

# Event Studies On The Effects Of The NAFTA And Asian Crisis: The Case Of Asia

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## ABSTRACT

*This study examines the effects of NAFTA implementation and Asian economic crisis on the inter-market relationships in Asia. Using the correlation analysis and the event-study model for a period of January 1992 - September 2006, this study finds that 1) the correlations between stock markets have been stable but volatile after the Asian crisis, 2) these markets became more integrated after the Asian crisis, and 3) the NAFTA had no major effects on the inter-market relationships. Since there have been no significant changes in the inter-market relationships after these two major events, there still exists much benefit from diversification to be exploited in these markets.*

## I. INTRODUCTION

In recent years, financial markets around the world have become more integrated due to various factors such as increased international trade and cross-border investing, deregulations, and development of communication technology. As the modern portfolio theory suggests, investors need to minimize risk without sacrificing returns by diversifying their investments over different types of assets with low correlations.<sup>1</sup> Since diversification gains mainly come from lower correlations between different types of assets, higher integration means decreased benefits from diversification. Empirical studies thus far reported that the correlations among stock markets have substantially increased in recent years, but there is no consensus regarding the trend of integration over time. Thus, it is of great importance to know the trend of inter-market relationships so that investors and portfolio managers can better control their investments abroad and foreign exposures.

The objective of this study is to examine 1) whether the inter-market relationships have been stable over time, and 2) whether two major events (i.e., Asian economic crisis, NAFTA) have changed the fundamental linkages between stock markets in Asia. This study uses the stock market indexes of ASEAN-5 (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) plus 4 Asian economies (Hong Kong, Japan, South Korea, and Taiwan).<sup>2</sup> These economies are chosen due mainly to their open, trade-driven economic policies to stimulate their economic growth. The open-economy macroeconomics maintains that small, open economies are more sensitive to changes in international conditions. For this period, their trade ratios significantly increased.<sup>3</sup> The average trade ratio of developed economies (i.e., Hong Kong, Japan, Singapore) is 1.88; which is much higher than 0.98 for developing economies. Interestingly, some developing economies have lower ratio (e.g., Indonesia (0.53), Korea (0.61)) while others have higher ratios (e.g., Malaysia (1.81), Thailand (0.99)).

This study is different from previous studies in three folds. First, this study uses correlation coefficients from a non-overlapping 90-day window of daily returns while previous studies used long-horizon overlapping returns. Second, this study examines the trend of correlation coefficients over the period rather than simple correlations. Third, this study examines whether Asian stock markets became more integrated as Asian economies gradually liberalized their markets since 1990s.<sup>4</sup> This study uses daily stock returns of the Morgan Stanley Capital International (MSCI) market indexes for a period of January 1992 and September 2006. This period is chosen because of the two major events (i.e., NAFTA (January 1994), Asian crisis (June 1997)), which greatly affected many Asian economies. The empirical results suggest

the following: 1) the correlations between stock markets have been stable but volatile after the Asian crisis; 2) Asian markets became (a little) more integrated after the Asian crisis, and 3) the NAFTA had no major impacts on the inter-market relationships in Asia. Since the correlations between stock markets had not significantly increased after these two major events, there still exists much benefit from diversification to be exploited in Asia. This study proceeds as follow. Section II provides review of previous studies. Section III discusses data and empirical results. Conclusions and further research follow in Section IV.

## **II. PREVIOUS STUDIES**

Empirical studies thus far have examined diversification benefits by using pair-wise correlations between stock markets.<sup>5</sup> There have been two groups of studies. The first group of studies examined the integration between financial markets before the Asian economic crisis. Bailey and Stulz (1990) examined portfolio diversification across Pacific-Basin stock markets during 1977 - 1985 and found a high degree of correlations between the US and Asian markets. Montiel (1993) found relatively higher capital mobility between Asian markets (i.e., Korea, Singapore, Thailand, Malaysia, and Philippines), which resulted in higher integration. Palac-McMiken (1997) reported that most Asian markets (except for Indonesia) are strongly linked with the Thailand market during 1987-1995. Garret and Spyrou (1997) noted that Asia-Pacific stock markets (i.e., India, Malaysia, Thailand, and Philippines) had a low inter-market dependency except for Korea and Taiwan.

