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Some Recent Evidences about the Global Integration of Chinese Share Markets

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Abstract:

First and second order instability tests and cointegration tests are applied to China and other seven market indices and their long run relationship on daily data from January 2 1992 through July 16 2004. First order instability is synonymous with non stationarity and second order instability with structural breaks. The methodologies developed by Perron (1997) and Zivot and Andrews (1992) are employed for unit root tests allowing for structural break while recursive estimation developed by Hansen and Johansen (1993) is applied to test cointegration relationships subject to structural breaks. The structural break identified among eight markets coincides with the Asian crisis period. The increasing strength of cointegrating relationships time (after the late of 2003) reflects the higher extent of economic interdependence among the eight countries following Asian crisis. Continuing upward growing trend with the extended period after 2004 indicates the more difficulties to maintain the benefits from international portfolio diversification. The results in this study also reveal that there exist long-run cointegration relationship between market of China and other countries. Analytical results in this study show China is interactive rather than fairly isolated as reported previously in the literature.

1. Introduction

When the government of the People's Republic of China opted for a strategic change in 1978, the global economies foresee an emerging market rich in both the diversity and depth of Chinese markets. Following that benchmark, decisions taken in 1978, foreign direct investment and experts have flowed into China and the Chinese economy has accommodated the expansion of foreign imports by achieving almost unprecedented growth rates up to occurrence of the Asian Currency Crisis in 1997-98, in spite of that hic up, China is back on a spectacular growth path. However, central to the substance of its current growth is the further sophistication of PRCs capital markets and the further reform of its currency exchanges and its share markets. It is this latter component of the capital which is the focus of the following study.

Our purpose in this paper is briefly stated. It is to determine the extent to which China's major share markets are integrated with global share markets. In pursuing this goal, we take into account evidence of both first and the second order stability of individual share price indices (SPIs) and of relationship between the time paths of the Chinese SPI with a mix of foreign SPIs. This distinction between first and second order stability is defined in Yan and Felmingham (2005) and in general it was reduced to the following interpretation: first order instability is broadly aligned with the non-stationarility of an individual time series and second order instability is concerned with structural breaks in individual time series and in the long term relationships linking China's SPIs with foreign ones.

For an emerging nation such as China's it is unlikely that the evolution of a mature share market will occur without incident or shocks to the system. Included among these incidents or shocks are the effects wrought by policy intervention, which is the case of an emerging countries such as China can have quite remarkable effects on the time path of prices. To accommodate the importance of breaks we conduct test for first and second order instability of the individual time series and test for structural breaks in the long run relationship between individual SPIs.

The following analysis of SPI integration based around the integration of China's Shanghai Composite Index with the Korea Composite Index, the Hong Kong Hang Seng Index, the Taiwan Weighted Index, the US S&P 500 Composite Index, the Japan Nikkei 225 Index, the Singapore Straits Times Index and the Australian All Ordinary Index.

There are two major Chinese share markets: the Shanghai Composite and the Shengzhen Composite. Since its establishment in 1990, the Shanghai market has expanded rapidly in terms of market capitalization, trading volume and the number of firms listed and it also has a strong contemporaneous relationship with the Shenzhen market through time. Also we believe the Shanghai market will become predominant in future years. Therefore, we have opted for the inclusions of the Shanghai Composite over the Shenzhen index.

It is appropriate also to include in our example because of the weight of two target economies, namely, the US and Japan. The inclusion of the Hang Seng and Taiwan weighted indices provides an opportunity to test the relationship between these Chinese markets. The inclusion of the Korea and the Singapore indices accommodate the influence of a major source of China's inward FDI (Korea) and one of smaller countries currently negating a bilateral free trade agreement with the PRC, namely Singapore. Australia too is seeking dialogue with the PRC for a bilateral agreement so its inclusion is warranted on the same grounds. From an Australian perspective, China is Australia's 2nd largest merchandise import market source behind Japan.

2. Data Description

All data are daily closing prices in local currency purchased from global financial database. The indices included in this study are the China Shanghai Composite Index, the Korea Composite Index, the Hong Kong Hang Seng Index, the Taiwan Weighted Index, the US S&P 500 Composite Index, the Japan Nikkei 225 Index, the Singapore Straits Times Index and the Australian All Ordinary Index. Have mentioned earlier, the choice of countries is based on the economic ties between these country and China. The sample covers the period from January 1992 to July 2004 all together 3273 daily observations. This enables us to test the stability of long-run stock market relationships with respect to major events over time. While observations are missing because markets were on some days closed, closing prices of the preceding day are used as a proxy for that day. In order to ensure the same number of observations, all the observations from Saturday's trading in Taiwan and Korea are omitted to ensure that the same number of observations is included for each index.

Literature showed that there is much stronger evidence of cointegration when using monthly data than when daily data are employed. In order to capture the effect of the cointegration relationship precisely daily data is used in this study. The starting dates are determined by the earliest date for which Chinese data are available. Using nominal stock prices means that the effect of inflation is buried in stock returns. Nevertheless, there is the non-trivial issue of how to deflate stock prices and the relationship between stock returns and inflation is quite complex. So we adopt the nominal stock prices in this study. All data are transformed by taking natural logarithms. The nine share price indices levels and differences are graphically displayed on Figure 1.

A brief discussion regarding the characteristics of the selected markets is useful. Such information is supplied on Table 1. Summary statistics are reported for levels calculated as the log of the price indices. Over the full period, the Hong Kong portfolio has the highest standard deviation. At the other extreme Japan has the lowest standard deviation. The skewness, excess kurtosis and normality statistics indicate that, overall, the levels showed significant deviations from normality over the sample period. This is a common feature of most financial data.

