24770
2009	0.09035	0.38564	0.52400	0.07392	0.01269	0.91339	0.08106	0.40782	0.51112
2010	0.05735	0.52010	0.42254	0.03040	0.29275	0.67685	0.04074	0.49973	0.45953
2011	0.03272	0.45891	0.50837	0.03522	0.11759	0.84719	0.09950	0.43014	0.47036
2012	0.24962	0.32607	0.42431	0.31050	0.00098	0.68852	0.13225	0.20369	0.66406
All-period	0.07404	0.29153	0.63443	0.04325	0.00506	0.95168	0.10342	0.28989	0.60669
Pre-Crisis	0.08422	0.22805	0.68774	0.03844	0.00100	0.96055	0.12361	0.14952	0.72687
Post-Crisis	0.05814	0.43749	0.50437	0.05285	0.01712	0.93002	0.07078	0.50558	0.42364

an integrated market amongst three countries would result in a significant decline in the unsystematic risk.

From these empirical results, we can draw the following conclusions. First, no market is fully integrated or segmented at any moment in time. Second, the global financial crisis causes only a temporary increase in stock market integration in the region. Third, individual market in the region remains relatively independent.

<Figure 3> Trend of Country Specific Risk



Description: Country specific risk is estimated by C score.

Ⅴ. Summary and Conclusions

Three main Northeast Asian countries, China, Japan, and Korea, are in the process of negotiating FTA. It is expected that the three nations FTA would lead to a competent capital market by facilitating more capital and new investment opportunities in the region. However, in spite of the importance of Northeast Asian region, there have been no empirical studies to investigate the stock market integration process in the region.

In this paper, we investigate dynamic patterns of stock market integration between the Northeast Asian and U.S. markets with a special attention focused on the effect of financial crisis on the level of integration. The primary findings of this study are as follows:

First, we find that there is a higher level of integration between the regional and U.S. markets after the financial crisis. Second, the increased level of integration returns to its pre-crisis level after the crisis. Third, each country shows a different pattern of integration. China is integrated more with the regional market compared to the U.S. market. On the other hand, Japan and Korea are influenced more by the U.S. market. Finally, the evidence suggests that a portfolio created through the regional market would result in a significant decline in the unsystematic risk of each country. Overall result suggests that the degree of integration among countries tends to change over time, especially around periods marked by financial crisis.

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