

Theory and Evidence.....

Regional Integration of Stock Markets in Asia Pacific  
Countries

by

Chang Liu

An honors thesis submitted in partial fulfillment

of the requirements for the degree of

Bachelor of Science

Undergraduate College

Leonard N. Stern School of Business

New York University

May 2009

Professor Marti G. Subrahmanyam

Faculty Adviser

Professor Menachem Brenner

Thesis Advisor

## **Abstract**

This paper is an empirical study of the changes in stock market interdependence in Asia-Pacific countries. The study found that Asian Pacific stock markets have become more integrated with one another over the selected time period of 1993 - 2008. This trend is observed in the cross-country correlations in the region and the relationships between country and index returns.

## **Table of Contents**

|                           |    |
|---------------------------|----|
| Introduction.....         | 4  |
| Literature Review .....   | 6  |
| Data.....                 | 8  |
| Analysis and Results..... | 10 |
| Conclusion.....           | 16 |
| References.....           | 19 |

## **Introduction**

In the age of globalization, national stock markets have become one of the major sources of financial integration in emerging market economies. An increase in cross-border capital flow has led to more financial integration in several regions of the world. Financial integration is generally thought to create several benefits, such as the development of markets and institutions and more effective price discovery. This will lead to higher savings, investments and economic progress (Raj and Dhal, 2008). Furthermore, investor can diversify more effectively by understanding the degree of integration between markets. Hence, international capital market relationships have important implications for portfolio diversification, macroeconomic policies that influence trade and fiscal balances of countries and the financial policies of different agents within the capital improving economy (Chittedi, 2008).

At the same time, financial integration also creates additional risks. In countries as India and China where the financial market are experiencing dramatic transformations, there are concerns regarding a country's exposure to risks in case of global or regional crises, such as the Asian financial crisis. During the recent Credit Crisis in the United States, many equity markets across the globe declined sharply. Many have since realized that it is beneficial for policy makers to monitor the interdependence of national stock markets (Raj and Dhal, 2008).

One of the major driving forces for integration is investors seeking freedom to make economic decisions, access different forms of finance, risk management techniques and investment and portfolio diversification opportunities. Over the years it has become much

easier to circumvent restrictions, which people regard as inimical to their private interests and this throws policy makers into a reactive role, forcing them to reassess their policy process (Chittedi, 2008).

In recent years, Asia Pacific has received significant spotlight as it is home to a few of the world's fastest growing economies. In a list of 20 largest stock exchanges in the world, 8 are located in Asia Pacific. China's Shanghai Stock Exchange has a market capitalization of US\$ 3.7 trillion (2007), making it the sixth largest in the world. Similarly, India's Bombay Stock Exchange (BSE) has become the largest stock exchange in the world in terms of the number of listed companies. With a market capitalization of US\$ 1.8 trillion (2007), it was the tenth largest stock exchange globally. Foreign capital flows have a significant impact on the growth of Asian Pacific equity markets. Using India as an example, 1,247 foreign institutional investors participate in its stock market. These investors account for approximately three fourths of the daily average turnover in India's stock market (Raj and Dhal, 2008). China's capital flows have overtaken Japan's, even though its stock of financial assets is only a quarter of Japan's. Since foreign investors tend to invest in a number of countries simultaneously, their investments can be expected to have contributed to the integration of the stock markets in the region. The purpose of this paper is to illustrate the changes, if any, in stock market interdependence in Asia-Pacific countries.

The paper is organized as follows. I will first proceed to discuss some of the existing literature on the topic, followed by an explanation of the data selection process. In the

third section, I will provide an explanation of the analysis I have performed, followed by the conclusion.

## **Literature Review**

Although there is a large collection of literature on the relationship between developed financial markets and the relationship of one country with the global market, few have investigated the interdependence between national markets in a specific region. Furthermore, a review of the related literature showed that very little work has been done for the Asia-Pacific region.

Heaney, Hooper and Jaugietis (2002) found that Latin American equity markets have become more regionally integrated in the last 20 years. The authors attributed this to the growing cooperation between Latin American countries since their liberalization in the 1990s. Prior to liberalization, Latin American stock market returns showed greater association with the more developed markets, particularly the USA, than with their closest neighbors. They also found evidence that both developed and developing countries markets are becoming integrated over time as market imperfections are reduced in order to encourage international capital flows. Furthermore, in regional markets, close economic ties in the form of trade agreements and coordinated macro economic policies cause similar returns to be generated.

Maghyreh (2006) investigated the interdependence among the daily equity market returns for four major Middle Eastern and North African (MENA) emerging markets. The four equity markets studied are the Jordanian, Egyptian, Moroccan and Turkish

markets. He concluded that none of the MENA markets is completely isolated and independent. However, the results indicate that the integration among these markets is still weak. He attributed this to the weakness of economic and financial ties between the MENA countries.