3. Methodologies

Our tests for instability of the price index level are based on Harvey's (1981) argument that a non stationary time series are explosive and therefore unstable. Following the argument of Felmingham and Mansfield (2003), a stationary time series exhibits stable properties having a time invariant, finite variance while random innovations have a transitory impact on a stationary series. The series is mean reverting and its autocorrelation function declines with lag length. So a stationary series is stable in this context. We deem the two series studied in this paper to be stable if they are stationary and label this first order stability. However, stability of price level does not rest on the stationarity issue alone. We also test the eight share price indices for structural breaks. It is one thing to have a smooth, stationary and therefore stable series; it is another altogether to have a series which is stable subject to a structural break in that series. This second order test for instability involves some basic questions as to the causes of the break.

Similarly with price indices levels, the long term relationship between variables based on Johansen cointegration test which suffers the influences of structural breaks in the data set. We test for the presence of second order stability of long term relationship between Chinese and other seven markets by firstly obtaining the results of long run relationship from a standard cointegration test and then we exam the instability of this long term equilibrium relationship. Whether this relationship between the countries keeps constant during all sample period without any outside influences is our focus. This second order instability test for a long-run relationship based on the recursive estimation method suggested by Hansen and Johansen (1993) explained later.

3.1 *Unit Root Tests*
(the first and second order instability test of individual price index time series)

A necessary but not sufficient condition for cointegration is that each of the variables involved in a study should be nonstationary in levels but stationary in first differences. Perron (1989) argues that if there is a break in a deterministic trend, then traditional Augmented Dicker Fuller unit root tests will lead to a misleading conclusion to the effect that there is a unit root, even if there is not. For each of the variables first order instability is synonymous with non stationarity and second order instability with structural breaks. Perron (1997) and Zivot and Andrews (1992) indicate that the date of any structural break point in a time series should be endogenously determined. In the following analysis, the null hypothesis of a unit root without an exogenous structural break is tested against the alternative that the series is trend-stationary with a one-time break. Perron's (1997) structural break test requires the estimation of the following regression:

$$y_t = \mu + \theta DU_t + \beta t + \gamma DT_t + \delta D(T_B)_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t \qquad (1)$$

Where $DU_t = 1$ if $t > T_B, DT_t = t - T_B$ if $t > T_B$ and $D\left(T_B\right) = 1$ if $t = T_B + 1$. T_B denotes the time at which a structural break occurs. We will select the breakpoint using the minimum t-statistic for testing the null hypothesis of a unit root (a = 1).

The structural break tests developed by Zivot and Andrews (1992) involve the following regressions:

$$y_t = \mu + \theta DU_t + \beta t + \gamma DT_t^* + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t \qquad (2)$$

Where $DUt = 1$ if $t > T_B, 0$ otherwise $DT_t^* = t - T_B$ if $t > T_B, 0$ otherwise. The break point is chosen as the value which minimizes the t-statistic for testing the null hypothesis of a unit root (a = 1). Unlike Perron (1997), the one-time break dummy, $D(T_B)$, is not included in Zivot and Andrews (1992) model. In equation (2), we estimate Zivot and Andrews' model which allows for a break in both intercept and trend of a time series. The testing procedure in Zivot and Andrews (1992) is similar to that of Perron (1997) described above. Perron (1997) simulates critical values for a finite sample size which are quite different from the asymptotic critical value derived by Zivot and Andrews.

3.2 Cointegration Analysis

After the individual series are found to be non-stationary and are integrated of the same order*, cointegration analysis is used to determine whether the index series become stationary in a linear combination. For example, two variables are cointegrated when a linear combination of these two variables is stationary, even though each may individually be non-stationary. So these two variables can be said to have a long run relationship. The cointegration test is performed using the Johansen (1991) method and involved error correction term.

3.2.1 Johansen's Cointegration Estimation
(the first order instability test of long run relationships)

Similarly, the first and second order stability is considered when investigating long run relationship. The first order stability test of long run relationships is cointegrated relationship among variables without structural breaks considered and the second order stability does take the breaks account.

Johansen (1991) demonstrate that the procedure involves the identification of the rank of Π in the following specification:

$$\Delta x_t = \zeta + \sum_{i=1}^{i=k-1} \Gamma_i \Delta x_{t-i} + \Pi x_{t-1} + \mu \quad (3)$$

where, Γ and Π represent coefficient matrices, Δ is a difference operator. If Π has zero rank, no stationary linear combination can be identified. In other words, the variables in x_t are noncointegrated. If the rank r of Π is greater than zero, however, there will exist r possible stationary linear combinations. The parameter Π may be decomposed into two matrices α and β, (each m ×r) such that Π = αβ′. In this representation β contains the coefficients of the r distinct cointegration vectors that render $\beta' x_t$ stationary, even though x_t is itself non-stationary and $\beta' x_t$ which is called the error correction term. Further, α is the speed-of-adjustment coefficient of the error correction term and measures the average speed of convergence of the series in question towards the long-run equilibrium. If α equal zero, then this series does not participate in the adjustment back towards equilibrium and is described as being weakly exogenous.

Additional testing of β, the coefficients of the cointegration vectors, can produce further information on long-run market linkages. We are interested in how many markets are excluded in all of the identified long-run relationships. This hypothesis can be tested by examining whether each coefficient is equivalent to zero. In order to test this proposition for each of the equity markets entering the cointegration vector significantly, we test for zero restrictions upon each of the coefficients derived by the Johansen procedure.

Applications of the Johansen procedure are quite popular in a multivariate context. As Masih and Masih (1995) point out, the results of the Johansen statistic in bivariate studies have also been shown to be more robust than those from the Engle-Granger approach. So we adopt the Johansen procedure for both bivariate and multivariate analysis at a later analysis.

