STOCK MARKET LINKAGES IN EMERGING MARKETS: IMPLICATIONS FOR INTERNATIONAL PORTFOLIO DIVESRIFICATION

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Abstract

This paper examines stock market linkages of a group of Pacific-Basin countries with U.S. and Japan by estimating the multivariate cointegration model in both the autoregressive and moving average forms over the period 1980-1998. Recursive estimation helps identify the evolution of the linkages. The results for the 1980s indicate that the relaxation of foreign ownership restrictions was not sufficient to attract foreign investors' attention and that other factors must have affected the portfolio diversification decision. The results of the 1990s suggest that the relaxation of the restrictions might have strengthened international market interrelations. Country Funds have provided access to highly regulated capital markets.

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1. Introduction

Financial literature has presented a strong emphasis on the interaction amongst international stock markets. The interest has increased considerably following the abolition of foreign exchange controls in both mature and emerging markets, the technological developments in communications and trading systems, and the introduction of innovative financial products, such as Country Funds and American Depository Receipts, which have created more opportunities for global international investments. In particular, the new remunerative emerging equity markets have attracted the attention of international fund managers as an opportunity for portfolio diversification and have also intensified the curiosity of academics in exploring international market linkages.[1]

The earliest studies on international stock market linkages have focused on the identification of short-term benefits of international portfolio diversification. For example, Levy and Sarnat (1970) and Solnik (1974), examined short-term correlations of returns across national markets and pointed out the existence of substantial possibilities to diversify internationally. More recently, Eun and Shim (1989), Hamao

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[1] See e.g. Hawawini (1994) for evidence on the increasing flow of funds to new capital markets and the importance of these markets to portfolio management.

et al. (1990), Koch and Koch (1991), Roll (1992), Longin and Solnik (1995), exploited more sophisticated econometric techniques to measure cross-country correlations, and found evidence of significant linkages between stock markets around the world. Other studies have focused on the evolution of linkages of emerging capital markets. Studies such as Harvey (1995), but particularly Bekaert and Harvey (1995), examined one period returns and the conditional means and variances of one period returns by examining a one factor asset pricing model, which did not assume the degree of segmentation to be constant through time. They allowed conditionally expected returns in a country to be affected by their covariance with a world benchmark portfolio and by the variance of the country returns. If the market was perfectly integrated then only covariance counted, while if the market was completely segmented then the variance was the relevant measure of market risk. Bekaert and Harvey (1995) used a conditional regime-switching model to account for periods when national markets were segmented from world capital markets and when they became integrated later in the sample.

Other studies have measured financial linkages (see Phylaktis and Ravazzolo (2001)) by analysing the covariance of excess returns on national stock markets of emerging economies. A major advantage of this framework is that by examining the comovement of future returns aggregated over a long horizon instead of the comovement of one period expected returns one can detect small but persistent movements in expected returns and more accurately measure the degree of financial integration than one period stock return regression models.

Another group of studies has concentrated on examining financial links amongst stock markets by using either bivariate or multivariate cointegration methodology. Taylor and Tonks (1989) were the first to apply bivariate cointegration

on the UK and U.S. markets to test the importance of the latter after the abolition of foreign exchange controls in 1979;[2] while Kasa (1992) was the first to apply multivariate cointegration method to five well-established financial markets in order to estimate the permanent and transitory components of stock price series and examine the existence of a single common stochastic trend as a driver of the cointegrated system. When markets share a single common stochastic trend, then this means that these markets are perfectly correlated over long horizons and there are limited gains to international diversification.

In the current study, we apply Kasa's (1992) approach and examine the potential inter-relationships amongst the trending behaviour of the stock price indices of a group of Pacific-Basin countries, Japan and U.S. These capital markets have attracted a substantial proportion of international capital flows to emerging markets. In 1996, 48 percent of net private capital flows to all emerging market economies[3] was directed to the Asian[4] capital markets. Our analysis is conducted in the light of

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[2] Other researchers, such as, Arshanapalli and Doukas (1993), have used bivariate cointagretion to explore changes in patterns of dynamic interactions among national stock market indices following the October 1987 crash.

[3] See "World Economic Outlook", (October 1999) published by the International Monetary Fund. Net capital flows comprise net direct investment, net portfolio investment, and other long- and short-term net investment flows, including official and private borrowing. Emerging markets include developing countries, countries in transition, and Korea, Singapore, Taiwan Province of China, and Israel. Data for Hong Kong are not available.

[4] It includes the economies of Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand.

Richards' (1995) comments on the selection of the correct order of VAR systems; and the use of a more sophisticated technique in the estimation of the common stochastic trend system, which is equivalent to the permanent component of stock prices, as recommended by Gonzalo and Granger (1995). Richards (1995) criticised Kasa (1992) for using extra lags to capture the possible effect of mean reversion in equity prices and make the error terms from the VARs more consistent with the Gaussian/i.i.d. assumption under which the Johansen methodology is derived. He noted that serial correlation was not present in the lower order VARs estimated by Kasa and that the inclusion of extra lags to remove the non-normality of residuals was inappropriate. He suggested the use of the Akaike and Schwartz information criteria, (AIC) and (SIC) respectively, for the selection of the correct order VAR systems.[5] In fact, when he repeated Kasa's estimation and in addition corrected for small sample bias, number of variables and lags as recommended by Reimers (1992) and Gregory (1994), he found that the five stock markets were not cointegrated in contrast to the results of Kasa that there were four cointegrating vectors and one single common stochastic trend.

As mentioned before the multivariate cointegration analysis will be applied in the current paper to a group of Pacific-Basin countries and the U.S. In particular, the objective is to identify how the financial links have evolved during the 1980s and 1990s and whether they bear any relationship to the existence of foreign exchange restrictions. As Bekaert and Harvey (2000) point out liberalisation may not be enough to induce foreign investors to actually invest in the country. Home bias or other concerns, such as lack of information on company stocks, may impede

[5] Reimers (1992) finds also that the SIC does well in selecting the lag length.

international investment.[6] On the other hand, economic integration between countries may provide a channel for linking stock markets even in the presence of foreign exchange controls.[7] Economic integration between countries implies a comovement in their output, corporate earnings and consequently in their stock markets.[8]

We will be examining the financial links of these markets by estimating the multivariate cointegration model in both the autoregressive and moving average forms.[9] The autoregressive form allows us to examine the long-run relationships of these markets, and the moving average form the relative importance of each market to the common trend or, alternatively, the relative importance of the trend to each market. Finally, we apply the recursive analysis to the cointegrating system developed by Hansen and Johansen (1998) in order to identify the evolution of linkages of these capital markets during the 1980s and 1990s. That constitutes a novel approach to examining this issue. The same technique allows us to examine the effects of the Asian crisis of mid 1997 on the financial linkages of the region.

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[6] See also Levine and Zervos (1996).

[7] Support for this proposition can be found in Phylaktis and Ravazzolo (2001). They find overwhelming evidence that economic integration always accompanies financial integration.

[8] The long-run positive relationship between economic activity and stock prices has been confirmed theoretically and empirically (see e.g. Cheung and Ng (1998), Canova and DeNicole (1995), Roll (1992), and Schwert (1990)).

[9] Although in our analysis we did not explicitly take into account the relative size of each market, we would expect large markets with high capitalisation to provide more opportunities to international investors, and that may foster closer financial links with other markets.

The analysis in the paper has implications for international portfolio diversification. If stock markets share a common trend, that implies that the markets move together and anyone market will be representative of the behaviour of that group of markets. That is the markets are driven by common shocks, which have a permanent effect, providing limited long-term gains to international diversification. If, however, there are persistent deviations from the common trend, then international investors might make short term speculative investments based on the forecast that the market will revert to its long-term relationship with the world market. The methodology used in this paper, that is, the moving average representation of the multivariate cointegration model, allows us to estimate the transitory component of each market and explore possible short-term diversification benefits.

The paper is structured as follows. Section 2 explains the multivariate cointegration model in autoregressive (AR) and moving average (MA) forms. It also introduces the recursive-based method to test for the evolution of stock market linkages. Section 3 reports the empirical results of the analysis of the cointegration space and the complementary common trend system. The final section summarises the main findings and offers some concluding remarks.

2. The multivariate cointegration model

2.1 The autoregressive (AR) representation

Financial literature affirms that stock price levels are non-stationary. In operating with non-stationary variables one can focus on the first differences of time series and apply the basic regression analysis to study potential links between their short-term movements. Otherwise, one can use the cointegration technique, introduced by

Granger (1981) and developed by Engle and Granger (1987), to analyse relationships amongst series, which overcomes the problem of non-stationarity and allows the investigation into both the levels and first differences of stock prices.

In the current study, we apply the multivariate cointegration analysis of Johansen (1988, 1991) to investigate the linkages amongst a group of stock price levels by looking for the existence of potential linear combinations amongst them.