A study done by Raj and Dhal (2008) performs a time series analysis of the BSE and major stock indices. Results showed that from April 1993 to March 2003, India's stock market was negatively correlated with UK and US markets and was weakly correlated with regional exchanges such as Singapore, Hong Kong and Japan. From 2003 onward, the Indian market exhibited strong correlation with regional and global markets. They also concluded that the Indian market's dependence on global markets, such as the United States and the United Kingdom, is substantially higher than on regional markets such as Singapore and Hong Kong.

Yang, Min and Kolari (2002) examined the long-run relationship and short-run dynamics among the U.S., Japanese, and ten Asian stock markets, paying particular attention to the 1997- 1998 Asian financial crisis. In general, the empirical results reveal that long-run cointegration relationships among these markets were strengthened during the crisis and that these markets have been more integrated after the crisis than before the crisis. The study also concluded that the U.S. substantially influenced the Asian markets but was almost unaffected by the Asian markets.

Faruquee (1992) suggested that many of the ASEAN countries have liberalized their financial markets by removing barriers to capital flows which has led to a convergence in

the rates of return between the countries and higher degree of regional integration of financial markets in South East Asia.

## **Data**

For this paper, I have limited the countries studied to China, Hong Kong, India, Japan, Korea and Singapore as they are the major markets in the region and data is readily available. Given that the focus of the paper is on the cointegration between Asia-Pacific countries, the availability of data is critical to the analysis. I chose to use the Morgan Stanley Capital International (MSCI) Index as the basis for country specific performance. MSCI keeps a record of the daily levels of each country index. While data is available for Hong Kong, Japan and Singapore prior to 1990, it is not available for India, China and Korea until the 1993. As a result, the analysis will be conducted on 1993 to 2008, which is the latest full year.

Although each local exchange maintains its own index, these are not used for two reasons:

- 1) Records of indices provided by local exchanges do not date back as far as MSCI's indices.
- 2) Local exchanges calculate their indices using different methodologies. Hence, the indices might not be comparable with one another due to differences in the representation of the local market, mathematical formulas, base dates and methods of adjusting for capital changes. In contrast, MSCI applies the same criteria and calculation methodology to all indices, which makes cross comparison easier.



Furthermore, all MSCI indices are free float weighted. The data is retrieved from Datastream using WRDS. The returns of the indices are continuously compounded rates of returns, calculated using the equation:

$$R = LN\left(\frac{I_{t+1}}{I_t}\right)$$

$I_t$  being the level of the index at time  $t$ . Depending on the analysis,  $t$  will be either daily or weekly. All returns are annualized.

In the remaining portions of the paper, returns will be expressed as  $R_i$ , with  $i$  denoting the country, i.e.  $R_{\text{China}}$ .

MSCI also maintains an Asia-Pacific regional index. However, this index is not incorporated into the analysis because it is weighted by market capitalization. As a result, markets with large market capitalizations will have a bigger impact on the results. In Asia-Pacific, Japan was and is the most developed market. In fact, the Tokyo Stock Exchange (TSE) is the second largest stock exchange in the world by market capitalization. Naturally, it accounted for the greater portion of the movements in the index. In fact, regressing  $R_{\text{Japan}}$  against  $R_{\text{APIndex}}$  gave a  $R^2$  of 0.97 in 1993 and 0.92 in 2008. To avoid this bias, I created an index by averaging the daily returns of each country. This approach should provide a more accurate assessment of the relationship between country returns and regional returns and reduce the possibility of spurious correlation.

## **Analysis and Results**

In the following analysis, I will find the Pearson correlation coefficients for each country in relation to the remaining 5 countries in the region. This calculation is carried out for every year using weekly returns. Weekly returns instead of daily returns are used to minimize noise, and at the same time, provided enough data points for meaningful results. The correlation coefficients are listed in Table 1.

To get a general overview of the integration in the region, I averaged the 15 correlation coefficients for each year and created a time series of average correlations. It is apparent from Figure 1. that average correlation between the countries has increased consistently from 1993 to 2008, dipping only in 1996. In 1993, the average correlation was 0.13 and reached a high of 0.47 in 2008.

Steep increases in average correlation are observed in 1997, 1998 and 2008, which coincides with the Asian financial crisis and the more recent credit crisis. There is a collection of literature that suggests markets become more correlated in turbulent or volatile times (Ramchand and Susmel, 1998). To test this assumption, I plotted a graph of daily volatility against the aforementioned average correlation graph (Figure 1). It can be observed that volatilities did increase sharply in 1997, 1998 and 2008, which coincides with the correlation increases. Interestingly, even after the Asian financial crisis from 1998 to 2005, average correlation grew from 0.31 to 0.38 despite average daily volatility dropping from 40.04% to 13.96%. Hence, this suggests that while the region experienced

spikes in correlation in times of high volatility, there is a structural change occurring that is causing correlation to increase over time.