3.1.2.2 Structural Break Tests
(the second order instability test in long run relationships)

Recent studies in particular (Elyasiani and Kocagil (2001)) have shown that Johansen's test suffers from temporal instability. An implicit assumption underlying these tests is that news and particular events do not significantly affect the stability of this system in terms of altering the number of common stochastic trends. This makes it necessary to carry out the second order stability test in order to get full information of cointegration relationship. To tackle this problem Hansen and Johansen(1993) have suggested some methods for the evaluation of parameter constancy in cointegrated VAR models to identify the structural breaks which changing the number of cointegration vectors.

In contrast to the previous studies cited above, recursive diagnostic techniques are performed to ensure the robustness of the results from the conventional Johansen tests and to examine the stability of the cointegration relationship.

There are three methods to evaluate the parameter constancy in cointegrated VAR models.

The first test is called the Rank test. This is accomplished by first estimating the model over the full sample, and the residuals corresponding to each recursive subsample are used to form the standard sample moment. The obtained sequence of trace statistics is scaled by the corresponding critical values.

Recall from earlier section that the Trace test is calculated in the following equation:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{p} \ln(1-\lambda_i)$$

When determining the number of cointegration vectors, sequential testing is used. Firstly, the null hypothesis of r = 0 is tested against the alternative of r = p (the null of all series being unit root series against the alternative hypotheses of all series being stationary series): $H\left(r \leq 0/r = p\right)$. If this test is rejected, the null hypothesis of at most one cointegration vector, r < = 1, is tested against the alternative hypothesis of r = p: $H\left(r \leq 1/r = p\right)$. And so on until the hypothesis of r < = p - 1 is tested against r = p: $H\left(r \leq p-1/r = p\right)$. When a particular hypothesis cannot be rejected, the sequential testing procedure is truncated.

Therefore, if the cointegration rank is constant throughout the sample period (no significant change of the rank), all recursive test statistics for the Trace hypotheses should exceed the critical test values and be upward sloping.

A second test deals with the null hypothesis of the constancy of the beta for a given cointegration rank. Hansen and Johansen propose a likelihood ratio test that is constructed by comparing the likelihood function from each recursive subsample with the likelihood function computed under the restriction that the cointegrating vectors estimated from the full sample falls within the space spanned from the estimated vectors of each individual sample. The test statistic is a chi-square distributed with (p - r)r degrees of freedom, where p stands for the number of endogenous variables and r for the cointegration rank.

The final test examines the constancy of the individual elements of the cointegrating vectors. When the cointegration rank is greater than one the elements of the vectors can not be identified unless certain restrictions are imposed. However there is a unique relationship between the eigenvalues and the cointegrating vectors. Therefore the structural change will be reflected in the estimated eigenvalues when these vectors have undergone a structural change.

3.3 Granger Causality Tests

In order to examine the predictive abilities of different time series in the model, a Granger causality test will be applied after cointegration method is used. It allows the framework to test for the presence of unidirectional causality and bi-directional causality which can give more information about the short term relationship in comparison with cointegration analysis. Pairwise Granger (1969) causality tests are carried out to test whether an endogenous variable can be treated as exogenous. To implement the Granger test, we estimate the reduced form of VAR equation the reduced form of VAR equation by equation as follows:

$$Y_t = \sum_{i=1}^{k} a_i Y_{t-i} + \sum_{i=1}^{k} b_i X_{t-i} + u_t$$

X and Y are stock market index levels. The Granger test regresses index Y on lagged index Y and lagged index X. The Granger F-statistic tests the null hypothesis that index X does not Granger cause or predict index Y in above equation. The null is rejected if the coefficients b_i, are significantly different from zero. Then we can conclude that the lagged right-hand side variable has significant linear predictive power (granger-cause) for the left-hand side variable. The estimation of the VAR model requires the variables to be unit root free and non-cointegrated.

4. Empirical Results

4.1 Unit Root Tests Results
(the first and second order instability test of price indices level)

In addition to the Zivot and Andrews (1992) test over the full sample, we also subject each index to an Augmented Dickey-Fuller (ADF) unit root test for the first and second order stability of share price indices. The relevant test statistics for the ADF, Zivot and Andrews (1992) analyses of stationarity for each share price index are shown on Table 2.

From the ADF tests on Table 2, it is clear that the null hypothesis of a unit root in all prices in levels at the 1 percent level of significance cannot be rejected. However, the Shanghai series is exceptionally significant at the 5 percent level. These results overwhelmingly support the suggestion that stock prices are non-stationary processes in levels. This finding is consistent with the finds of Kasa (1992) and Blackman et al (1994) that equity market prices, in general, contain a unit root in their levels form. ADF unit root tests, using the first difference of each series, were also conducted to test for higher orders of integration. None of these tests for higher order integration reject the null hypothesis that all share market price indices are I(1) at the one percent level of significance. Overall, the unit root tests do not indicate any significant evidence to reject the hypothesis that all indices are I(1).

The results of Zivot and Andrews tests are reported on Table 2 and suggest that all stock series are non-stationary allowing for a break in the level and trend of the time series except for the Shanghai market at the 5 percent significance level. According to estimated test statistics based on Zivot and Andrews test, the break points occurred during sample period in the most time series are supported by visual inspection of the graphs shown on Figure 1.

The unit root test results shown on Table 2 indicate that most stock indices are integrated of order one suggesting that the analysis should proceed to cointegration and error correction model tests of long-run relationships between share price movements.