Consider a vector Y_t that contains p variables. If all p variables are integrated of order one, I(1), then the VAR(k) model can be written in the error-correction form as:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \mu + \theta D_t + \varepsilon_t, \qquad (1)$$

where k is the order of the VAR system; μ is a vector of constants; D_t is a vector of seasonal dummies orthogonal to the constant; and ε_t is *i.i.d.* errors. The matrix Π, in equation (1) is defined as $\alpha\beta'$, where α and β are $(p \times r)$ matrices; it has rank equal to r; and it can be written as $\Pi = -(I - A_1 - \ldots. - A_k)$; and the matrix $\Gamma_i = -(I - A_1 - \ldots. - A_i)$, with i = 1, .., k.

As shown in Johansen and Juselius (1990), the estimation procedure is simplified by reformulating model (1) as:

$$R_{0t} = \alpha\beta' R_{1t} + \text{error}, \quad t = 1, \ldots, T. \qquad (2)$$

The vector R_{0t} and R_{1t} obtained as residuals from the auxiliary regressions:

$$\Delta Y_t = \hat{B}_1 \Delta z_{t-1} + \hat{B}_2 D_t + R_{0t} \qquad (3)$$

and

$$Y_{t-1} = \hat{B}_3 \Delta z_{t-1} + \hat{B}_4 D_t + R_{1t}, \qquad (4)$$

where B_1, B_2, B_3 and B_4 are estimated by ordinary least squares regressions. The maximum likelihood estimator of β is found by solving the equation

$$\left| lS_{11} - S_{10}S_{00}^{-1}S_{01} \right| = 0, \tag{5}$$

which gives the eigenvalues $\hat{l}_1 \succ ... \succ \hat{l}_p$ and the corresponding eigenvectors $\hat{V} = (\hat{v}_1,...,\hat{v}_p)$ normalized such that $\hat{V}'S_{11}\hat{V} = I$. The matrices S_{11}, S_{10} and S_{00} are appropriately defined covariance matrices (for further details, see Johansen and Juselius (1990)). The eigenvalues $\hat{l}_i$ correspond to the squared canonical correlations between the "levels" residuals and the "difference" residuals, as defined above. The eigenvectors $\hat{v}_i$ determine the linear combinations $\hat{v}_i'z_t$, i =1, k-1.

The Johansen likelihood ratio test statistic of the null hypothesis that there are at most r cointegrating vectors $0 \le r \le p$, and thus (p-r) common stochastic trends is

$$\text{trace} = -T \sum_{i=r+1}^{p} \ln(1 - \hat{l}_i), \tag{6}$$

where $\hat{l}_i$'s are the p-r smallest squared canonical correlations as described above.

In this study, we define Y_t as composed of p elements, which represent the stock price indices of a selected group of financial markets.[10] We use the trace statistic to test if the system of p markets is cointegrated and identify the number of long-run relationships they share. We perform the exclusion statistic tests on the coefficients of the cointegrating vectors related to each stock market to examine whether it is participating to the cointegration space.[11] If the null hypothesis of exclusion of the market from the cointegration space is rejected, then that confirms the existence of close links amongst the markets in the system. In the case where the

[10] The data representing the stock price indices are transformed by natural logarithms.

[11] The test statistic is a χ^2 distributed with r degrees of freedom.

null hypothesis is accepted it is concluded that there is no cointegration amongst the group of markets and therefore no close financial links.[12]

2.2 The recursive estimation of the trace test statistics

The selection of the cointegrating rank is one of the most sensitive steps in the cointegration analysis. Stepthon and Larsen (1991) have shown that Johansen's test may be characterised by sample dependency. This is specifically relevant to our study for two reasons. First, the liberalisation of stock markets could have attracted the interest of international investors and affected the amount of capital inflows to those markets inducing an increase in the degree of comovements with the rest of the financial world. Secondly, the Asian financial crisis in mid 1997 might have temporarily affected the links amongst international stock markets, as previously verified by work on the 1987 stock market crash and the Mexican crisis (see e.g. Dwyer and Hafer (1988), Hardouvelis (1988), King and Wadhwani (1990), and Roll (1989) on the 1987 crash; and Calvo and Reinhard (1996) on the Mexican crisis). Moreover, the application of this analysis could be exploited to identify when financial links strengthened and whether that coincided with events of liberalisation.

We apply the recursive estimation suggested by Hansen and Johansen (1998) in the estimation of cointegrated VAR models, using estimates from the Johansen FIML technique under two VAR representations. In the "Z-representation" all the parameters of VECM are re-estimated during the recursions, while under the "R-

[12] It should be noted that Kasa (1992) did not present these exclusion tests on the coefficients of the cointegrating vectors and as a result it is not clear whether all markets contributed to the cointegration space.

representation" the short-run parameters are kept fixed to their full sample values and only the long-run parameters are re-estimated.

We perform the trace tests to visually inspect the time path of these statistics and identify potential changes in the rank r over time or during the Asian crisis. From equation (6) each Trace test is calculated as

$$\text{Trace}_j = T \sum_{i=j}^{p} \ln(1 - \hat{l}_i) \ , \quad j = 1, \ldots, p-1, \tag{7}$$

and each statistic is scaled by the 90% quantile of the trace distribution derived for the select model.[13] For a specific t, we identify the rank r as the number of Trace_j statistics presenting an upward slope and above the critical value of one, which indicates the 10 percent statistical significance. Thus, when estimating the model recursively on a group of stock markets, which is in the process of moving together, the convergence should show up in an increasing number of cointegration vectors being accepted as the system is being increasingly driven by the same common stochastic trends.

2.3 The moving average (MA) representation of cointegrated systems

The study of a cointegrated system can be conducted in a dual way. This is because of a direct relationship between the number of stationary relations, r, of a p-dimension system, and the number of linearly independent non-stationary relations, p-r, defined as common trends. As introduced by Stock and Watson (1988), if a cointegrated system of p variables present r linear combinations, then the p

[13] The model does not include exogenous variables or dummies. In case of inclusion of these variables the critical value has to be computed again.

components share p-r common trends. Thus, if four stock markets are found to share 3 linear combinations, then these markets share one (4-3) common trend.

The duality between the number of cointegration relations and common trends is useful for a full understanding of the generating mechanism of our system of stock markets. While the autoregressive form is informative about the long-run relationships amongst the stock markets, which is useful in identifying if a group of financial markets is linked together, the moving average form is informative about the underlying stochastic and deterministic trends and helpful in recognizing the components driving the system of markets.

The moving average representation of model (1) is given by:

$$\Delta Y_t = C(L)(\varepsilon_t + \mu + \phi D_t), \tag{8}$$

where C(L) can be developed as $C(L) = C(1) + (1-L)\tilde{C}(L)$, (see Engle and Granger (1987)). In integrated form (8) is given by:

$$Y_t = Y_0 + C\sum_{i=1}^{t} e_i + Cmt + C\sum_{i=1}^{t} fD_i + \tilde{C}(L)(e_t + fD_t), \tag{9}$$

where $C = C(1)$ and $\tilde{C}(L) = (1-L)^{-1}[C(L)-C(1)]$.

As shown in Johansen (1991) the link to the AR form of the model is given by

$$C = \beta_\perp(\alpha_\perp'(-I + \Gamma_1)\beta_\perp)^{-1}\alpha_\perp', \tag{10}$$

where $\alpha_\perp$ and $\beta_\perp$ are the orthogonal complements of α and β, respectively. The matrix $\alpha_\perp$, of order $p \times (p-r)$, reports the coefficients of the common trends indicating the contribution of each component to the stochastic vector; and the matrix $\beta_\perp$, of order $p \times (p-r)$, includes the loading factors indicating the effect of each common

trend on each variable. The matrix C determines how the non-stationary part of the process Y_t is generated from the underlying stochastic and deterministic trends.[14]

Gonzalo and Granger (1995) show that the matrix C also identifies the permanent component of a system. A simple decomposition of Y_t into its transitory and common trend components based on the estimators from the cointegration tests, is

$$Y_t = \alpha(\beta'\alpha)^{-1}X_t + \beta_\perp(\alpha_\perp'\beta_\perp)^{-1}Z_t, \quad (11)$$

where $X_t = \beta'Y_t$ is defined as the stationary or transitory process (which is actually the deviation from the cointegration relationship), $Z_t = \alpha_\perp'Y_t$ is defined as the non-stationary permanent component.[15] Gonzalo and Granger (1995) demonstrated that this non-stationary permanent component in the decomposition (11) corresponds to the common trend of the Stock-Watson decomposition through the Wold representation of ΔY_t,

$$\Delta Y_t = C(L)\varepsilon_t = C(1)\,\varepsilon_t + \Delta\tilde{C}(L)e_t, \quad (12)$$

where C(1) is defined as in equation (10) for the model (1) and $\tilde{C}(L)$ is defined as in equation (9).[16]

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[14] From equation (1) it is easy to verify that the choice of variables in D_t can affect the statistical description of the trend component in Y_t. To make sure that there are no seasonal trend effects in the model, in case there are fixed seasonal effects in the data, we use centered seasonal dummies.