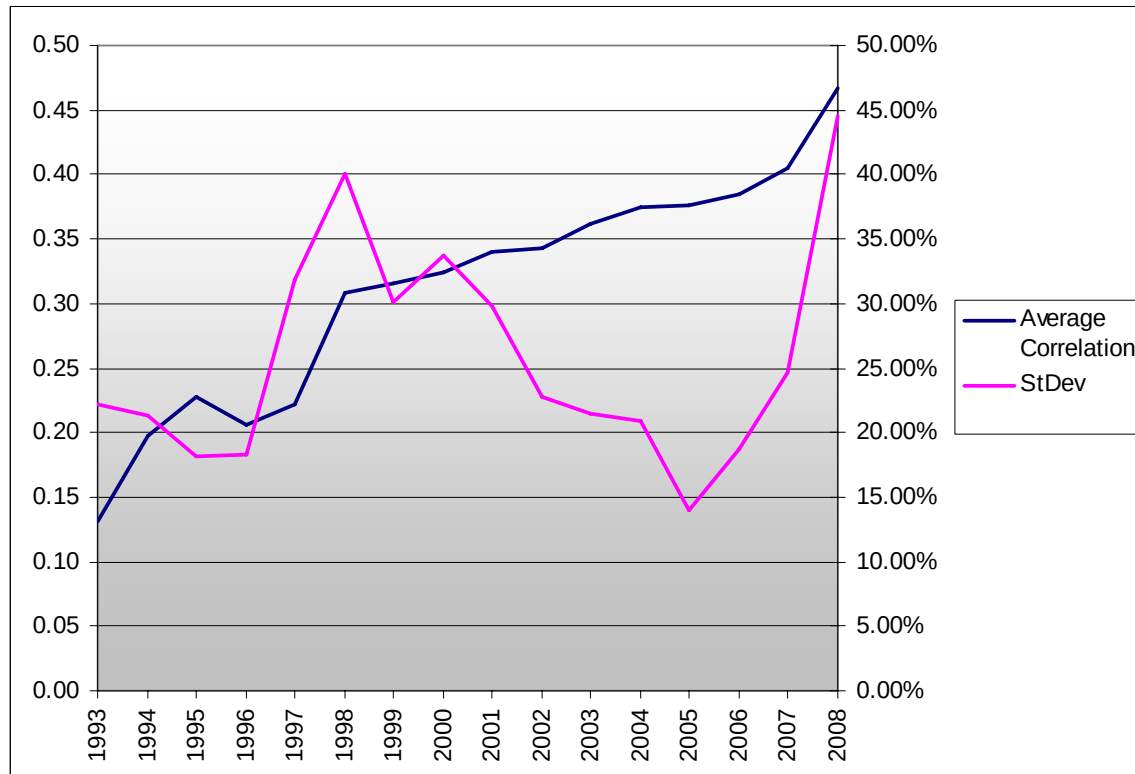


Figure 1. Left Axis: Average correlation for all country pairs calculated for each year using weekly returns from 1993 to 2008. Right Axis: Average volatility for all countries calculated using daily returns from 1993 to 2008.

The average coefficient is only telling us that returns in the region are becoming more correlated in general without specifying which countries are more correlated with the others. To get a better understanding of which countries are becoming more integrated with the rest, I found the average correlation for each country with respect to the remaining 5 countries and created a time series (Figure 2). The results indicate that all countries have become more correlated with the region. Hong Kong's average correlation is almost always the highest and India has consistently lagged behind the other countries.

Even though Korea and Japan started off with similar average correlations as India, both have pulled ahead significantly by 2008. A high average correlation, as with the case of Hong Kong, suggests that, on average, Hong Kong is more likely to generate returns similar to the other countries, adjusted for volatility. Hong Kong, Singapore and China have the highest average correlations in the region, this is because these countries have always had strong correlations with each other. Using 2008's data, Hong Kong – China had a correlation of 0.70, Hong Kong – Singapore had a correlation of 0.72 and China – Singapore had a correlation of 0.59. These are the 3 highest correlations for 2008.