4.2 Bivariate Cointegration Test
(The first and second order instability test of long run relationship)

The unit root test statistics reveal that each series is nonstationary in log levels but stationary in log first differences. Given the common properties of the share price indices, all indices are stationary after applying differencing only once, like many macroeconomic variables. The relationships between Chinese markets with other international share markets are initially investigated using bivariate techniques. As mentioned in previous chapter, Shanghai series representative Chinese markets. There will be seven different individual pairings, and therefore seven VAR models.

The Johansen bivariate cointegration test is used to obtain the rank of the cointegration vector after the lag length is identified via LR tests. An intercept and no trend are specified for the cointegration equation. Eigenvalues and corresponding trace and maximum-eigenvalue statistics are detailed on Table 3.

The test statistics on Table 3 for the bivariate relationship between China and four other markets: Hong Kong, Korea, Australia and the US are significant according to the critical values provided by Johansen Nielsen(1993). This implies that there are long-term cointegration relations existing between the Shanghai market and markets in Hong Kong, Korea, Australia and the US. However, the relationships involving China and the remaining markets are not cointegrated.

Diagnostic tests were undertaken to check the residuals for all indices and the results of these tests are shown on Table 4. The critical values of the Johansen cointegration test on Table 3 were conducted subject to the assumption of normal innovations (the error terms of time series have constant variance and the correlation between error terms does not change over time). Therefore, deviations from assumption properties affect the results adversely. It is necessary to test whether the assumptions are sustainable or not in this case studied.

On Table 4, LM tests for first and fourth order autocorrelation do not indicate its presence in the residuals for the models and suggest that the lag length in each model has captured serial correlation effectively. The test of normality is based on a multivariate version of the univariate Shenton-Bowman test, see Doornik & Hansen (1994). This confirms the results of the Jaque-Bera test shown on Table 1.

4.3 *Granger Causality Analysis*

In Table 2 and Table 3 we reported unit root and bivariate cointegration test. As can be seen all variables are stationary and three pairs of variable are not cointegrated. This made the causality analysis possible to find out the predictability of each price index particularly if the Shanghai index has a significant effect on other international price indices (Taiwan, Singapore and Japan) or if these international price indices have a significant effect on Shanghai price index we are interested in this study.

It clearly shows from Table 5 that causality from the Shanghai index to every other three remaining indices are not significant during the whole sample period. Interesting findings of linkage here are that the changes of every other market index are strong Granger-cause change of Shanghai market. The strong form of causality is evident running from Taiwan to Shanghai. The causal influence of the Singapore market on Shanghai market is also obviously observed even it is not strong as the causality from Taiwan. In addition, Japan market change Granger-cause change of Shanghai market at the highest significant level in comparison with Taiwan and Singapore.

4.4 *Multivariate Cointegration Analysis Results*

The bivariate analysis completed in the previous section cannot reveal the full extent of the long run relationships existing among the full set of share price indices. We require a multivariate cointegration analysis to achieve this purpose. The results from this multivariate study will indicate the number of cointegration vectors present and if the number of these is equal to the number of individual series (8 series in this case), then the eight share market are perfectly integrated: see Cooray and Felmingham (2004). If these markets are perfectly cointegrated then there is an apparent opportunity for share market investors to diversify away systemic risks, so the information provided by the multivariate analysis will provide important information for the international investors.

Results of the rank test for multivariate variables appear on Table 6. The maximal eigenvalues shown on Table 6 suggests that there is at most a single cointegration vector or analogously seven independent common stochastic trends within this eight-variable system. But the trace test statistic indicates two cointegration relationships in this system of eight markets, meaning these markets share six common trends over the sample period.

The Johansen cointegration test is applied based on the normal innovations of the vector autogressive model (the error terms of time series have constant variance and the correlation between error terms does not change over time). Therefore, violations from assumption properties influence the results adversely. So diagnostic tests are required to check the characteristics of the residuals in the multivariate case as well. The results are presented on Table 7. The LM statistic indicates that the optimal lag structure has captured serial correlation adequately. Non-normality and heteroskedasticity are statistically significant as they are in the bivariate case.

4.5 Cointegrating Vector Parameter's Constancy Test (the second order test for instability of long run relationship)

The number of cointegrating vectors resulted from above section is based on the assumption that the number of cointegrating vectors is fixed and the speed-of-adjustment coefficient of the error correction term (α) is constant over all sample periods. If the number of cointegrating vectors in the economic system changes over time because structural break occurs in the sample period, the rank will vary consequently. Both long-term and short-run coefficients in the Error-correction model may change as well. Accordingly the chance of conflicting trace and max eigenvalue statistics results will increase. In this case the Trace

Statistic 127.28 rejects the null hypothesis that there is one cointegration relation but max eigenvalue 41.82 is not significant enough to reject the null hypothesis.

This conflict may be explained by structural breaks which determine second order instability of long run relationship. This problem can be resolved by conducting diagnostic test advocated by Hansen and Johansen (1993) to ensure the robustness of the test results and the reliability of subsequent inferences. A structural break occurring in the sample period can be captured by recursive cointegration tests presented in Graph 3,4 and 5, 6 regard for rank test, cointegration vector test and individual elements of cointegration vectors test respectively.