The second group of studies examined the effects of the Asian crisis on the path of financial integration. Roca et al. (1998) found that with an exception of Indonesia, ASEAN-5 markets were closely linked in the short run but not in the long run, and the two (e.g., Singapore, Thailand) markets had been strongly linked with the other markets. Gosh et al. (1999) reported that there were three types of stock markets with distinctive features during the Asian crisis: the first group is greatly influenced by the US stock market (i.e., Hong Kong, Korea, and Malaysia); the second group by the Japanese market (i.e., Indonesia, Philippines, and Singapore); and the third group by no other markets (i.e., Thailand, Taiwan).<sup>6</sup> Worthington et al. (2003) noted that 1) the relationship between developed and emerging stock markets had been getting weaker, 2) four stock markets (i.e., Hong Kong, Japan, Korea, Singapore) account for most of the significant causal relationships before the Asian crisis, and 3) the two markets (i.e., Taiwan, Thailand) account for significant causal relationships after the Asian crisis. Yang et al. (2003) found that 1) both long-run cointegrations and short-run causal linkages between stock markets became stronger during the Asian crisis, 2) the US market greatly influenced the Asian markets, and 3) the Japanese market had little influence on other markets in Asia (except during the Asian crisis). Park (2005) showed that the level of financial integration greatly improved after the Asian crisis. Fooladi and Rumsey (2006) reported that despite lower integration (January 1988 - June 2000), diversification benefits (in US dollars) persistently exist, and the increased co-movements between stock markets (in local currencies) had been counterbalanced by exchange-rate changes.

In a different context, Forbes and Rigobon (2002) found the existence of high co-movement(s) between stock markets during the Asian crisis, the Mexican peso crisis, and the black Monday (October 1987). Atteberry and Swanson (1997) studied the effects of the NAFTA implementation on the equity market linkages during 1985 - 1994 but found no evidence of stable relationships except during 1993-1994. Using monthly data during 1987-1997, Ewing et al. (1999) have not observed any major impacts of the NAFTA on the inter-market relationships. Darrat and Zhong (2005) found the existence of long-run relationships between stock markets after the NAFTA but not before the NAFTA.

Despite scant evidences of financial markets integrations, empirical studies thus far have not provided a consensus regarding the inter-market relationship between stock markets in Asia around the major events of interest: Some studies reported higher correlations after the Asian crisis whereas other studies found no major differences before and after the crisis.

## **III. DATA AND EMPIRICAL RESULTS**

This study uses 90-day windows of daily returns of the MSCI market indexes (local currency) to examine the inter-market relationships during January 1992 - September 2006.<sup>7</sup> The holding period returns for the whole period are as

follow: Indonesia (338%), Hong Kong (258%), Korea (84%), Malaysia (66%), the Philippines (62%), Singapore (46%), Taiwan (33%), Thailand (0.4%), and Japan (-47%).<sup>8</sup> On average, these stock markets posted 92.8% return for this period. Table 1 provides the annualized returns. Before the Asian crisis, Hong Kong posted the highest return (43.4%), followed by Indonesia (34%), while Thailand had the lowest return (-3.8%).<sup>9</sup> After the crisis, Korea posted the highest return (17.9%), followed by Indonesia (14.3%), but Japan had the lowest return (-4.2%). As a whole, the average return for these markets declined around 67.6% (17.9% to 5.8%) after the crisis. The average return of developed economies declined around 84% (16.37% to 2.62%) and that of developing economies decreased around 60.6% return (18.67% to 7.35%).

Table 1 The Annualized Average Returns of the Asian Stock Markets

Countries	Before	After	Changes (%)
Hong Kong (HKN)	43.3963	5.858759	-86.50%
Japan (JAP)	-0.90836	-4.18084	-360.26%
Singapore (SIN)	6.634226	6.168269	-7.02%
Korea (KOR)	8.360253	17.93256	114.50%
Taiwan (TAI)	23.70543	-1.48539	-106.27%
Indonesia (IND)	33.74825	14.28962	-57.66%
Malaysia (MAL)	21.38093	3.263996	-84.73%
Philippines (PHI)	28.58223	-2.05906	-107.20%
Thailand (THA)	-3.76018	12.14158	422.90%
Average (overall)	17.90434	5.7699434	-67.77%
Average (developed economies)	16.37406	2.6153968	-84.03%
Average (developing economies)	18.66948	7.3472167	-60.65%