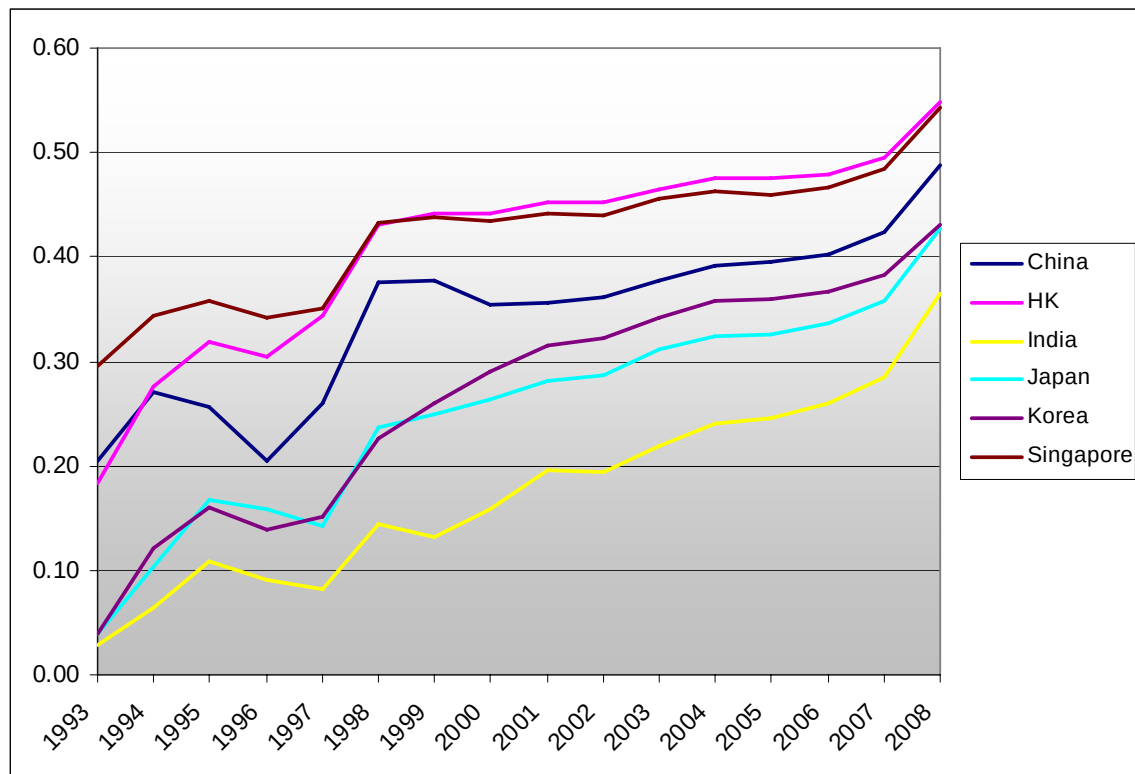


Figure 2. Graph of each country's average correlation with the other countries based on weekly returns. The correlations are calculated yearly for 1993-2008.

Another factor that investors are often concerned with is the volatility of a market. The following analysis will provide some insight to the volatility of the returns in the region from 1993 to 2008. In this analysis, we will compare 2 volatilities:

- 1) Volatility of the index, which as mentioned earlier, was created by averaging the returns of the 6 countries
- 2) The average volatility of the country returns

The index in fact is a portfolio of the 6 countries in equal weights. Based on our knowledge regarding portfolio construction, the volatility of the index should be lower than the average volatility. As the correlations between the countries increase, the average volatility should approach the volatility of the index. If all the correlations between the countries are one, average volatility should equal to the volatility of the index. This is because perfectly correlated investments offers not diversification and hence, create the same risks.

Figure 3 shows the analysis graphically, an additional line is added, which is the difference between the two. Once again we can observe that the volatility in the region increased dramatically in 1997-1998 and 2007-2008. Judging from the difference curve, the difference between the volatility has been decreasing steadily since 1998. We can infer from this observation that correlation between the countries have increased over the time period.

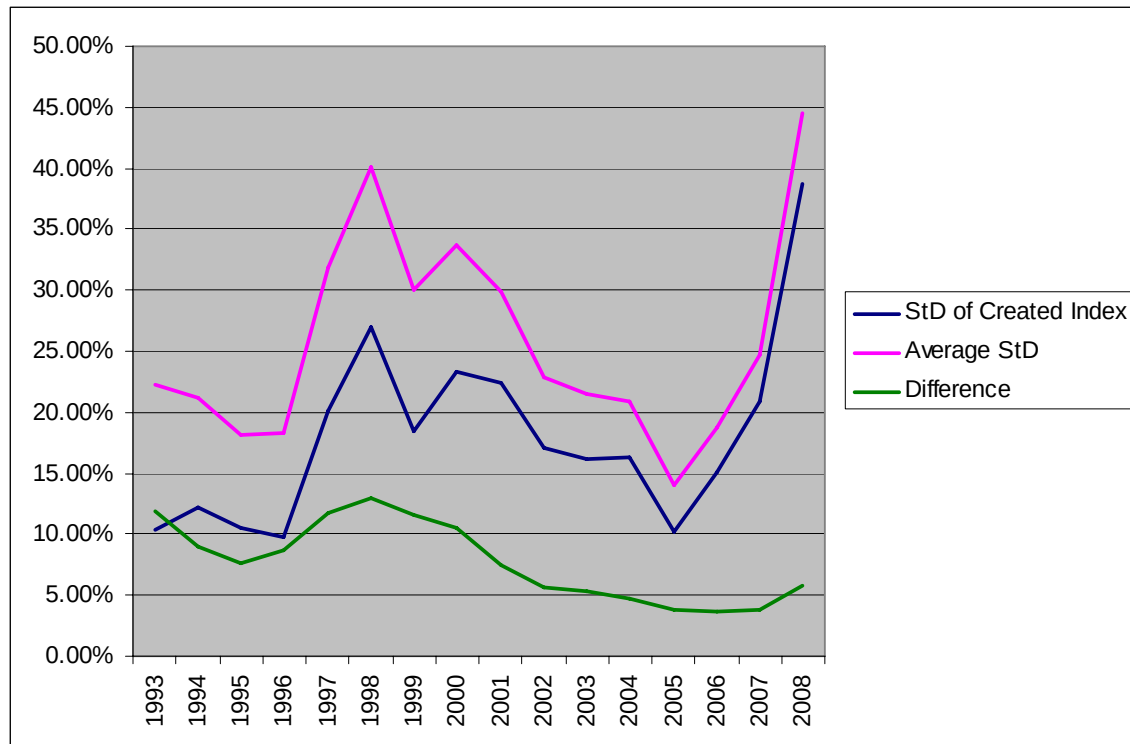


Figure 3. Graph of volatility of regional index, average volatility of the countries and the difference. Volatility is calculated using daily returns for each year from 1993-2008.