On Graph 3, the recursive trace statistics are normalized using their 10% critical values such that the values exceeding 1 indicate statistical significance at the 10% level, while the number of lines above 1 are the number of cointegrating vectors observed plotted against time.* In this case, a two-year period between 1992:1:02 and 1994:7:18 is used as the initial estimation period. The plots of the recursive trace statistics over the period 1994:7:19 through 2004:7:16 are shown on Graph 3. The upper line in the graphs show the path of tests for $H\left(r \leq 0/r=8\right)$ and the lower line in the graph shows the path of tests for $H\left(r \leq 7/r=8\right)$. The first cointegrating vector is statistically significant indicating that eight time series are linked together by one cointegration vector and according driven by seven common stochastic trends. However the significant of second cointegration vector after 2003 show that this group are linked together by two cointegration vectors. On the other hand, the third cointegrating vector emerging after approximately year 2004 to become statistically significant need more time to be proved as one of the vectors joining markets together. In the common trends framework such findings are to be interpreted as signs of increased convergence as the data generating process is then characterized by an increasing number of cointegration vectors and correspondingly that the share price series are increasingly driven by the same relatively few shocks with a permanent effect (Jesper Rangvid, 2001). So we draw the conclusion that a system consisting of eight non-stationary time series is driven by six common stochastic trends and linked together by two cointegration vector. However we need to note here that all of the cointegrating vectors are upward sloping after late 2003 and the values of the recursive trace statistics continue to increase hereafter. There seems to be a tendency for fewer and fewer stochastic trends to drive the whole system as the sample period is extended. So we could say that these eight markets have become increasingly convergent over time.

Graph 4 shows Hansen-Johensen (1993) recursive analysis tests result for stability of the parameter of cointegration vector, beta, giving one cointegration vector. The test statistic has been scaled by the normalized using their 5% critical values such that the values exceeding 1 indicate statistical significance at the 5% level, while the line above 1 means the inconstancy of beta. The numbers in vertical axis show chi-square value. The test statistic is a chi-square distributed with (p – r)r degrees of freedom, where p, 8 stands for the number of endogenous variables and r, 1 for the cointegration rank. Rejection of the null hypothesis in the middle of 1998 indicates rejection of parameter constancy. In other words, there is evidence of temporal instability in the long run. Additionally the results suggested that there is break in the cointegrating vector which is identified as 7th September 1998 which coincides with the outbreak of Asian crisis. These results confirm the conclusions of Meric and Meric (1997) (and other researchers) that there is a long-term persistent rise in the co-movement of equity markets following the Asian crisis. These breaks are partially supported by visual inspection of graph 1 in terms of slumping indices at the time of Asian Crisis. However these break points confute the breaks found in the unit root test(see Table 1) confirming the fact that the single individual time series breaks are not necessary same with the combination of number of time series.

In order to get an appropriate reference of impact of structural break on cointegration number, we also test the stability of the parameter of cointegration vector when there are two cointegration vectors. The results shown on Graph 5 clearly indicate that there is no evidence of temporal instability in the long run giving two cointegration vectors.

Finally with the last test, Graph 6 shows the time paths of the non-zero eigenvalues with 95% confidence bands giving two cointegration vectors. We get strong support favour of the constancy of the cointegration vector since the path of the respective Eigenvalue didn't present any break point. However it is observed that some observations-especially in the period around 1998-have a large impact on the parameter estimates.

Hence, based on the overall evidence of the three tests we argue that the estimated cointegrating vector does display instabilities in recursive estimation.

4.6 Exclusion Test

Giving two cointegration vectors among 8 market indices from the preceding analyses, a test of whether cointegration is achieved through the adjustment of all indices proceeds according to the method described above. Zero restrictions are placed upon each of the coefficients of cointegrating vector in Johansen's procedure and the results are shown on Table 8.

The likelihood ratio tests indicate that all these restrictions are rejected except or the Shanghai and US market and further indicate that the Shanghai and US share indices can be individually excluded from the cointegrating vectors at the .05 level. This implies that all of the markets enter the cointegrating vector at a statistically significant level except for the Shanghai and S&P 500 Composite Index. In general, these results indicate that most markets adjust in a significant fashion to clear any short run disequilibrium. In addition the largest coefficient is related to the Singapore index followed by the coefficient for Hong Kong, while the smallest coefficient is the US index indicating that Singapore and HK react quickly to adjust towards a long run relationship in this eight-country system.

Based on the likelihood ratio test statistics above, the null hypothesis that the Shanghai and US stock indices are not part of the equilibrium relations cannot be rejected at the 0.05 level across all possible vector relationships, suggesting that the VAR be reconstructed without these two indices. So the Johansen cointegration test is conducted again using six variables in the VAR system without the Shanghai and US markets. This revised cointegration results appear on Table 9 indicating that there is one long run relationship based on both trace and max eigenvalue statistics. The comparative results from the eight-country system and six-country system without Shanghai and US suggest that there exists a geographical separation between of US and Asia Pacific markets. Additionally, China's share market here appears to be relatively isolated from most world markets which will be also tested in later analysis.

4.7 Exogeneity Test

Following the result that the Shanghai and US market do not enter the long run relationship as identified by the exclusion test, a further test of the role of speed adjustment parameter is carried out to find out which index not responsive to disequilibria and form one of the p - r common stochastic trends.

Based on the present two cointegrating vectors among all eight indices, there must be 6 common stochastic trends. The null hypothesis that the stock indices of Shanghai, Taiwan, Korea, Australia and Japan are individually weakly exogenous cannot be rejected at the .05 level. Each of them is irresponsive to disequilibria and is one of the (p-r) common stochastic trends.

So we infer from these weak exogenity test results that any of these countries, namely, Shanghai, Taiwan, Korea, Australia and Japan do not display any short term adjustment to equilibrium. However, Taiwan, Korea, Australia and Japan do have a long run, but not a significant short run relationship.

Combined with our earlier exclusion test results which show that the Shanghai market does not share linkages with other markets through an error-correction channel of causality, we can draw the conclusion that the Shanghai market does not exert a significant influence on other markets in the short as well as the long run.

For other markets, particularly, not significantly weakly exogenous ones, they do not adjust to clear short run equilibria although they are form part of the error correlation process.