[15] See also Park (1990) for a similar decomposition of Y_t.

[16] It should be noted that this correspondence applies by imposing the condition that the permanent component is a linear combination of the variables and that the transitory component does not have any permanent effect on the variables.

In our analysis, we estimate the moving average representation of the cointegrated system in order to investigate the non-stationary or permanent component, which drives the set of capital markets in the long-run.

3. The empirical evidence of integration

3.1 Data

The sample of countries examined in the paper includes: Japan, U.S., Hong Kong, South Korea, Malaysia, Singapore, Taiwan and Thailand.[17] The sample period covers from January 1980 to December 1998. The data consist of end of the month observations of stock market index prices (1990=100) expressed in local currency. The data were obtained from *Datastream*. The stock market index prices used are as follows: the Hang Seng Price Index for Hong Kong; the Nikkei 225 for Japan; the Korean Stock Exchange composite for Korea; the Kuala Lumpur Stock Exchange Composite Price Index for Malaysia; the Singapore Straits Times Price Index for Singapore; the Taiwan Stock Exchange weighted - price index for Taiwan; the Bangkok S.E.T. Price Index for Thailand; and the Standard and Poor's 500 Composition Index for the U.S.

The analysis in the paper was repeated using stock price indices expressed in local currencies, in U.S. dollars and in real U.S. dollars (named real terms in the rest of the paper). The logarithm of stock market index price expressed in U.S. dollars was computed as $\ln SP_t^i - \ln e_t^{PBC}$, where SP_t^i was the stock market index price for

[17] It was our intention to include Indonesia and the Philippines as well. However, because data were available only from May 1983 for Indonesia and January 1986 for the Philippines, we excluded these two countries.

country i, and e_t^{PBC} was the nominal exchange rate defined as local currency per U.S. dollar. The logarithm of stock market index price expressed in U.S. dollars and in real terms was defined as $\ln SP_t^i - \ln e_t^{PBC} - \ln CPI_t^{US}$, where SP_t^i is defined as above and CPI_t^{US} is the U.S. consumer price index. [18]

3.2 Criteria for selecting potential groups of closely linked stock markets

Strong links amongst capital markets are expected to be found when there is a high degree of openness. However, previous studies on international linkages have found surprising results. For instance, Bekaert and Harvey (1995) when analysing the time-varying integration of twelve emerging markets for the period December 1975 to the end of 1992, found that some markets appeared more integrated than one might have expected based on prior knowledge of investment restrictions, such as ownership restrictions and taxes.[19] Phylaktis and Ravazzolo (2000) in analysing potential linkages between stock prices and exchange rate dynamics for a group of Pacific-Basin markets show lack of comovement during the eighties for the free stock markets of Hong Kong and Singapore. In contrast, in the same study the authors found that markets were closely linked during the nineties even in countries such as Indonesia, Philippines and Thailand, where capital markets still had foreign exchange restrictions. This evidence underlines the fact that capital market liberalisation is neither a necessary nor a sufficient condition for close international financial market linkages and that other factors might exert an effect, such as information availability,

[18] Calculating the stock market index in U.S. dollars eliminates the location inflation. However, the U.S. inflation remains in the stock price level.

[19] For instance the markets of Korea, Taiwan and Thailand.

accounting standards, and investor protection; and specific emerging equity market risks, such as liquidity, political or currency risks (see Bekaert (1995). At the same time, there can also be a situation in which foreign investors use alternative vehicles, such as Country Funds, to enter equity markets with foreign restrictions.

Based on these observations we select the group of countries to examine the presence of linkages by adopting the following criteria. First, we select the free capital markets. In the case where no linkages are found amongst these markets and the ones of Japan and the U.S., we use an alternative criterion. We consider equity markets in which foreign ownership restrictions are still in existence, but there are alternative financial vehicles to allow foreign investors to invest in them. Bekaert and Harvey (2000), Bekaert (1995) and Chang, Eun and Kolodny (1995) suggest Country Funds as an alternative channel for entering restricted capital markets.

Information regarding the date of official liberalisation as reported by the International Finance Corporation (IFC) and the date of the First Country Fund (FCF) and American Depository Receipts (ADRs) is given in Table 1. The IFC date is based on the Investibility index, which represents the ratio of the market capitalisation of stocks that foreigners can legally hold to total market capitalisation. A large jump in the Index is evidence of an official liberalisation. What is clear is that all countries had either liberalised or started the process of liberalisation by the beginning of the 1990's.[20] Thus, dividing the sample period into two sub-periods, the pre-liberalisation ending in December 1989, and the post-liberalisation sub-period covering the period between January 1990 and December 1998, seems appropriate for examining the effect of stock market liberalisation on financial links between the countries. It

[20] Table 1 gives also the extent of some of the main direct and indirect barriers at the end of 1989.

should be noted that in the case of favourable results to close financial linkages the application of recursive estimation will provide us with further details of their evolution over time.

3.3 The analysis of the cointegration space

Before testing for cointegration we tested for unit roots in all stock market indices expressed in local currencies, in U.S. dollars, and in real terms. The results are not presented but can be made available by the authors. We used the Augmented Dickey Fuller test with and without trend as recommended by Engle and Granger (1987) and the Phillips and Perron (1988) test again with and without trend. We found that the null hypothesis of a unit root for the first difference can be rejected for all series. On the other hand, the null hypothesis of a unit root in levels was accepted in all cases.[21] Thus, like most financial series, the stock market levels are I(1), which means that first differencing is required to achieve stationarity.

We proceeded to test for cointegration for the selected group of Pacific Basin stock markets and the financial markets of Japan and the U.S. We use the Johansen trace statistic, which is corrected for small sample bias (see Reimers (1992)).[22] Thus,

[21] Lags were added in order to induce whiteness of the residuals.

[22] The trace test appears to be more robust to nonnormality of errors compared to the maximal eigenvalue (see Cheung and Lai (1993) for Monte Carlo results on this issue).

we use *(T - pk)* in equation (6) instead of T. The lag length was one and was chosen by applying the (AIC) and (SIC) on the undifferenced VAR models.[23]

We started our investigation by testing for the presence of cointegration for the period 1980 to 1989 amongst all the Pacific Basin capital markets of our sample, i.e. Hong Kong, Korea, Malaysia, Singapore, Taiwan, Thailand and the established financial markets of Japan and the U.S. The analysis was performed for three different cases: the stock price indices expressed in U.S. dollars, the stock price indices expressed in U.S. dollars and deflated by the U.S. consumer price index as has been used by Kasa (1992) and the stock price indices expressed in local currency. The results of the Johansen trace tests are reported in panel A of Table II and suggest the selection of two cointegrating vectors for the system when indices are expressed in U.S. dollars and one cointegrating vector for the systems when indices are expressed in real terms and local currency. The results of the exclusion tests are reported in panel B of Table 2 and show that when indices are expressed in U.S. dollars the stock markets of Hong Kong, Malaysia and Thailand can be excluded from the system, or in others words they do not participate to the cointegration space. The exclusion tests for the system when indices are expressed in real terms show that only Taiwan and Japan cannot be excluded from the cointegration space; and finally the results of the exclusion tests for the system when the indices are expressed in local currency show that only Korea and Taiwan cannot be excluded from the cointegration space. Thus, the findings indicate lack of linkages amongst the group of Pacific Basin

[23] To test the sensitivity of the results to the selection of k the analysis was repeated by using higher number of lags. We obtained similar results to the ones of a lower-order VAR system.

capital markets of Hong Kong, Korea, Malaysia, Singapore, Taiwan, Thailand and the developed equity markets of Japan and U.S. in all three cases.

We proceeded the analysis by selecting smaller groups of capital markets to investigate for the presence of cointegration using the criteria discussed in section 3.2.[24] We tested first to see whether the open equity markets of Hong Kong, Malaysia, and Singapore are cointegrated with Japan and U.S. The results of the Johansen trace tests are reported in panel A of Table 3 and show lack of cointegration amongst this group of countries. Since the openness of the Malaysian capital market only started in the late eighties and might have affected the cointegration results amongst the considered group of countries, we repeated the tests including only the countries of Hong Kong, Singapore, Japan and the U.S. In this case also the results do not reveal stock market linkages. The exclusion tests reported in panel B of Table 3, show that Hong Kong does not enter into the cointegration space highlighting an interesting point, namely that the lack of foreign exchange restrictions might not be a sufficient condition for links amongst stock markets.[25] The existence of *de facto* barriers may discourage foreign investors from entering financial markets e.g. lack of sufficient information, as suggested by Levine and Zervos (1996), or of specific

[24] For the sub-groups we present and discuss the results only for the case in which stock price indices are expressed in U.S. dollars. The findings for the alternative definitions present strong similarities.