Table 2 Descriptive Statistics of the Returns of the Stock Market Indexes

	Mean	Std. Dev.	COV	Min.	Max.	Range
Hongkong	0.0980%	<sup>1</sup> 1.3910%	14.1965	-8.0094%	5.8733%	13.8827%
	0.0156%	<sup>2</sup> 1.7771%	113.7563	-13.7005%	18.8237%	32.5243%
Japan	-0.0025%	1.3521%	-551.6299	-5.5981%	7.8431%	13.4412%
	-0.0117%	1.4590%	-124.7193	-6.9785%	7.9615%	14.9401%
Singapore	0.0176%	0.7798%	44.3281	-4.4820%	4.1895%	8.6715%
	0.0164%	1.2976%	78.9994	-8.0111%	9.1577%	17.1688%
Korea	0.0220%	1.3029%	59.1373	-5.5638%	8.5313%	14.0951%
	0.0452%	2.2723%	50.3013	-12.0188%	10.5434%	22.5622%
Taiwan	0.0583%	1.5042%	25.8113	-6.7380%	7.6894%	14.4274%
	-0.0041%	1.6682%	-404.9334	-9.4583%	8.8932%	18.3516%
Indonesia	0.0797%	0.8657%	10.8605	-5.8029%	7.9506%	13.7535%
	0.0366%	1.9217%	52.5012	-11.9549%	22.8662%	0.0366%
Malaysia	0.0531%	1.1183%	21.065	-6.4350%	10.1995%	16.6345%
	0.0088%	1.8276%	207.0743	-21.4578%	23.1427%	0.0088%
Philippines	0.0689%	1.2574%	18.2555	-5.6786%	7.4604%	13.1390%
	-0.0057%	1.5981%	-280.9317	-9.2845%	17.5597%	-0.0057%
Thailand	-0.0105%	1.4509%	-138.5075	-8.8758%	9.0497%	17.9255%
	0.0314%	1.8551%	59.1529	-9.5416%	12.0187%	0.0314%

- Notes: (a) The numbers ("1", "2") refer to the period before and after the Asian crisis.  
 (b) The mean returns (before and after) are not significantly different at the 10% level.  
 (c) The two SDs are significantly different at the 1% level (Levene 1960).  
 (d) The COV is to measure the relative riskiness (i.e., risk per unit of return as the standard deviation over the mean return).

The first step in empirical tests is to examine the stationarity (i.e., unit root test) of market indexes in the framework of the Augmented Dickey-Fuller (Dickey and Fuller 1979) model:

$$\Delta y_t = \alpha + \beta(1 + \lambda)y_{t-1} + \sum_{j=1}^k (1 + \lambda)\Delta y_{t-j} + \varepsilon_t \tag{1}$$

where y is the series being tested, and k is the number of lags to be included to capture any autocorrelations. A dummy variable is used to capture any changes due to structural breaks in pooling data for this period. The test is t-statistic for the null hypothesis of “b = 0”. The results (not reported to save space) show that each index contains a unit root, but no unit root is found in first-differenced series.<sup>10</sup> Thus, the first-differenced series are used in empirical tests below.

The second step is to examine cointegration between stock market indices. If two series are cointegrated, there is a common component(s) for a long-run relationship which greatly reduces diversification benefits. This study uses Johansen's trace and maximum eigenvalue methods (Johansen 1995, 1997). The null hypothesis of no cointegration for the first-differenced series is not rejected at the 5% significance level.<sup>11</sup> This result is consistent with the findings by Abbott and Chow (1993) and Arshanapalli and Doukas (1993).