We still cannot assume that all five of these markets(Shanghai, Taiwan, Korea, Australia and Japan) which are not statistically significant in exogenous tests are non-causal and totally exogenous because the short-run channels via the coefficient of difference of variable (Γ in equation (2)) are still active.

The significance of US market indicates that it seems the most likely link to other markets via short-term channels even if does not involve the long run relationship of system of an eight share price indices.

The above results are drawn from equation 3 defined as model 1 which allows a deterministic trend in the level but not in the cointegration relations. In order to get accurate inferences from the coefficient in the models allowing different specifications of the deterministic components, another two models arising from restriction on the deterministic components are also needed to be investigated. The model allowing intercepts in the cointegration relations is referred model 2. The model allowing a deterministic trend in the level as well as in the cointegration relations is defined as model 3.

Calculated eigenvalues, the trace test and the corresponding critical values under each model specifications are listed on Table 11. These results can be used to determine if a trend in the cointegration relations is included and whether this including affects our rank selection greatly. It is clearly shown in Table 11 that all the statistics are consistent in these three models with different specifications suggesting that the rank test is not sensitive to the deterministic components included.

5. Implications

Whether these eight markets converge or not is an important question since portfolio investment strategies will depend on the degree of integration of these financial markets. Multivariate cointegration results show that the Chinese markets are cointegrated in the system. However, market exclusion tests indicate that Chinese market is indeed minimally integrated with world markets, offering substantial potential for risk reduction in the Shanghai market.

Exposure to the Australia and US markets do not appear to provide substantial diversification benefits opportunity for Chinese investors in the long term.

Common trend between the markets of China and Hong Kong does not surprise because of the increasingly close relationship in trade and politics particularly after 1997 when Hong Kong returned to China. Yong Miao Hong (2003) finds that there exists significant risk spillovers between Shares B (the share designed for foreign investors trading in foreign currencies) and the market in Hong Kong. In fact, a strong relationship between Share B and international markets is expected because B Shares are more sensitive to the fluctuations of foreign markets. This issue is beyond our scope in this study and will not be discussed further.

Singapore and Korea, two newly industrialized markets in East Asia, have different ties with the Shanghai market. Stronger common trend between Shanghai and Korea exist in comparison with the common trend between Shanghai and Singapore. This may be due to the stronger economics link between China and Korea. China has become the third largest trading partner of Korea at the end of 2002, while Korea's total direct investment in China constitutes about one third of Korea's total outward foreign direct investment. Economic ties reinforce the relationship between the two share markets.

The lack of cointegration between the Shanghai and other markets in the group suggest that the Shanghai market is an attractive market for achieving international diversification. They should balance their long-run investment on the markets of Taiwan, Singapore and Japan compared with those of Hong Kong, Korea, Australia and US.

It is interesting to determine if there is a cointegration relationship between China and the US or Japan. Since Japan is a major investor and trading partner of China, a share market relationship with Japan may exist. Similarly, because of its economic influence and market size, the US impact on China's market could be expected. From the results of the bivariate cointegration, China's share market does not share a common trend with Japan in the share market. Instead, the bivariate cointegration test is strongly statistically leading to the rejection of the significant to against the null hypnosis that there are no cointegration vectors between China's share market and US share market. So basically, it could be said that Chinese market belongs to the markets those which are moved with US. The fact that the Japan market is not cointegrated with the Chinese market doesn't mean the Japan market lost its interests to investors. Instead, Japan market is still attractive to Chinese investors because of its size and liquidity. So compared with Japan, US market is more likely to affect Chinese market.

It should be noted in addition that Chinese companies are allowed to go beyond traditional domestic equity-financing channels to raise capital by listing in overseas capital markets such as the Hong Kong and New York stock exchanges. The existence of foreign listing shares in these two markets certainty reinforces their long run equilibrium relationships with China's share market.

The structural break identified among eight markets coincides with the Asian crisis period. The increasing strength of cointegration relationships time (after the late of 2003) reflects the higher extent of economic interdependence among the eight countries following Asian crisis. Continuing upward growing trend with the extended period after 2004 indicates the more difficulties to maintain the benefits from international portfolio diversification. The results in this study consistent with the conclusions of Sorin and Burton (2001) that the co-movement of global equity markets increase after the Asian Crisis.

Also it is noticed that all the stock markets except Shanghai and US enter the long run relationship suggesting that there may exists a geographical separation between the US and Asia-Pacific markets. Additionally, china's share market is relatively isolated from most world markets in the long run.

The stock indices of Shanghai, Taiwan, Korea, Australia and Japan are individually weakly exogenous and each of them is irresponsive to disequilibria. Therefore these five countries offer good investment diversify in the short run.

It is true that segmented financial markets present greater opportunities for investors to improve their risk-adjusted returns in comparison with integrated financial markets. However, investors diversifying their portfolios internationally may earn a higher rate of return for any given level of risk than they could achieve by holding a purely domestic portfolio. Some investment barriers such as restrictions on capital movements have made it hard to fully realise the benefits of diversification. No wonder there is still strong home country bias that investor still hold a substantial domestic assets portion as explained by Tesar and Werner (1995). Tesar and Werner use data on international financial transactions across five OECD countries including the US,UK, Canada, Germany and Japan and find evidence of a home bias in portfolio compositions for investors in all the five countries they examine. While investors have increased their holdings of foreign stocks in recent years, the fraction of the portfolio invested abroad remains far less than the share implied by standard models of optimal portfolio choice. Particularly, when foreign investors facing Chinese stock markets, the problems with international diversification like currency risk, information costs, controls to the free flow of capital and political risk need to be considered seriously as well as portfolio returns.