[25] This result for Hong Kong was rather surprising in view of the fixed parity of the Hong Kong dollar with US dollar as part of Hong Kong's currency board arrangements established in 1983. The pegging to the dollar should have increased the transmission mechanism of shocks between the countries (see Frankel et al (2002)) and should have influenced positively their financial links.

country risks, such as the liquidity, political, economic policy and currency risks, and macroeconomic instability, as noted by Chuhan (1994) and Bekaert (1995). In our opinion the most relevant factor for Hong Kong was the political risk. Hong Kong suffered from frequent political shocks during that period relating to the question of its democracy after 1997, to China's human rights developments and political reforms, as well as to China's most favoured-nation trade status. Discussions between China and UK about Hong Kong's political status started in the early 1980's with a formula been worked out of "one country, two systems" in 1984. In 1989 the Tienanmen Democracy Movement took place dashing hopes of short-term political reforms. Following that there was a deterioration in the Sino-US relations with US threatening to cancel China's most-favoured nation (MFN) trading status, which would have affected Hong Kong's foreign trade and its position as China's window to the West. In October 1992, there was additional political uncertainty, when Hong Kong's new governor, Chris Patten, introduced new democratic reform measures, which infuriated China, who threatened to abandon its 1984 agreement with Britain. The above political instability had an effect on the stock market as shown by e.g. Kim and Mei (2001), who demonstrated that unexpected return jumps and changes in stock market volatility were associated with political news relating to the above events.

However, such factors could not have applied to the case of Singapore. For this reason we proceeded to test for the presence of cointegration in the group of markets of Singapore Japan and the US. The results show the existence of one cointegrating vector and that all markets participate in the cointegration space, thus confirming that the three stock markets are linked (see Table 3).

We next adopted an alternative criterion in the selection of potential countries for stock market linkages as discussed in section 3.2. We selected the countries of

Korea, Taiwan and Thailand as potential candidates for close linkages because they had Country Funds from the middle of the eighties, which allowed foreigners to invest in their markets. For example, by the early 1990's Korea had 17 US dollar denominated country funds and 17 non-US dollar country funds, while Thailand had 26 closed-end and 11 open-end Thai funds trading worldwide. Taiwan, on the other hand, had 9 open-end funds and 4 investment trusts.[26] According to Kaminsky, Lyons and Schmukler (2001) in 1995 holdings of dedicated Emerging Funds in Korea were 10.3 billion US dollars and had 6% of the market capitalisation. The respective figures for Taiwan were 4.6 and 2 and for Thailand 9.8 and 7.[27] According to the authors these figures should only be taken as an indication because they exclude holdings of global funds, which account for a substantially larger share of the stock market capitalisation of the emerging market. What should be noted, however, is that although the typical size of a country fund may be very small relative to the total market capitalisation of the emerging market, its introduction may drive up the prices of local companies reducing the cost of capital and essentially rendering the local

[26] See Bekaert and Harvey (1995). UK investment trusts are the equivalent of US closed-end funds.

[27] Data on dedicated funds come from Emerging Market Funds Research, which collects aggregate data of emerging market mutual funds. They track the net cash flows of nearly 1,400 international emerging market equity funds, with an average position of about $120 billion in 1996. The data cover both US-registered and offshore funds as well as funds registered in Luxembourg, the UK, Ireland, Cayman Islands, Canada and Switzerland. It includes both open and closed-end funds.

market partially integrated with global markets. This has been shown to be the case theoretically by Errunza, Senbet and Hogan (1998).[28]

The results of the trace statistics, when considering the system of five markets of Korea, Taiwan, Thailand, Japan and the U.S., show the presence of one cointegrating vector (see panel A, Table 4). However, the exclusion tests, reported in panel B of the same Table, shows that the Korean stock market does not participate in the cointegration space. This may indicate that the lack of cointegration of this system of five variables could be due to the presence of the Korean capital market in the group. Therefore, we repeated the analysis excluding the Korean market. The trace tests reported in panel A of Table 4, indicate the presence of one cointegrating vector and the exclusion tests, reported in panel B of the same Table, show that all four countries participate in the cointegration space and therefore that the capital markets of Taiwan, Thailand, Japan and U.S. are linked during the eighties. On the one hand, these findings underline the importance of Country Funds as a channel for international investors to enter highly regulated capital markets and on the other hand, the exclusion of Korea from that group of markets highlights that other conditions have to be met for that to be the case. Thus, we explored whether various types of risk existed at the time, which put Korea apart from Thailand and Taiwan. Table 5 summarises information on some emerging market specific risks, which might shed light on this issue.

Panel A presents information on company stocks since lack of information might have discouraged foreign investors from investing in those markets. As it can be seen there is no difference amongst the three countries. Panel B presents

[28] Tandon (1997) using an event study of returns around country fund launchings presents empirical evidence that seems to support this statement.

information on macro-economic instability and currency risk. It seems that all three countries have experienced very high rates of economic growth, which increased even more in the second half of the 1980's. Regarding inflation, however, it looks as if Thailand and especially Taiwan have performed better throughout the 1980's than Korea. As one would have expected this was reflected on the stability of their exchange rates, with the volatility of the Korean Won being substantially greater than that of the Thai Baht and the Taiwanese dollar.[29] The higher exchange rate volatility in Korea seems to have affected investment flows. For example, net foreign direct investment fell from 0.7 billion dollars in 1988 to –0.3 by 1992, in contrast to the other countries, where there was an increase.[30] Finally, Panel C gives information on stock market turnover ratio as an indicator of the liquidity of the markets. As Chuhan (1994) underlines, institutional investors are interested in highly liquid markets even when there are access limitations to the markets. It seems that Taiwan was the most liquid market during that period followed by Thailand and then Korea. In conclusion, the above information shows that possibly macroeconomic instability and a less liquid market might have influenced the behaviour of the Korean market.

We continued our analysis by computing the trace statistics and exclusion tests for the subperiod 1990 to 1998 for the same groups of countries, which were considered for the subperiod 1980 to 1989. The finding for all countries, is given for indices expressed in US dollars, in real terms and in local currencies; for the groups of open countries; and for the groups of the semi-open countries are (see panels A and B of Table 6, 7 and 8 respectively). While for this period also there is lack of

[29] For more information on the Korean economy and financial policies see Fry (1995).

[30] IMF, World Economic Outlook.

cointegration amongst the group of all countries, we found cointegration for the group of open countries, which were found not to be cointegrated during the eighties, and the group of semi-open countries. Furthermore, there is a general increase in the number of cointegrating vectors shared by the semi-open economies. The capital markets of Taiwan, Thailand, Japan and US, which were sharing one cointegrating vector and three common trends in the pre-liberalisation period, now, in the post-liberalization period, share three cointegrating vectors and only one common trend. This indicates an increase in the degree of linkages of these stock markets during the recent period of more open capital markets.

Based on this evidence, we continued our analysis and performed the recursive estimation of the group of countries presenting the highest degree of international comovements since the early eighties, namely that consisting of Taiwan, Thailand, Japan and the U.S.

3.3 The recursive trace test statistics

We examine the time path of the trace statistics recursively estimated to find when exactly the stock markets of Taiwan, Thailand, Japan and the U.S. started to be linked together. As described in section 2.3, each trace statistics is scaled by the 90% quantile of the trace distribution derived for the model. The number of trace statistics showing an upward behavior and above the critical value of one, indicates the number r of cointegrating vectors shared by the cointegrated system.

Figures 1.a reports these statistics for the period 1980 to 1989. Only one trace statistic presents an upward trend in the period of the analysis and that assumes a value just above one at the end of the 1985, beginning of 1986. It considerably increased in the second half of 1986. This indicates that the linkages of these stock

markets started between the end of 1985 and the middle of 1986. This period corresponds to the introduction of the First Country Fund for Thailand (July 1985) and of the three Country Funds for Taiwan (May 1986). Thus, the analysis indicates that financial links with world markets increased with the introduction of a vehicle of investment, which was accessible to foreign investors.

Looking now at the recursive estimation during the nineties we observe one statistic to be above one for the full period of the nineties and another two statistics to have an upward behaviour and reach the line of one at the beginning of 1996 (see figure 1.b). The three statistics continued to show an upward trend until the end of 1997. This evidence suggests that the stock markets of these countries were strongly linked in the period preceding the Asian crisis of mid 1997. The Asian crisis might have fostered these links but does not seem to have had a substantial effect. This is confirmed by looking at the R(t) representation, which keeps short-run dynamics constant and presents a similar behaviour to Z(t) representation. Unlike other crises, which have been found to cause an increase in market links, the Asian crisis concerned a group of countries, which was already integrated prior to the crisis, not only financially but economically as well.[31]

In conclusion, the recursive analysis suggests that First Country Funds have been an important channel for international investors to enter equity markets, in which foreign ownership restrictions are still in existence. In particular, it shows that stock market started in the period of the introduction of the First Country Funds. Furthermore, it shows that the Asian crisis of mid 1997 did not have a substantial effect on the financial links of these countries.