Table 3.A The Means of the Correlation Coefficients between Stock Markets

	Hongkong	Japan	Singapore	Korea	Taiwan	Indonesia	Malaysia	Philippines	Thailand
Hongkong	1.0000								
	1.0000								
Japan	0.1877	1.0000							
	0.4666 (+) *	1.0000							
Singapore	0.3734	0.1522	1.0000						
	0.5828 (+) *	0.4017 (+) *	1.0000						
Korea	0.0413	-0.0026	0.0390	1.0000					
	0.4637 (+) *	0.4256 (+) *	0.4254 (+) *	1.0000					
Taiwan	0.1253	0.0643	0.0882	0.0161	1.0000				
	0.3585 (+) *	0.3020 (+) *	0.3488 (+) *	0.3608 (+) *	1.0000				
Indonesia	0.2362	0.0915	0.2648	0.0372	0.0367	1.0000			
	0.2950 (+)	0.2270 (+) *	0.3179 (+)	0.2420 (+) *	0.2090 (+) *	1.0000			
Malaysia	0.3745	0.1454	0.5095	0.0453	0.0717	0.2673	1.0000		
	0.3263 (-)	0.2573 (+) *	0.3570 (-) *	0.2403 (+) *	0.2071 (+) *	0.2337 (-)	1.0000		
Philippines	0.2060	0.0351	0.2158	0.0247	0.0628	0.2375	0.1889	1.0000	
	0.2514 (+)	0.2146 (+) *	0.2574 (+)	0.2263 (+) *	0.1771 (+) *	0.2526 (+)	0.2023 (+)	1.0000	
Thailand	0.2963	0.0620	0.3042	0.0611	0.0187	0.1977	0.3067	0.1740	1.0000
	0.3456 (+)	0.2685 (+) *	0.3980 (+)	0.3222 (+) *	0.2498 (+) *	0.2878 (+)	0.2983 (-)	0.2358 (+)	1.0000

Note: 1. The numbers in **Row 1** for each country refer to the mean of the correlation coefficients before the crisis whereas and those in **Row 2** the mean of the correlation coefficients after the crisis.

2. “+” (or “-”) denotes “significant increase (or decrease)” in the mean of the correlation coefficients.

3. “\*” denotes “significant increase (or decrease) at the 5% level” in the mean of the correlation coefficients after the Asian crisis.

The third step is to analyze the correlation coefficients (CCs) of the first-differenced series. Table 3.A provides the means of CCs before and after the Asian crisis. Before the crisis, most CCs are positive and range between 0.0161 (Korea-Taiwan) and 0.3745 (Hong Kong-Malaysia). The average CC before the crisis is 0.1544, which is much smaller than 0.4 which was reported in previous studies. There is observed one negative CC (-0.0026 for Korea-Japan), which suggests that investors could reduce much risk by diversifying across these two markets despite their geographical proximity. After the Asian crisis, the average CC is 0.29 and the CCs range between 0.1771 (Taiwan-Philippines) and 0.5828 (Hong Kong-Singapore). The CCs increased in 32 cases out of 36 (denoted in positive (“+”) sign). However, the CC for Hong Kong-Korea increased as much as 1,022% (0.0413 to 0.4637), which is much higher than only 17% increase for Thailand - Hong Kong. Interestingly, there are 4 cases in which the CCs decreased: 39.6% (Malaysia - Singapore), 12.9% (Malaysia-Hong Kong), 2.7% (Malaysia-Thailand), and 1.6% decrease (Malaysia-Indonesia). After the crisis, the CCs increased around 64% on average, but there still exists much diversification benefit to be exploited in Asia.

Table 3.B The Standard Deviations of the Correlation Coefficients

	Hongkong	Japan	Singapore	Korea	Taiwan	Indonesia	Malaysia	Philippines	Thailand
Hongkong	0.0000 0.0000								
Japan	0.1521 0.0879 (-)	0.0000 0.0000							
Singapore	0.1718 0.1062 (-)	0.1968 0.1318 (-)	0.0000 0.0000						
Korea	0.1532 0.1780 (+)	0.1452 0.1992 (+)	0.1527 0.1549 (+)	0.0000 0.0000					
Taiwan	0.0985 0.1814 (+) *	0.0783 0.1573 (+) *	0.1337 0.1586 (+)	0.1115 0.2077 (+) *	0.0000 0.0000				
Indonesia	0.1780 0.1461 (-)	0.0894 0.1453 (+)	0.2073 0.1582 (-)	0.1285 0.1728 (+)	0.1017 0.1622 (+)	0.0000 0.0000			
Malaysia	0.1771 0.1082 (-)	* 0.1135 0.1211 (+)	0.1616 0.1618 (+)	0.1152 0.1513 (+)	0.1340 0.1515 (+)	0.1745 0.1291 (-)	0.0000 0.0000		
Philippines	0.1574 0.1533 (-) *	0.1593 0.1270 (-)	0.1837 0.1900 (+)	0.1632 0.1047 (-)	0.1128 0.1252 (+)	0.2190 0.1591 (-)	0.2004 0.0988 (-) *	0.0000 0.0000	
Thailand	0.2316 0.1729 (-)	0.1758 0.1209 (-)	0.2098 0.1387 (-) *	0.1382 0.1055 (-)	0.1343 0.1389 (+)	0.2008 0.1522 (-)	0.1825 0.1498 (+)	0.1975 0.1731 (-)	0.0000 0.0000