If an investor had purchased a portfolio of the countries in equal weights in 1993, in 1997, the volatility of the portfolio will be on average 12.99% lower than the volatility of any country by itself. The same portfolio's volatility will only be 3.81% lower in 2007. Hence, we can conclude that an investor's ability to diversify has decreased dramatically over the time period.

To further explore the countries' relationship with the regional index, I regressed the daily returns of each country against the daily returns of the index for each year and recorded the beta and  $R^2$  for each regression. I observe that the standard deviation of the betas for each year became progressively smaller from 1997 to 2008 and are closer to 1. This information tells us that not only are directions of movements becoming similar, the

returns are becoming closer as well. In other words, it is more likely for countries to have similar returns of x%.

The beta is only informative if the regression is reliable, this reliability can be illustrated through  $R^2$ . In my analysis, I observe that the average  $R^2$  in 1993 is 0.30 whereas the average  $R^2$  in 2008 is 0.82 (Figure 4). This suggests that the regressions are becoming more accurate. Even though  $R^2$  is simply the correlation coefficient squared, it contains more information than the correlation coefficient.  $R^2$  tells us how much of Y's behavior is explained by X or, as an example, how much of Hong Kong's risks is explained by the returns of the regional index. In the case of Hong Kong, this turns out to be 0.92 in 2008. This information tells us that 92% of Hong Kong's risks are derived from the region and only 8% is country specific.

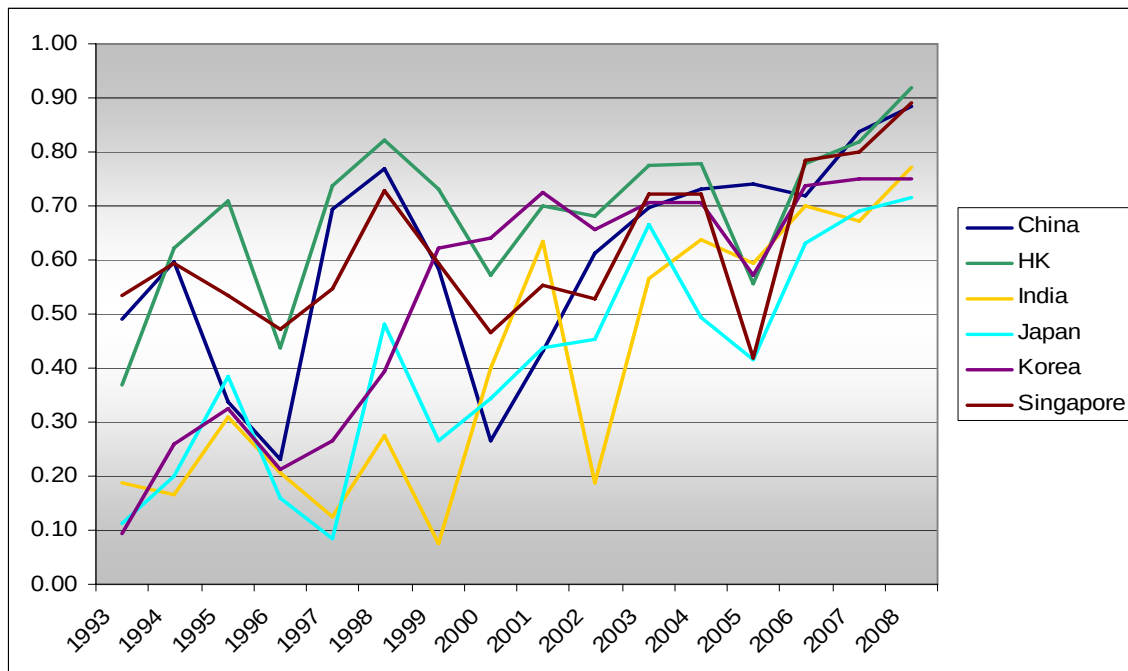


Figure 4.  $R^2$  of each country's return when regressed against the return of the index. Regressions are performed for each year from 1993 – 2008 using daily data.

## **Conclusion**

The purpose of this paper is to illustrate the changes in stock market interdependence in Asia-Pacific countries. As the evidence suggests, APAC countries have become increasingly integrated since 1993. Not only are indices more likely to move in the same direction, returns in the markets have become very similar as well. Moreover, a larger percentage of the countries risks are due to the region risks and less country specific.