[31] See Phylaktis and Ravazzolo (2001). This substantial degree of stock market linkages may have contributed to the generation of the contagion effect in 1997.

3.4 The analysis of common trends

We estimate the moving average process of a cointegrated system in order to investigate the non-stationary common trend or permanent component, which drives our set of capital markets. We conduct the analysis by considering the two subperiods of 1980 to 1989 and 1990 to 1998 in order to investigate possible changes in the potential driver of the system.

The system of the capital markets of Taiwan, Thailand, Japan and U.S share one cointegrating vector and three common trends during the period of 1980-89. The estimation of the common trend mechanism for this subperiod is reported in Table 9, where panel A indicates the estimated coefficients of each common trend; and panel B the loading factors for each common trend. Looking at panel A, we can identify that the Thai stock market provides the major contribution to the first common trend, while the United States and Japan to the second and third common trends, respectively. Focusing on panel B, which reports the loading factors of each common trend, we can note that for all common trends, the Taiwanese stock market reacts most to common trend movements followed by the Thai and the Japanese stock markets. In contrast, the stock price index of the U.S. is the least affected by common trend comovements.

For the period 1990 to 1998 the same group of countries share three cointegrating vectors and one common trend. The results of the estimated common trend system are reported in Table 10. Panel A indicates that the only common trend shared by the group of countries is dominated equally by the Thai and Japanese stock markets. In contrast, Taiwan is the stock market most affected by this common stochastic trend. If we make the normalisation that the sum of the common trend

coefficients is unity then we see that the Thai and Japanese stock markets receive a weight of about 41 percent, while the U.S. market has a share of only 17 percent. These results are somewhat surprising because they do not reflect relative market capitalisation. For instance, at the end of 1995 the market capitalisation was 187,206 US$ million for Taiwan; 141,507 US$ million for Thailand; 3,667,292 US$ million for Japan and 6,857,622 US$ million for U.S. A factor, which could be influencing the results, is the role of persistent movements in real exchange rates. Further research should attempt to incorporate real exchange rate dynamics.

A different approach to investigate the relative importance of the trend to the various markets during this period is to compare the plots of the permanent component of each market, which corresponds to the common trend as shown by Gonzalo and Granger (1995), and the actual stock price behaviour. The plots are presented in Figures 2 to 5.[32] As it is suggested by the weights in the common trend, the trend or permanent component tracks closely the stock market behaviour in Thailand and Japan throughout the period. In contrast, the trend tracks closely the stock markets of Taiwan and U.S. only up to the beginning of 1996, i.e. before the onset of the Asian crisis. Subsequently, the transitory component becomes important. This confirms the fact that both markets were not affected as much by the Asian crisis as the other two countries.

Thus, the results show that the stock market of Taiwan has not been a driver of our set of capital markets and has been responding to the common trend. On the other hand, Thailand and Japan have been the main drivers, while U.S. contribution has remained small.

[32] It should be noted that the trend may lie consistently above or below the stock price series because the stock price indices are in different units.

4. Conclusion

In this paper, we have investigated the linkages and dynamic interactions amongst a group of Pacific-Basin stock markets and the industrialized countries of Japan and U.S. Our main objective was to examine whether these financial linkages were affected by the existence of foreign exchange restrictions. Furthermore, we wanted to investigate, whether alternative financial vehicles, such as Country Funds, provide a channel through which international investors access capital markets.

We have examined these issues by applying the multivariate cointegration model in the autoregressive and moving average form in terms of stable long-run comovements and common stochastic trends driving the system. We performed the recursive-based estimation to date the beginning of the linkages and the effects of the Asian crisis on them and that constitutes a novel approach to the examination of these issues. Our main findings are as follows:

First, we found that all the stock markets under investigation were not linked together for either the 80s or the 90s. Similar results were found for the open markets of Honk Kong and Malaysia for the 80s. This evidence suggests that the relaxation of foreign exchange restrictions is not sufficient to attract international investors' attention and strengthen international market interrelations. There exist other factors, possibly related to information availability, accounting standards, or liquidity and political risk, which may affect the portfolio diversification decision. In the specific case of Hong Kong, a high political risk might have been the reason for its lack of long-run comovement with other Pacific Basin markets and US. On the other hand, the increase in financial links for open and semi-open markets in the second sub-

period suggests that the relaxation of foreign ownership restrictions might have enhanced links with world markets.

Secondly, we found close financial links for Taiwan and Thailand with both Japan and U.S., during the first sub-period in which foreign ownership and other restrictions were in place. The results of the recursive analysis detect that the first forms of linkages correspond to the period of the introduction of First Country Funds. This underlines the importance of alternative financial instruments to access emerging equity markets and increase their financial links with world markets. It confirms evidence found that country funds provide statistically significant diversification benefits.[33] The results for Korea, however, point out that even in this case as it is with the official opening of the capital market, other conditions have to be met for markets to be closely linked.

Thirdly, the recursive analysis for the most recent period indicates that the Asian crisis did not have a substantial effect on the degree of linkages of these markets.

Finally, the estimated common trends mechanisms show that neither Japan, nor the U.S. has a unique influence in the Pacific Rim. U.S. plays a role, but small in magnitude, while Japan plays a more significant role, but is equally important as that of Thailand. Plotting the permanent component of each market, which corresponds to the common trend, and the actual stock price behaviour, we find that the difference of the two - the transitory component - to be substantial for Taiwan and US in the post 1996 period, thus offering short-run diversification opportunities to international investors.

[33] See Bekaert and Urias (1999) and Chang et al. (1995).

The analysis in the paper of stock market linkages in these emerging markets has indicated that international investors have opportunities for portfolio diversification by investing in most of the Pacific Basin countries. On the one hand, the results for the open economies show that although the linkages have increased in recent years, they do not seem to respond to a common world growth factor, but to be affected by national factors, leaving room for long-term gains by investing in these markets. On the other hand, the results for the semi-open economies show that although long-term diversification benefits from exposure to these markets might be limited, short-run benefits might exist due to substantial transitory fluctuations.

References

Arshanapalli, B. and J. Doukas, 1993, International stock market linkages: evidence from the pre- and post-October 1987 period, Journal of Banking and Finance 17, 193-208.

Bekaert, G., 1995, Market integration and investment barriers in emerging equity markets, World Bank Economic Review 9, 75-107.

Bekaert, G. and C.R. Harvey, 1995, Time-Varying world market integration, Journal of Finance 50, 403-444.

Bekaert, G. and C.R. Harvey, 1998, Capital flows and the behaviour of emerging market equity returns, NBER Working Paper 6669.

Bekaert, G. and C.R. Harvey, 2000, Foreign speculation and emerging equity markets, Journal of Finance 55, 565-613.

Bekaert, G. and M.S. Urias, 1999, Is there a free lunch in emerging market equities? The Journal of Portfolio Management Spring, 83-95.

Calvo, S. and C.M. Reinhart, 1996, Capital flows to Latin America: is there evidence of contagion effects, in: G. Calvo, M. Goldstein and E. Hochreiter, eds., Private capital flows to emerging markets after the Mexican crisis, (Washington DC:IIE).

Canova, F. and G. DeNicole, 1995, Stock markets and real activity: a structural approach, European Economic Review 39, 981-1015.

Chang, E., C.S. Eun and R. Kolodny, 1995, International diversification through closed-end country funds, Journal of Banking and Finance 19, 1237-1263.

Cheung, Y.W. and K.S. Lai, 1993, Finite-sample sizes of Johansen's likelihood ratio for cointegration, Oxford Bulletin of Economics and Statistics 55, 313-328.

Cheung Y.W. and L.K. Ng, 1998, International evidence on stock market and aggregate economic activity, Journal of Empirical Finance 5, 281-296.

Chuhan, P., 1994, Are institutional investors an important source of portfolio investment in emerging markets? World Bank Working Paper 1243.

Dwyer, G.P. and R.W. Hafer, 1988, Are national stock markets linked? Federal Reserve Bank of St. Louis Review 70, 3-14.

Engle, R.F. and C.W.J. Granger, 1987, Cointegration and error correction: representation, estimation and testing, Econometrica 55, 251-277.

Errunza, V., L. Senbet, and K. Hogan, 1998, The pricing of country funds from emerging markets: theory and evidence, International Journal of Theoretical and Applied Finance 1, 111-143.

Eun, C.S. and S. Shim, 1989, International transmission of stock market movements, Journal of Financial and Qualitative Analysis 24, 241-256.

Frankel, J., S.L. Schmukler and L. Serven, 2002, Global transmission of interest rates: monetary independence and currency regime, World Bank Working Paper 2424.

Fry, M., 1995, Money, interest and banking in economic development (Johns Hopkins University Press).

Gonzalo, J. and C.W.J. Granger, 1995, Estimation of common long-memory components in cointegrated systems, Journal of Business and Economics Statistics 13, 27-36.