Therefore, two factors were seen as driving foreign investment toward emerging markets. One is investor's desire for portfolio diversification and higher profits. Another is macroeconomic and structural reform in developing countries. Sensible investors prefer for countries with sound policies. Stringent capital controls and lack of convertible currency make Chinese market not favourable to some investors who pursue low risk in the markets. Such investors wait for further reforms of China's economy such as freeing up A Shares market to foreign investors. The history of stock markets' development in the world shows that financial market liberalization particularly the relaxation of rules constraining foreign investors contributed greatly to the surge of stock market. So the openness of Chinese stock market to the foreign investors is a biggest challenge for maintaining the continuous high speed growth of stock markets. The empirical evidence suggests that rapid development in the Chinese share markets has succeed over the past few years, but it is acknowledged that China's share market is not as developed and open as some other international markets. On the other hand, investors who are willing to accept higher risk in search of high return will favour the China's share markets.

*note: Due to some technical limitations, the software we use(CATS in RATS 6.0) only produces plots of trace test statistics using built-in 10 percent critical values. However, the use of the 5 percent significance level does not change the inference reported below.

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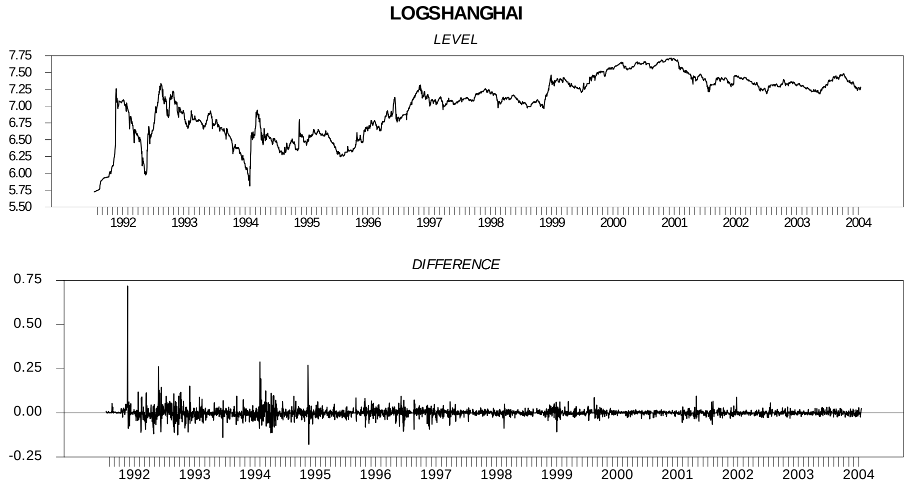
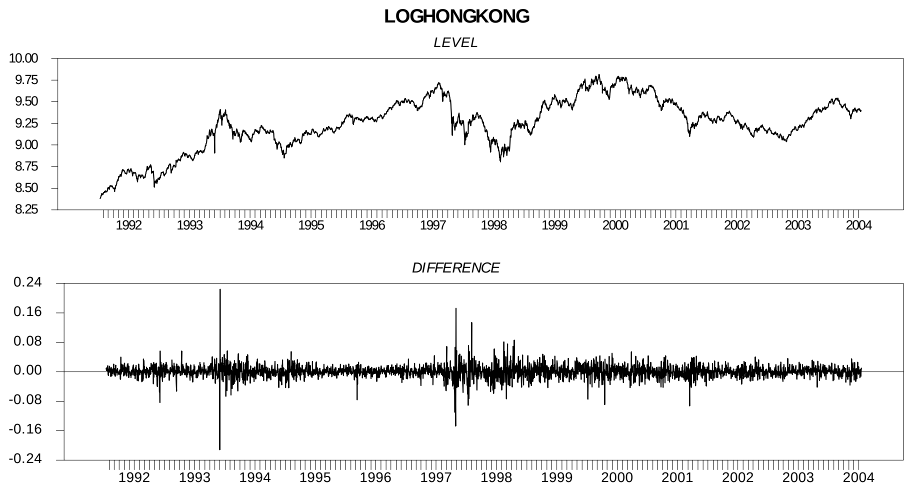
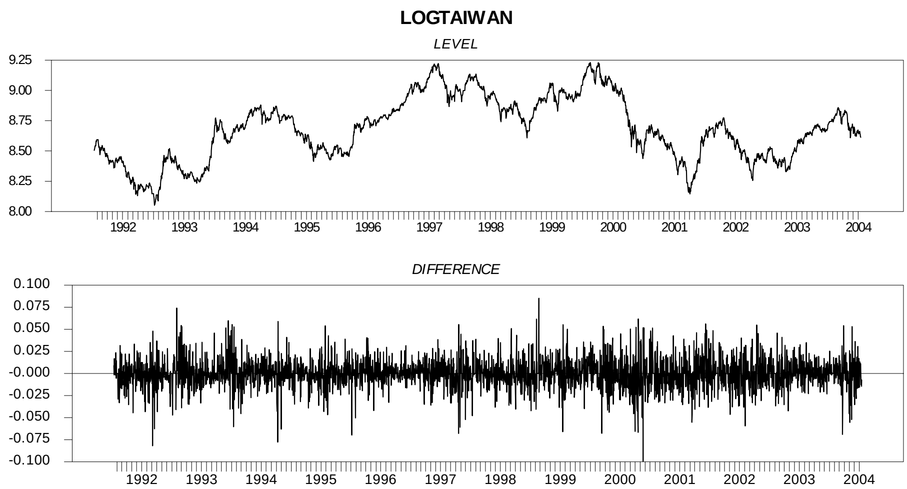
Graph 1. Nine Share Markets Indices