Table 1. Yearly correlations between each country pair. Correlations are calculated using weekly returns

| 1993      |       |       |       |       |       |           |
|-----------|-------|-------|-------|-------|-------|-----------|
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.42  | 0.05  | 0.15  | -0.09 | 0.50      |
| HK        | 0.42  | 1.00  | -0.11 | 0.03  | 0.07  | 0.51      |
| India     | 0.05  | -0.11 | 1.00  | -0.03 | 0.06  | 0.17      |
| Japan     | 0.15  | 0.03  | -0.03 | 1.00  | -0.05 | 0.10      |
| Korea     | -0.09 | 0.07  | 0.06  | -0.05 | 1.00  | 0.20      |
| Singapore | 0.50  | 0.51  | 0.17  | 0.10  | 0.20  | 1.00      |
| 1994      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.54  | 0.11  | 0.13  | -0.04 | 0.54      |
| HK        | 0.54  | 1.00  | -0.05 | 0.07  | 0.16  | 0.66      |
| India     | 0.11  | -0.05 | 1.00  | 0.09  | 0.08  | 0.09      |
| Japan     | 0.13  | 0.07  | 0.09  | 1.00  | 0.06  | 0.16      |
| Korea     | 0.04  | 0.16  | 0.08  | 0.06  | 1.00  | 0.27      |
| Singapore | 0.54  | 0.66  | 0.09  | 0.16  | 0.27  | 1.00      |
| 1995      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.54  | 0.13  | 0.10  | 0.06  | 0.45      |
| HK        | 0.54  | 1.00  | 0.02  | 0.16  | 0.22  | 0.66      |
| India     | 0.13  | 0.02  | 1.00  | 0.14  | 0.13  | 0.12      |
| Japan     | 0.10  | 0.16  | 0.14  | 1.00  | 0.13  | 0.30      |
| Korea     | 0.06  | 0.22  | 0.13  | 0.13  | 1.00  | 0.26      |
| Singapore | 0.45  | 0.66  | 0.12  | 0.30  | 0.26  | 1.00      |
| 1996      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.49  | 0.05  | 0.11  | -0.03 | 0.40      |
| HK        | 0.49  | 1.00  | 0.00  | 0.17  | 0.21  | 0.64      |
| India     | 0.05  | 0.00  | 1.00  | 0.11  | 0.16  | 0.14      |
| Japan     | 0.11  | 0.17  | 0.11  | 1.00  | 0.11  | 0.29      |
| Korea     | -0.03 | 0.21  | 0.16  | 0.11  | 1.00  | 0.24      |
| Singapore | 0.40  | 0.64  | 0.14  | 0.29  | 0.24  | 1.00      |
| 1997      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.55  | 0.07  | 0.11  | 0.13  | 0.44      |
| HK        | 0.55  | 1.00  | 0.05  | 0.22  | 0.23  | 0.66      |
| India     | 0.07  | 0.05  | 1.00  | 0.04  | 0.12  | 0.13      |
| Japan     | 0.11  | 0.22  | 0.04  | 1.00  | 0.05  | 0.29      |
| Korea     | 0.13  | 0.23  | 0.12  | 0.05  | 1.00  | 0.23      |
| Singapore | 0.44  | 0.66  | 0.13  | 0.29  | 0.23  | 1.00      |
| 1998      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.67  | 0.19  | 0.23  | 0.21  | 0.58      |
| HK        | 0.67  | 1.00  | 0.14  | 0.31  | 0.32  | 0.72      |
| India     | 0.19  | 0.14  | 1.00  | 0.10  | 0.10  | 0.20      |
| Japan     | 0.23  | 0.31  | 0.10  | 1.00  | 0.19  | 0.36      |
| Korea     | 0.21  | 0.32  | 0.10  | 0.19  | 1.00  | 0.31      |
| Singapore | 0.58  | 0.72  | 0.20  | 0.36  | 0.31  | 1.00      |
| 1999      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.66  | 0.15  | 0.25  | 0.27  | 0.57      |
| HK        | 0.66  | 1.00  | 0.14  | 0.33  | 0.36  | 0.72      |
| India     | 0.15  | 0.14  | 1.00  | 0.08  | 0.11  | 0.18      |
| Japan     | 0.25  | 0.33  | 0.08  | 1.00  | 0.22  | 0.37      |
| Korea     | 0.27  | 0.36  | 0.11  | 0.22  | 1.00  | 0.35      |
| Singapore | 0.57  | 0.72  | 0.18  | 0.37  | 0.35  | 1.00      |
| 2000      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.62  | 0.14  | 0.22  | 0.25  | 0.53      |
| HK        | 0.62  | 1.00  | 0.18  | 0.33  | 0.38  | 0.70      |
| India     | 0.14  | 0.18  | 1.00  | 0.12  | 0.16  | 0.19      |
| Japan     | 0.22  | 0.33  | 0.12  | 1.00  | 0.28  | 0.37      |
| Korea     | 0.25  | 0.38  | 0.16  | 0.28  | 1.00  | 0.38      |