Granger, C.W.J., 1981, Some properties of time series data and their use in econometric model specifications, Journal of Econometrics 28, 121-136.

Gregory, A.W., 1994, Testing for cointegration in linear quadratic models, Journal of Business and Economic Statistics 12, 347-360.

Hamao, Y., R. Masulis and V. Ng, 1990, Correlations in price changes and volatility across international stock markets, Review of Financial Studies 3, 281-308.

Hansen H. and S. Johansen, 1998, Some tests for parameter constancy in cointegrated VAR-models, Working Paper, University of Copenhagen, Institute of Mathematical Statistics.

Hardouvelis, G., 1988, Evidence on stock market bubbles: Japan, the United States and Great Britain, Federal Reserve Bank of New York, Quarterly Review 13, 4-16.

Harvey, C.R., 1995, Predictable risk return in emerging markets, Review of Financial Studies 8, 773-816.

Hawawini, G., 1994, Equity price behaviour: some evidence from markets around the World, Journal of Banking and Finance 18, 603-620.

Johansen, S., 1988, Statistical analysis of cointegration vectors, Journal of Economic Dynamics and Control 12, 231-254.

Johansen, S., 1991, Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models, Econometrica 59, 1551-1581.

Johansen, S. and K. Juselius, 1990, Maximum likelihood estimation and inference on cointegration - with applications to the demand for money, Oxford Bulletin of Economics and Statistics 52, 169-210.

Kaminsky, G.L., R.K. Lyons, and S.L. Schmukler, 2001, Mutual fund investment in emerging markets: an overview, The World Bank Economic Review 15, 315-340.

Kasa, K., 1992, Common stochastic trends in international stock markets, Journal of Monetary Economics 29, 95-124.

Kim, H.Y. and J.P.Mei, 2001, What makes the stock market jump? An analysis of political risk on Hong Kong stock returns, Journal of International Money and Finance, 20, 1003-1016.

King, M.A. and S. Wadhwani, 1990, Transmission of volatility between stock markets, Review of Financial Studies 3, 5-33.

Kock, P.D. and T.W. Kock, 1991, Evolution in dynamic linkages across daily national stock indexes, Journal of International Money and Finance 10, 231-251.

Levine, R. and S. Zervos, 1996, Capital control liberalisation and stock market development, Policy Research Working Paper, The World Bank, 1622.

Levy, H. and M. Sarnat, 1970, International diversification of investment portfolios, American Economic Review 60, 668-675.

Longin, F. and B. Solnik, 1995, Is the correlation in international equity returns constant: 1960-1990? Journal of International Money and Finance 14, 3-26.

Osterwald-Lenum, M., 1992, A note with quantiles of the asymptotic distribution of the maximum likelihood cointegration test statistics, Oxford Bulletin of Economic and Statistics 54, 461-471.

Park, J.Y., 1990, Disequilibrium inputs analysis, Working Paper, Cornell University.

Phylaktis, K. and F. Ravazzolo, 2000, Stock prices and exchange rate dynamics, Mimeo, City University Business School.

Phylaktis, K. and F. Ravazzolo, 2001, Measuring financial and economic integration with equity prices in emerging markets, Mimeo, City University Business School.

Phillips P. and P. Perron, 1988, Testing for unit root in time series regression, Biometrica 75, 335-346.

Reimers, H.E., 1992, Comparisons of tests for multivariate cointegration, Statistical Papers 33, 335-346.

Richards, A.J, 1995, Comovements in national stock market returns: Evidence of predictability, but not cointegration, Journal of Monetary Economics 36, 631-654.

Roll, R., 1989, The International Crash of October 1989, in R.W. Kamphuis et al. eds., Black Monday and the future of financial markets (Dow Jones-Irwin), 35-70.

Roll, R., 1992, Industrial structure and the comparative behaviour of international stock market indices, Journal of Finance 47, 3-41.

Schwert, G.W., 1990, Stock returns and real activity: a century of evidence, Journal of Finance 45, 1237-1257.

Solnik, B.H., 1974, Why do not diversify internationally rather than domestically? Financial Analyst Journal 30, 48-54.

Stepthon, P.S. and K.S. Larsen, 1991, Tests of exchange market efficiency: fragile evidence from cointegration tests, Journal of International Money and Finance 10, 561-570.

Stock, J.H. and M.W. Watson, 1988, Testing for common trends, Journal of the American Statistical Association 83, 1097-1107.

Tandon, K., 1997, External financing in emerging markets: an analysis of market responses, Emerging Markets Quarterly 1, 63-74.

Taylor, M.P. and I. Tonks, 1989, The internationalisation of stock markets and the abolition of U.K. exchange control, The Review of Economics and Statistics 71, 332-336.

Table 1

A: Different signals of liberalisation

Country	IFC official liberalisation	First Country Fund	First ADR introduction
Hong Kong	01.73	-	-
Korea	01.92	08.84	11.90
Malaysia	12.88	12.87	08.92
Singapore	06.78	-	-
Taiwan	01.91	05.86	12.91
Thailand	09.87	07.85	01.91

B: Emerging stock markets - direct and indirect barriers for institutional investors (end-1989)

	Foreign ownership Limit	Dividends Repatriation	Capital Repatriation	Withholding Taxes on Dividend	Taxes on Capital Gains
Hong Kong	100%	Free	Free	0%	0%
Japan	100%(25%)[a]	Free	Free	20% (0-15%)	0%
Korea	10%(8%)[b]	Some Restrictions[c]	Some Restrictions[c]	25% (10-21.5%)	0% (11-27%[e])
Malaysia	100%[d]	Free	Free	35%(0%)	0%
Singapore	100%	Free	Free	0.0%	0%
Taiwan[f, g]	Special Funds only[h]	Free	Free	20%	0.6%
Thailand	49% (25%)[i]	Free[k]	Free	20%(10)	25%(10)

Notes: The Table is based on the information provided in the International Financial Corporation' s (IFC) Factbook, the Euromoney annual report, the Exchange Arrangements and Restrictions, IMF and Bekaert and Harvey (1998). Percentages shown in brackets apply only to approved new Country Funds, where these may be different from normal treatment. The IFC official liberalisation date is based on the investibility index, which represents the ratio of the market capitalisation of stocks that foreigners can legally hold to total market capitalisation. A large jump in the index is taken as evidence of an official liberalisation.

[a] The foreign ownership limit is up to 100% in case of companies classified as "non-strategic". The limit is reduced to 25% in case of "national interest" companies such as mining, agriculture, nuclear power, gas, railways, banks, aircraft, pharmaceutical industries and oil refineries. Direct inward investment in a listed corporation, which represents more than 10% of the corporation's issued capital when aggregated with the existing holdings of the investor and its related parties, or in the acquisition of shares in any non-listed corporation, requires a specific report to be filed with the Ministry of Finance and other Ministries prior to the transactions.

[b] Foreign ownership restriction of up to 10% of market capitalisation for "non-limited" industries and of up to 8% of market capitalisation for "limited" industries.

[c] The repatriation of initial capital, capital gains and dividends is subject to approval by the Ministry of Finance.

[d] Foreign acquisition of investments exceeding M$ 5 million in value or equivalent of 15% or more of voting power in a Malaysian company requires the prior approval of the Foreign Investment Committee.

[e] Of net gains or gross sales proceeds respectively.

[f] Existence of transaction taxes on gross transaction value.

[g] Available only to investors in approved investment vehicles.

[h] Foreign investors who open an account in a local brokerage house may only invest in four listed funds – Kwang Hua Growth Fund, NITC Fuyuan Fund and Citizen Fund. Domestic residents are allowed to remit outwards up to US$5 million per annum.

[i] Foreign investors are allowed to hold up to 49% of companies listed on the SET with the exception of the commercial banks and finance companies, where foreign ownership is restricted to 25% of the capital.

[k] A report is required for the repatriation of dividends and capital gains.

Table 2 Multivariate cointegration, all countries 1980-1989.

Panel A: Johansen trace test statistics

Countries in the group	H_0:r=0	H_1:r≤1	H_2:r≤2	H_3:r≤3	H_4:r≤4	H_5:r≤5	H_6:r≤6	H_7:r≤7
HK KO MA SG TA TH JP U.S. (US dollars)	162.1**	105.2**	70.3	24.7	24.7	11.4	4.2	0.7
HK KO MA SG TA TH JP U.S. (Real terms)	157.2**	100.8	68.7	41.4	23.9	11.1	3.3	0.04
HK KO MA SG TA TH JP U.S. (Local currency)	169.5**	120.0	85.5	54.3	36.6	16.9	9.2	2.1

Panel B: Exclusion test

Countries in the group		HK	KO	MA	SG	TA	TH	JP	U.S.
HK KO MA SG TA TH JP U.S. (US dollars)	χ^2 (2)	4.6	5.1**	2.2	7.1**	9.4**	4.4	12.7**	7.5**
HK KO MA SG TA TH JP U.S. (Real terms)	χ^2 (1)	0.23	0.18	0.5	2.5	6.9**	1.7	11.7**	0.0
HK KO MA SG TA TH JP U.S. (Local currency)	χ^2 (1)	1.5	3.8**	1.7	0.7	7.4**	0.2	0.5	0.7

Notes: The following abbreviations have been used for the countries: HK: Hong Kong; KO: Korea; MA: Malaysia; SG: Singapore; TA: Taiwan; TH: Thailand; JP: Japan; and US: United States. The Johansen trace statistic tests the hypothesis that there are at most r cointegrating vectors $0 \le r \le p$ where p is the number of stock markets in each case. The critical values have been obtained from Osterwald-Lenum (1992). The statistics include a finite sample correction (see Reimers (1992)). * and ** denote significance at 10% and 5% level respectively. The exclusion statistic tests the null hypothesis that the coefficients of the cointegrating vectors relating to each market are zero. The test statistic is χ^2 distributed with r degrees of freedom.