Note: 1. The numbers in **Row 1** for each country refer to the *SD* of the correlation coefficients before the crisis whereas and those in **Row 2** the *SD* of the correlation coefficients after the crisis.  
 2. “+” (or “-”) denotes “significant increase (or decrease)” in the *SD* of the correlation coefficients.  
 3. “\*” denotes “significant increase (or decrease) at the 5% level” in the *SD* of the correlation coefficients after the Asian crisis.

Table 3.B presents the standard deviations (*SDs*) of correlation coefficients. Before the crisis, the average *SD* is 0.1567 and the *CCs* range between 0.0783 (Taiwan–Japan) and 0.2316 (Hong Kong–Thailand). After the crisis, the average *SD* is 0.1466 and the *SDs* range between 0.0879 (Japan–Hong Kong) and 0.2077 (Hong Kong–Singapore)). The average *SD* of correlation coefficients decreased around 6.38% after the crisis, but the change is not statistically significant. The results suggest that the Asian crisis had no major impacts on the volatility of inter-market relationships during this period. Thus, it is hard to draw any meaningful conclusion regarding the trend, volatility, and impacts of the Asian crisis on the inter-market relationships. This issue needs to be investigated more in depth below.

The fourth step is to examine the trend of inter-market relationships by using the regression analysis. In this framework, the *CCs* are regressed on the time variable (“*t*”) and a dummy variable which reflects the impacts of the Asian crisis as follow.

$$y_{t,i} = \beta_{0,i} + \beta_{1,i}t + \delta_{1,i}I + \delta_{2,i}I^*t + \varepsilon_{t,i} \quad (2)$$

where *I* refers to Asian crisis, and *i* (= 1 ~ 9) refers to the stock market series of interest.

Table 4 (Column 2) shows that 12 slope coefficients are significant and positive before the crisis (i.e., 2, 7, and 5 coefficients at the 1%, 5%, and 10% significance levels, respectively). The positive coefficients suggest that these markets became more integrated before the Asian crisis (e.g., Hong Kong – Japan). Though there are 6 negative coefficients, none of them is significant. Table 4 (Column 4) shows the changes in slope coefficients before and after the Asian crisis. Out of 16 significant changes, 5 changes are positive (i.e., 1, 3, and 1 coefficient at the 1%, 5%, and 10% significance levels, respectively). The positive changes imply more integration between stock markets after the Asian crisis (e.g., Japan–Taiwan). In contrast, there are 11 significant negative changes (i.e., 4, 4, and 3 coefficients at the 1%, 5%, and 10% significance levels, respectively). These negative changes suggest that stock markets became less integrated after the Asian crisis (e.g., Hong Kong–Indonesia, Hong Kong–Philippines). The results are consistent with those in Table 3. As a whole, the results show that the Asian crisis had no great impacts on the inter-market relationships, and Asian stock markets became less integrated after the Asian crisis.