| Singapore | 0.53  | 0.70  | 0.19  | 0.37  | 0.38  | 1.00      |
| 2001      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.61  | 0.16  | 0.24  | 0.27  | 0.50      |
| HK        | 0.61  | 1.00  | 0.22  | 0.33  | 0.40  | 0.70      |
| India     | 0.16  | 0.22  | 1.00  | 0.15  | 0.21  | 0.23      |
| Japan     | 0.24  | 0.33  | 0.15  | 1.00  | 0.31  | 0.38      |
| Korea     | 0.27  | 0.40  | 0.21  | 0.31  | 1.00  | 0.39      |
| Singapore | 0.50  | 0.70  | 0.23  | 0.38  | 0.39  | 1.00      |
| 2002      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.62  | 0.16  | 0.23  | 0.26  | 0.50      |
| HK        | 0.62  | 1.00  | 0.22  | 0.34  | 0.40  | 0.69      |
| India     | 0.16  | 0.22  | 1.00  | 0.15  | 0.21  | 0.23      |
| Japan     | 0.25  | 0.34  | 0.15  | 1.00  | 0.32  | 0.38      |
| Korea     | 0.28  | 0.40  | 0.21  | 0.32  | 1.00  | 0.41      |
| Singapore | 0.50  | 0.69  | 0.23  | 0.38  | 0.41  | 1.00      |
| 2003      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.63  | 0.19  | 0.26  | 0.29  | 0.51      |
| HK        | 0.63  | 1.00  | 0.24  | 0.36  | 0.41  | 0.69      |
| India     | 0.19  | 0.24  | 1.00  | 0.18  | 0.23  | 0.25      |
| Japan     | 0.26  | 0.36  | 0.18  | 1.00  | 0.35  | 0.40      |
| Korea     | 0.29  | 0.41  | 0.23  | 0.35  | 1.00  | 0.42      |
| Singapore | 0.51  | 0.69  | 0.25  | 0.40  | 0.42  | 1.00      |
| 2004      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.64  | 0.22  | 0.28  | 0.31  | 0.52      |
| HK        | 0.64  | 1.00  | 0.26  | 0.37  | 0.43  | 0.69      |
| India     | 0.22  | 0.26  | 1.00  | 0.20  | 0.26  | 0.27      |
| Japan     | 0.28  | 0.37  | 0.20  | 1.00  | 0.37  | 0.41      |
| Korea     | 0.31  | 0.43  | 0.26  | 0.37  | 1.00  | 0.43      |
| Singapore | 0.52  | 0.69  | 0.27  | 0.41  | 0.43  | 1.00      |
| 2005      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.64  | 0.23  | 0.28  | 0.31  | 0.51      |
| HK        | 0.64  | 1.00  | 0.26  | 0.36  | 0.42  | 0.69      |
| India     | 0.23  | 0.26  | 1.00  | 0.21  | 0.26  | 0.27      |
| Japan     | 0.28  | 0.36  | 0.21  | 1.00  | 0.37  | 0.40      |
| Korea     | 0.31  | 0.42  | 0.26  | 0.37  | 1.00  | 0.43      |
| Singapore | 0.51  | 0.69  | 0.27  | 0.40  | 0.43  | 1.00      |
| 2006      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.64  | 0.24  | 0.29  | 0.32  | 0.52      |
| HK        | 0.64  | 1.00  | 0.27  | 0.37  | 0.43  | 0.69      |
| India     | 0.24  | 0.27  | 1.00  | 0.23  | 0.27  | 0.29      |
| Japan     | 0.29  | 0.37  | 0.23  | 1.00  | 0.38  | 0.41      |
| Korea     | 0.32  | 0.43  | 0.27  | 0.38  | 1.00  | 0.43      |
| Singapore | 0.52  | 0.69  | 0.29  | 0.41  | 0.43  | 1.00      |
| 2007      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.66  | 0.27  | 0.32  | 0.34  | 0.53      |
| HK        | 0.66  | 1.00  | 0.30  | 0.38  | 0.44  | 0.69      |
| India     | 0.27  | 0.30  | 1.00  | 0.25  | 0.29  | 0.31      |
| Japan     | 0.32  | 0.38  | 0.25  | 1.00  | 0.40  | 0.44      |
| Korea     | 0.34  | 0.44  | 0.29  | 0.40  | 1.00  | 0.45      |
| Singapore | 0.53  | 0.69  | 0.31  | 0.44  | 0.45  | 1.00      |
| 2008      |       |       |       |       |       |           |
|           | China | HK    | India | Japan | Korea | Singapore |
| China     | 1.00  | 0.70  | 0.36  | 0.40  | 0.39  | 0.59      |
| HK        | 0.70  | 1.00  | 0.38  | 0.45  | 0.49  | 0.72      |
| India     | 0.36  | 0.38  | 1.00  | 0.34  | 0.34  | 0.40      |
| Japan     | 0.40  | 0.45  | 0.34  | 1.00  | 0.44  | 0.51      |
| Korea     | 0.39  | 0.49  | 0.34  | 0.44  | 1.00  | 0.49      |
| Singapore | 0.59  | 0.72  | 0.40  | 0.51  | 0.49  | 1.00      |