Table 3 Multivariate cointegration, open markets 1980-1989

Panel A: Johansen trace test statistics

Countries in the group	H_0: r = 0	H_1: r ≤ 1	H_2: r ≤ 2	H_3: r ≤ 3	H_4: r ≤ 4
HK MA SG JP U.S.	51.2	18.4	9.0	1.6	0.0
HK SG JP U.S.	38.1*	6.3	2.1	0.0	
SG JP U.S.	28.23**	1.14	0.23		

Panel B: Exclusion test

		HK	MA	SG	JP	U.S.
HK MA SG JP U.S.		-	-	-	-	-
HK SG JP U.S.	$c^2(1)$	2.34		15.3**	4.9**	19.5**
SG JP U.S.	$c^2(1)$			18.66**	5.21**	19.93**

Notes: see notes to Table 2.

Table 4 Multivariate cointegration, semi-open markets 1980-1989

Panel A: Johansen trace test statistics

Countries	H_0: r = 0	H_1: r ≤ 1	H_2: r ≤ 2	H_3: r ≤ 3	H_4: r ≤ 4
KO TA TH JP U.S.	90.5**	34.2	20.8	8.5	0.5
TA TH JP U.S.	57.3**	16.6	7.8	0.5	

Panel B: Exclusion test

		KO	TA	TH	JP	U.S.
KO TA TH JP U.S.	$c^2(1)$	0.5	16**	3.5**	3.4**	5.0**
TA TH JP U.S.	$c^2(1)$		17.5**	9.8**	16.1**	17.7**

Notes: see notes to Table 2.

Table 5 Information on emerging market specific risks (end-1989)

Panel A: Emerging markets information and investor protection

	Securities Exchange publications (1)	Regular publication of Price/Earnings and Price/ Dividends (2)	Market Commentaries in English (3)	Company brokerage reports (4)	Interim Statement (5)	Accounting standards (6)	Investor protection (7)
Korea	AMWD	C	LR,IR	LR,IR	S	G	GS
Thailand	AQMWD	C	LR,IR	LR,IR	Q	A	AS
Tawain	AMWD	C	LR,IR	LR,IR	Q	P	PS

Notes: Emerging Stock Markets Factbook published by International Finance Corporation
(1) A=Annual, Q=Quarterly, M=Monthly, W=Weekly, D=Daily
(2) P=Published, C=Comprehensive and published internationally
(3) and (4) LR=Prepared by local broker or analysts; IR=Prepared by international brokers or analysts
(5) Q=Quarterly results must be published, S=Semiannual results must be published
(6) and (7) G=Good of international acceptable quality; A=Adequate; P=Poor, requires reform; S=Functioning Securities Commission or similar government agency concentrating on regulating market activity

Panel B: Stock market turnover ratios

	1984	1987	1990
Korea	62.17	75.73	68.67
Thailand	25.23	93.59	95.90
Taiwan	82.86	172.95	709.96

Notes: Emerging Stock Markets Factbook published by International Finance Corporation

Panel C: Macroeconomic indicators

	Real economic growth (%)		Inflation rate (%)		Exchange rate volatility (standard deviation)	
	1981-84	1985-89	1981-84	1985-89	1981-84	1985-89
Korea	8.98	9.40	2.85	4.22	71.72	84.75
Thailand	5.68	9.02	2.30	3.18	1.41	0.69
Taiwan	10.20	11.95	0.40	1.38	1.71	5.38

Notes: See section 3.1.

Table 6 Multivariate cointegration, all countries 1990-1998

Panel A: Johansen trace test statistics

Countries in the group	H_0:r=0	H_1:r≤1	H_2:r≤2	H_3:r≤3	H_4:r≤4	H_5:r≤5	H_6:r≤6	H_7:r≤7
HK KO MA SG TA TH JP U.S. (US dollars)	155.4**	102.2	69.2	42.9	23.1	12.7	5.4	0.1
HK KO MA SG TA TH JP U.S. (Real terms)	155.2**	102.1	69.1	42.8	23.1	12.7	5.4	0.1
HK KO MA SG TA TH JP U.S. (Local currency)	188.6**	126.8	89.4	58.9	35.3	23.4	14.1	6.7

Panel B: Exclusion test

Countries in the group		HK	KO	MA	SG	TA	TH	JP	U.S.
HK KO MA SG TA TH JP U.S. (US dollars)	c^2 (1)	0.0	13.2**	4.9**	2.0	2.2	0.8	0.6	3.2*
HK KO MA SG TA TH JP U.S. (Real terms)	c^2 (1)	0.0	13.2**	5.1**	2.0	2.2	0.9	0.6	3.2*
HK KO MA SG TA TH JP U.S. (Local currency)	c^2 (1)	2.2	4.4**	8.6**	0.9	5.7**	2.2	3.0*	1.1

Notes: see notes to Table 2

Table 7 Multivariate cointegration, open markets 1990-1998

Panel A: Johansen trace test statistics

Countries in the group	H_0: r = 0	H_1: r ≤ 1	H_2: r ≤ 2	H_3: r ≤ 3	H_4: r ≤ 4
HK MA SG JP U.S.	73.6**	40.1**	16.7	7.1	0.0
HK SG JP U.S.	49.7**	27.4**	7.4	0.0	
SG JP U.S.	36.06**	13.5	0.11		

Panel B: Exclusion test

		HK	MA	SG	JP	U.S.
HK MA SG JP U.S.	$c^2(2)$	10.5**	13.3**	18.9**	15.8**	9.7**
HK SG JP U.S.	$c^2(2)$	16.1**		20.3**	22.9**	5.0*
SG JP U.S.	$c^2(1)$			7.70**	5.62**	7.50**

Notes: see notes to Table 2.

Table 8 Multivariate cointegration, semi-open markets 1990-1998

Panel A: Johansen trace test statistics

Countries in the group	H_0: r = 0	H_1: r ≤ 1	H_2: r ≤ 2	H_3: r ≤ 3	H_4: r ≤ 4
KO TA TH JP U.S.	100.0**	55.8**	30.6	14	3.8
TA TH JP U.S.	58.3**	28.0**	12.2**	0.03	

Panel B: Exclusion test

	c^2	*KO*	*TA*	*TH*	*JP*	*U.S.*
KO TA TH JP U.S.	$\chi^2(2)$	17.0**	6.0**	11.0**	5.2**	6.7**
TA TH JP U.S.	$\chi^2(3)$		21.0**	16.0**	17.3**	19.6**

Notes: see notes to Table 2.

Figure 1.a: Recursive estimation of the trace statistics for the system composed of Taiwan, Thailand, Japan and the United States during 1980-1989