Table 4 Results of the Regression Analyses with the Correlation Coefficients

	Before		Change	
	Intercept	Slope	Intercept	Slope
Hong Kong - Japan	0.0055	0.0228 <sup>a</sup>	0.3143 <sup>a</sup>	-0.0173 <sup>b</sup>
Hong Kong - Singapore	0.2970 <sup>a</sup>	0.0096	0.3010 <sup>b</sup>	-0.0101
Hong Kong - Korea	-0.0391	0.0100	0.0300	0.0075
Hong Kong - Taiwan	0.0760	0.0062	-0.1260	0.0090
Hong Kong - Indonesia	0.0324	0.0255 <sup>a</sup>	0.3220 <sup>b</sup>	-0.0277 <sup>a</sup>
Hong Kong - Malaysia	0.2600 <sup>a</sup>	0.0143 <sup>c</sup>	0.0250	-0.0127
Hong Kong - Philippines	0.0631	0.0179 <sup>b</sup>	0.5860 <sup>a</sup>	-0.0326 <sup>a</sup>
Hong Kong - Thailand	0.2000 <sup>c</sup>	0.0120	0.3100	-0.0181
Japan - Singapore	0.0589	0.0117	0.0160	0.0004
Japan - Korea	-0.0418	0.0049	-0.1580	0.0183 <sup>c</sup>
Japan - Taiwan	0.0780	-0.0017	-0.2900 <sup>a</sup>	0.0208 <sup>a</sup>
Japan - Indonesia	-0.0121	0.0129 <sup>c</sup>	0.0800	-0.0071
Japan - Malaysia	0.0965	0.0061	0.0530	-0.0021
Japan - Philippines	-0.1020	0.0171 <sup>b</sup>	0.3060 <sup>b</sup>	-0.0167 <sup>a</sup>
Japan - Thailand	-0.0328	0.0118	0.1350	-0.0057
Singapore - Korea	0.0811	-0.0053	-0.0870	-0.0212 <sup>b</sup>
Singapore - Taiwan	0.0643	0.0030	-0.0610	0.0098
Singapore - Indonesia	0.0685	0.0245 <sup>b</sup>	0.3430 <sup>c</sup>	-0.0280 <sup>b</sup>
Singapore - Malaysia	0.4820 <sup>a</sup>	0.0035	0.0130	-0.0086
Singapore - Philippines	0.0590	0.0196 <sup>b</sup>	0.6180 <sup>a</sup>	-0.0352 <sup>a</sup>
Singapore - Thailand	0.1870 <sup>b</sup>	0.0147	0.3180 <sup>c</sup>	-0.0186
Korea - Taiwan	-0.0447	0.0076	-0.2700 <sup>b</sup>	0.0174 <sup>b</sup>
Korea - Indonesia	0.1040	-0.0083	-0.2100	0.0212 <sup>b</sup>
Korea - Malaysia	0.0607	-0.0019	-0.0670	0.0111
Korea - Philippines	-0.0338	0.0073	0.2070	-0.0054
Korea - Thailand	0.0720	-0.0014	0.2110	0.0028
Taiwan - Indonesia	0.0530	-0.0020	-0.0860	0.0110
Taiwan - Malaysia	0.0123	0.0074	0.0610	-0.0025
Taiwan - Philippines	0.0218	0.0051 <sup>b</sup>	0.1120	-0.0035 <sup>b</sup>
Taiwan - Thailand	-0.0119	0.0038	0.0700	0.0033
Indonesia - Malaysia	0.0927	0.0218 <sup>b</sup>	0.1270	-0.0213 <sup>b</sup>
Indonesia - Philippines	0.0208	0.0271 <sup>b</sup>	0.3800 <sup>b</sup>	-0.0326 <sup>a</sup>
Indonesia - Thailand	0.0586	0.0174 <sup>c</sup>	0.3090 <sup>c</sup>	-0.0203 <sup>c</sup>
Malaysia - Philippines	0.0137	0.0219	0.2310	-0.0235
Malaysia - Thailand	0.2760 <sup>a</sup>	0.0038	0.0690	-0.0055
Philippines - Thailand	0.1040	0.0088	0.4650 <sup>b</sup>	-0.0211 <sup>c</sup>

Note: Two columns for statistics after the crisis are deleted to save space. The notations, “a, b, and c”, denote “statistical significance” at the 1, 5, and 10% levels, respectively.

The last step is to use the event-study model to examine the effects of lagged CCs (“t-2” and “t-1” windows) and leaded CCs (“t+1” and “t+2” windows) on the concurrent CC (“t” window, i.e., event date). This model captures partial adjustment that one CC makes to shocks caused by other CCs as follow:

$$y_{t,i} = \beta_{0,i} + \beta_{1,i}t + \sum_{j=-2}^2 \phi_{-j}EV_j + \varepsilon_{t,i} \tag{3}$$

where  $y$  is the correlation coefficient,  $EV$  denote dummy variable for the crisis,  $i$  ( $= 1 \sim 9$ ) refers to the stock market indexes, and  $j$  ( $= -2, -1, 0, 1, \text{ and } 2$ ) refers to the number of lags and leads from the event window, and  $e$  is a stationary random process to capture other pertinent information that is not reflected in the model.