Table 2. Average correlation for all country pairs calculated for each year using weekly returns from 1993 to 2008 and average volatility for all countries calculated using daily returns from 1993 to 2008.

| <b>Year</b> | <b>Average<br/>Correlation</b> | <b>StDev</b> |
|-------------|--------------------------------|--------------|
| 1993        | 0.13                           | 22.22%       |
| 1994        | 0.20                           | 21.26%       |
| 1995        | 0.23                           | 18.11%       |
| 1996        | 0.21                           | 18.34%       |
| 1997        | 0.22                           | 31.90%       |
| 1998        | 0.31                           | 40.04%       |
| 1999        | 0.32                           | 30.10%       |
| 2000        | 0.32                           | 33.72%       |
| 2001        | 0.34                           | 29.89%       |
| 2002        | 0.34                           | 22.84%       |
| 2003        | 0.36                           | 21.53%       |
| 2004        | 0.38                           | 20.93%       |
| 2005        | 0.38                           | 13.96%       |
| 2006        | 0.39                           | 18.75%       |
| 2007        | 0.40                           | 24.69%       |
| 2008        | 0.47                           | 44.50%       |

Table 3. Each country's average correlation with the other countries based on weekly returns. The correlations are calculated yearly for 1993-2008.

| <b>Year</b> | <b>China</b> | <b>HK</b> | <b>India</b> | <b>Japan</b> | <b>Korea</b> | <b>Singapore</b> |
|-------------|--------------|-----------|--------------|--------------|--------------|------------------|
| 1993        | 0.20         | 0.18      | 0.03         | 0.04         | 0.04         | 0.29             |
| 1994        | 0.27         | 0.28      | 0.06         | 0.10         | 0.12         | 0.34             |
| 1995        | 0.26         | 0.32      | 0.11         | 0.17         | 0.16         | 0.36             |
| 1996        | 0.20         | 0.30      | 0.09         | 0.16         | 0.14         | 0.34             |
| 1997        | 0.26         | 0.34      | 0.08         | 0.14         | 0.15         | 0.35             |
| 1998        | 0.38         | 0.43      | 0.14         | 0.24         | 0.23         | 0.43             |
| 1999        | 0.38         | 0.44      | 0.13         | 0.25         | 0.26         | 0.44             |
| 2000        | 0.35         | 0.44      | 0.16         | 0.26         | 0.29         | 0.43             |
| 2001        | 0.36         | 0.45      | 0.20         | 0.28         | 0.31         | 0.44             |
| 2002        | 0.36         | 0.45      | 0.19         | 0.29         | 0.32         | 0.44             |
| 2003        | 0.38         | 0.47      | 0.22         | 0.31         | 0.34         | 0.46             |
| 2004        | 0.39         | 0.48      | 0.24         | 0.32         | 0.36         | 0.46             |
| 2005        | 0.39         | 0.47      | 0.25         | 0.33         | 0.36         | 0.46             |
| 2006        | 0.40         | 0.48      | 0.26         | 0.34         | 0.37         | 0.47             |
| 2007        | 0.42         | 0.49      | 0.28         | 0.36         | 0.38         | 0.48             |
| 2008        | 0.49         | 0.55      | 0.36         | 0.43         | 0.43         | 0.54             |

## **References**

Campbell, John Y., Martin Lettau, Burton G. Malkiel and Yexiao Xu (2000). “Have Individual Stocks Become More Volatile? An Empirical Exploration of Idiosyncratic Risk”, working paper, Harvard University, Federal Reserve Bank of New York, Princeton University, and The University of Texas at Dallas

Estrada, Javier (2008). “Black Swans in Emerging Markets”, working paper, IESE Business School

Chittedi, Krishna Reddy (2008). “Indian Stock Market Integration and Cross Country Analysis”, working paper, Center for Development Studies

Hauner, David, and Manmohan S. Kumar (2005). “Financial Globalization and Fiscal Performance in Emerging Markets”, working paper, IMF, WP/05/212

Heaney, Richard, Vince Hooper, and Martin Jaugietis (2002). “Regional Integration of Stock Markets in Latin America”, *Journal of Economic Integration*, Vol. 17, No. 4, pp.745-760.

Janak, Raj, Sarat Dhal (2008). “Integration of India’s stock market with global and major regional markets”, BIS Papers, No. 42

Maghyereh, Aktham (2006) “Regional Integration of Stock Markets in MENA Countries”, *Journal of Emerging Market Finance*, Vol. 5, No. 1, 59-94

Morgado, Pedro, and Jose Tavares (2007) “Economic Integration and the Correlation of Stock Returns”, working paper, Universidade Nova de Lisboa

Yang, Jian, James W. Kolari, and Insik Min (2002). “Stock Market Integration and Financial Crises: The Case of India”, working paper, Prairie View A&M University, and Texas A&M University