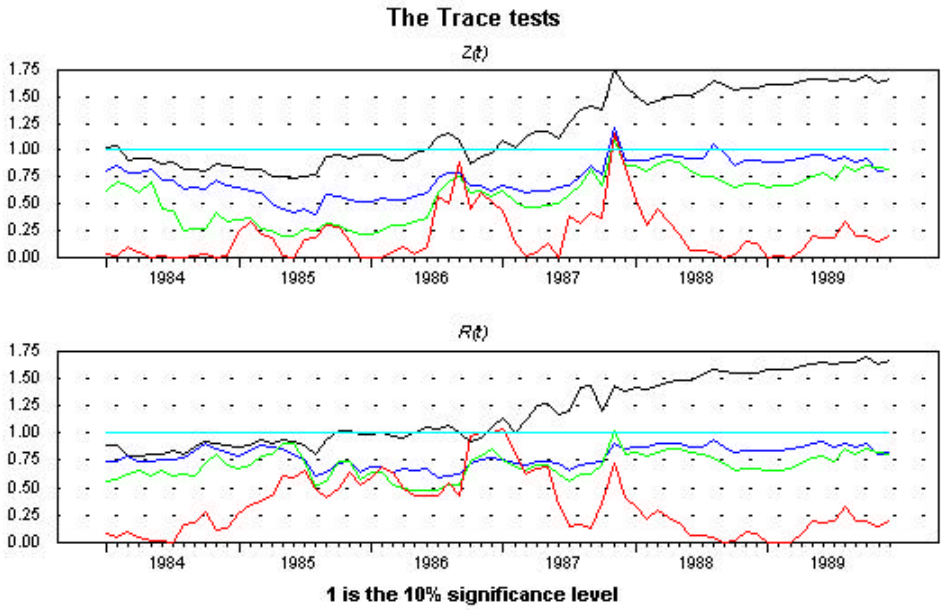
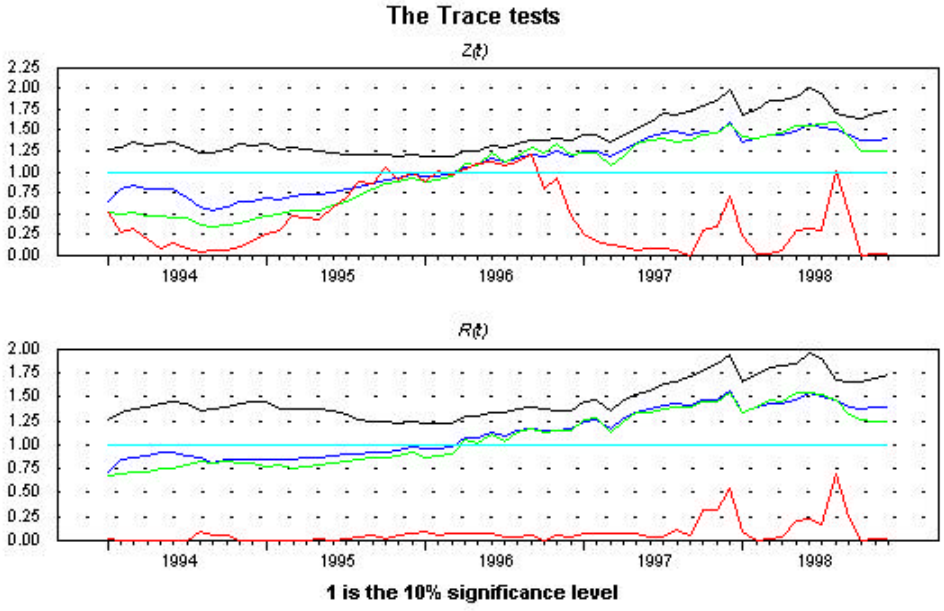


Figure 1.b: Recursive estimation of the trace statistics for the system composed of Taiwan, Thailand, Japan and the United States during 1990-1998



Notes: The number of Trace test statistics above unity correspond to the cointegration rank at 10% significance level. All the parameters of the VAR are re-estimated during the recursions under the Z representation; the short-run parameters are kept fixed to their full sample values and only the long-run parameters are re-estimated under the R representation.

Table 9 Orthogonal complement of the cointegration space with one cointegrating vector for the group of Taiwan, Thailand, Japan and U.S. during 1980-89

Panel A: Estimates of the common trend matrix ($\alpha_{\perp}$)

	Taiwan	Thailand	Japan	United States
Common trend 1	-0.137	0.889	-0.407	-0.160
Common trend 2	0.110	-0.123	0.080	-0.983
Common trend 3	0.435	-0.315	-0.843	0.019

Panel B: Estimates of the matrix ($\beta_{\perp}$)

	Common trend 1	Common trend 2	Common trend 3
Taiwan	5.154	-4.192	-6.454
Thailand	3.645	-2.073	-3.831
Japan	1.407	-1.791	-3.442
United States	0.419	-1.506	-0.734

Notes: The elements of $\alpha_{\perp}$ indicate the weight of each market to the trend; $\beta_{\perp}$ gives the relative importance of the trend to each market.

Table 10 Orthogonal complement of the cointegration space with three cointegrating vectors for the group of Taiwan, Thailand, Japan and U.S. during 1990-98

Panel A: Estimates of the common trend matrix ($\alpha_{\perp}$)

	Taiwan	Thailand	Japan	United States
Common trend 1	0.025	-0.675	-0.681	-0.282

Panel B: Estimates of the matrix ($\beta_{\perp}$)

	Common trend 1
Taiwan	-0.998
Thailand	-0.672
Japan	-0.391
United States	-0.679

Notes: See Notes to Table 9.

Figures 2 to 5: Stock price index decomposition for the system Taiwan, Thailand, Japan and U.S. over 1990 – 1998

Figure 2

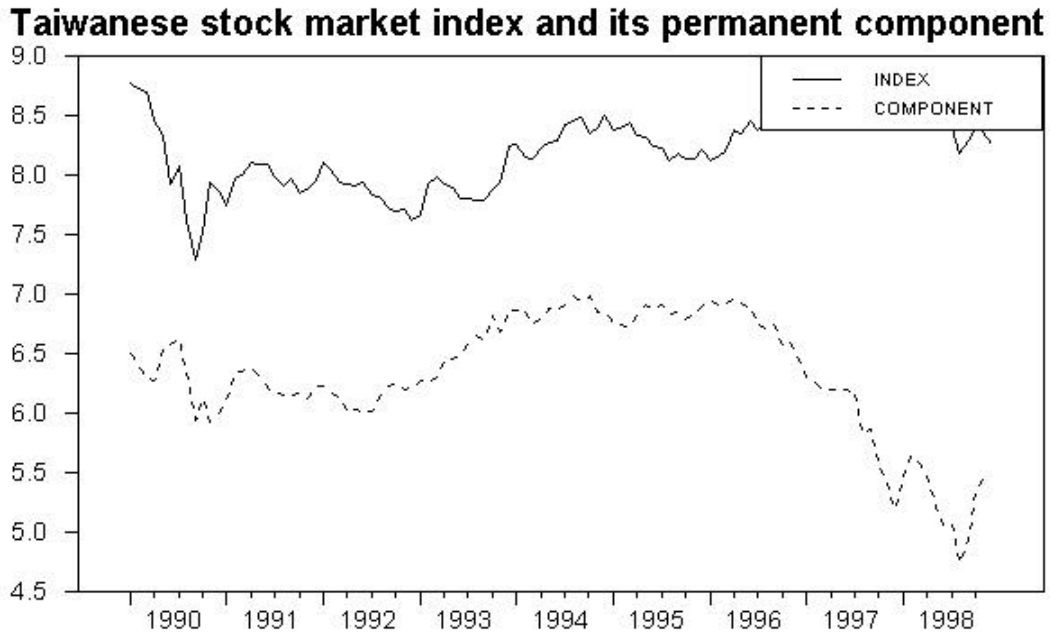
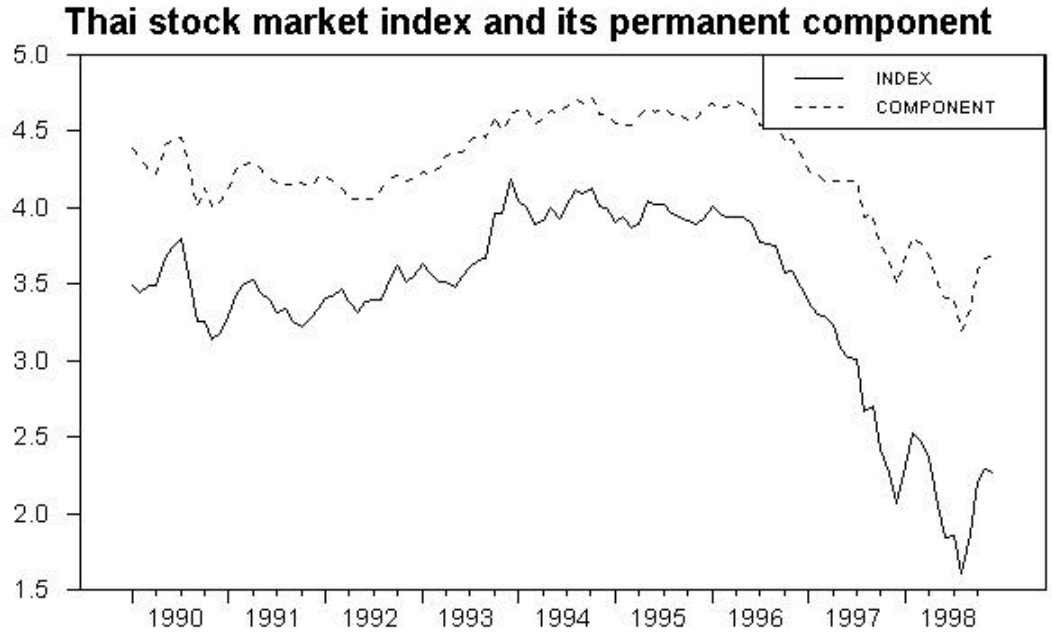


Figure 3



Notes: Each stock price index is decomposed into the permanent and transitory components. The transitory component in each figure is represented by the difference between the actual price index and the permanent component.

Figure 4

Figure 5