Table 5.A Results of the Effects of the Asian Crisis on the Inter-market Relationships

	HKN	JAP	SIN	KOR	TAI	IND	MAL	PHI	THA
HKN									
JAP	xx+xx								
SIN	xxx+x	xxxxx							
KOR	xxx-x	xxx-x	--x-x						
TAI	xxx++	xxxxx	x-x+x	xxxxx					
IND	xxx+x	xxxxx	xxxx+x	-xxxx	xxxxx				
MAL	xxxx+	xxxx+	xxxx+	xxxx+	xxx+x	xxxxx			
PHI	xxx+x	xxxx+	xx++x	xxxxx	xxx+x	xxxxx	xxxx+		
THA	xxxxx	x-xxx	xxxxx	-xxxx	xxx+x	xxxxx	xxxxx	xxx++	

Note: The notations, “x, +, and -”, imply “no change, significant positive impact, and significant negative impact” at the 5% significance level, respectively.

The first result in Table 5.A (i.e., “xx+xx” for JAP~HKN) suggests that the Asian crisis had a positive impact only on the concurrent CC between Japan and Hong Kong (i.e., positive effect on *t*-window) but no significant impact (denoted as “x”) before or after the Asian crisis. In other words, these two markets became more integrated only during the Asian crisis, but not before or after the Asian crisis. In contrast, there are five cases in which stock markets became less integrated in 90 or 180 days before the Asian crisis: JAP~THA, SIN~KOR, SIN~TAI, KOR~IND, and KOR~THA.

After the Asian crisis, stock markets became more integrated in the following 17 cases (with “+” sign in (t+1) and (t+2) windows): HKN~SIN, HKN~TAI, HKN~IND, HKN~MAL, HKN~PHI, JAP~MAL, JAP~PHI, SIN~TAI, SIN~IND, SIN~MAL, SIN~PHI, KOR~MAL, TAI~MAL, TAI~PHI, TAI~THA, MAL~PHI, and PHI~THA. However, there are two cases (i.e., KOR~JAP, KOR~SIN) where stock markets became less integrated (with “-” sign). In these two instances, investors could have gained more benefits from diversification. Interestingly, the Thai market became more integrated with Taiwan and the Philippines even though the Asian crisis broke out in Thailand. As a whole, the results show that Asian stock markets became (a little) more integrated after the crisis. This result is consistent with findings by previous studies (e.g. Yang et al. (2003), Park (2005)).

Table 5.B Results of the Effects of the NAFTA on the Inter-market Relationships

	HKN	JAP	SIN	KOR	TAI	IND	MAL	PHI	THA
HKN									
JAP	--xxx								
SIN	xxxxx	x-xxx							
KOR	xxxxx	xxxxx	xxxxx						
TAI	xxxxx	xxxxx	xxxxx	xxxxx					
IND	-xxxx	xxxxx	-xxxx	xxxxx	xxxxx				
MAL	--xxx	x-xxx	xxxxx	xxx+x	xxxxx	x-xxx			
PHI	x-xxx	xxxxx	x-xxx	xxxxx	x-xxx	x-xx-	-xxxx		
THA	--xxx	-xxxx	xxxxx	xxxxx	-xx+x	xxxxx	xxxxx	--xxx	

Note: The notations, “x, +, and -”, imply “no change, significant positive impact, and significant negative impact” at the 5% significance level, respectively.

Table 5.B shows the effects of the NAFTA on the inter-market relationships. The first minus-sign in *t-2* window (in “--xxx for JAP~HKN”) suggests a negative effect of the NAFTA on the concurrent CC (i.e., less integration between Japan and Hong Kong). That is, the CC for JAP~HKN had a negative impact on the concurrent CC in 180 days (i.e., two 90-day windows) before the NAFTA implementation. The second minus-sign (*t-1* window) reveals a similar result. The three “x” signs (*t*, *t+1*, and *t+2* windows) suggest that there is not observed any significant effect of the NAFTA on the inter-market relationship between Japan and Hong Kong. Similar results are also observed in the following 12 cases: HKN~IND, HKN~MAL, HKN~PHI, HKN~THA, JAP~MAL, JAP~THA, SIN~IND, SIN~PHI, TAI~PHI, IND~MAL, MAL~PHI, and PHI~THA. There are 3 interesting cases (e.g., KOR~MAL, TAI~THA, and IND~PHI) worth discussing.

First, the two (Korea, Malaysia) markets became more integrated in 90 days after the NAFTA (i.e., “xxx+x”). Second, the two (Indonesia, Philippines) markets were predicted to become less integrated in 90 days before the NAFTA and to be less integrated in 180 days after the NAFTA (i.e., “x-xx-”). Third, the two (Taiwan, Thailand) markets were predicted to be less integrated in 180 days prior to the NAFTA and became more integrated 90 days later (i.e., “-xx+x”). These results suggest that the NAFTA had no major effects on the inter-market relationship in Asia.

#### IV. SUMMARY AND CONCLUSION

This study examined the inter-market relationships in Asia. This study finds the following: 1) the inter-market relationships have been stable but volatile during this period, 2) Asian markets became more integrated after the Asian crisis, and 3) the NAFTA had no major impacts on the inter-market relationship. Since correlation coefficients between Asian stock markets have not significantly increased after these two major events, there still exists much diversification benefit to be exploited. The results suggest that investors need to be more careful when investing in developing economies due to more risk exposure; investors need to consider the trend of the correlation coefficients due to their potential predictive (or forecasting) power on the inter-market relationships. Future studies need to examine the effects of other major economic/financial events such as the Mexican peso crisis (1994) and the Russian crisis (1998).

#### NOTES

- <sup>1</sup> In practice, correlation estimates influence individuals' investment decisions (e.g., asset allocation and/or index replication strategies) that require the correlation as an important input.
- <sup>2</sup> The Chinese market is excluded due to lack of data. Laurenceson (2003) found that China and ASEAN-5 economies had strong linkages only with respect to goods and services markets, and the level of financial integration between them was much weak.
- <sup>3</sup> The trade ratios  $\left[\frac{(\text{export} + \text{import})}{\text{GDP}}\right]$ , as a measurement of economic openness, are as follow (min ~ max; average): Japan (0.14 ~ 0.24; 0.19), Hong Kong (2.17~3.33; 2.58), Singapore (2.57~3.65; 2.94); Indonesia (0.37~0.81; 0.53), Korea (0.50~0.69; 0.61), Malaysia (1.55~2.0; 1.81), Thailand (0.7~1.18; 0.99); China (0.31~0.64; 0.43), the US (0.18~0.26; 0.22), Netherlands (0.78~1.14; 0.97) (Source: International Financial Statistics).
- <sup>4</sup> The policies to open financial markets could be beneficial to development of the domestic financial sector, impose discipline on macroeconomic policies, and increase efficiency gains among domestic firms by exposing domestic firms to foreign competition. Kose, Prasad, Rogoff, and Wei (2006) reported that equity market liberalizations had great impacts on economic growth, and thus it is better to use micro-data to detect the growth and productivity gains from financial integration.
- <sup>5</sup> It was reported that the correlations between weekly returns are not the same as those of monthly returns (due to stochastic trends).
- <sup>6</sup> The Singapore stock market was not affected by other markets (Azman-Saini et al. 2002).
- <sup>7</sup> Alternatively, 60-day windows of daily returns were also tested, but the results are qualitatively the same.
- <sup>8</sup> This is the geometric return, assuming that individuals hold their investments for the whole period.
- <sup>9</sup> The annualized return is calculated as follow:  $\text{Return (annual)} = [1 + \text{Return (daily)}]^{365} - 1$ .
- <sup>10</sup> The results from the Phillips-Perron model (Perron 1990) are consistent with the ADF results.
- <sup>11</sup> The results are not reported here but available upon request. DeFusco et al. (1996) reported that there is no cointegration factor between US and most Asian stock markets (e.g., Hong Kong, Korea, Singapore, Taiwan, Malaysia, Thailand, and the Philippines). Click and Plummer (2005) found one co-integration vector between the ASEAN markets (especially, Singapore and Hong Kong).

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