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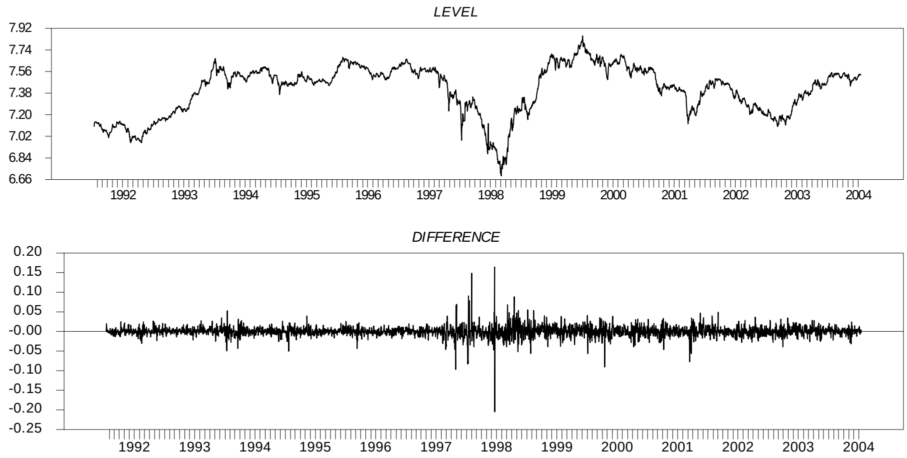

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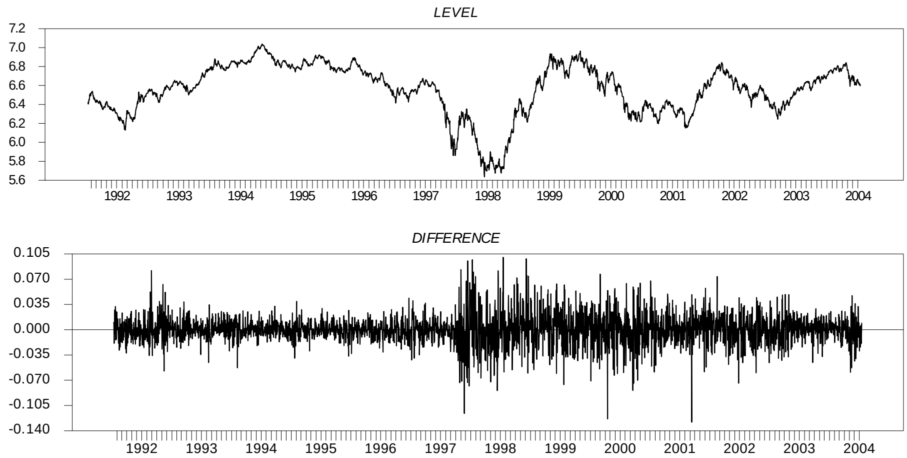

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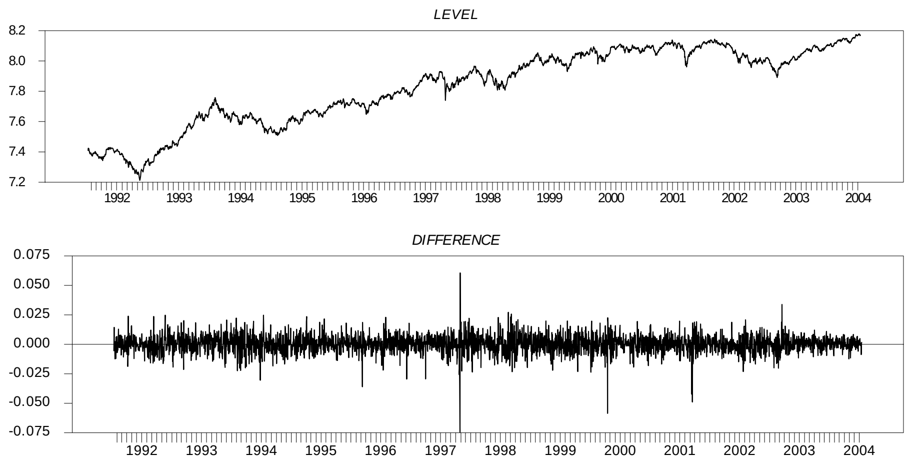

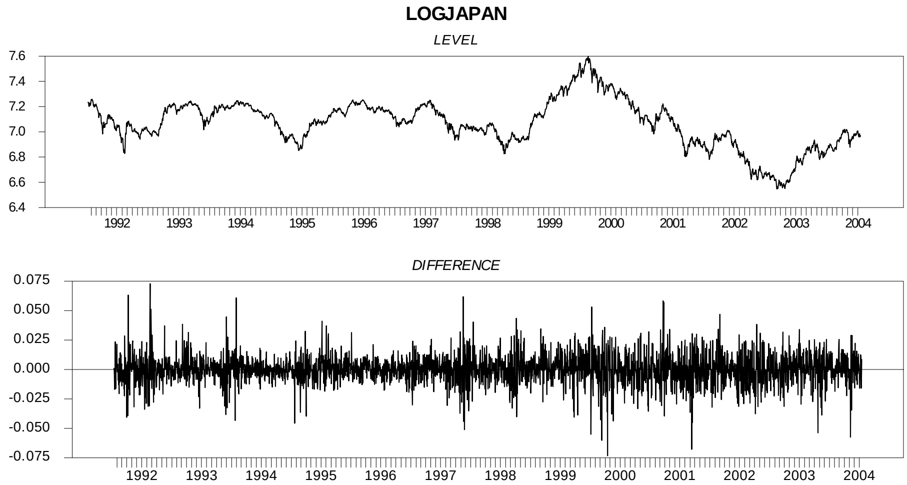
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7.0
6.8
6.6
6.4
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0.000
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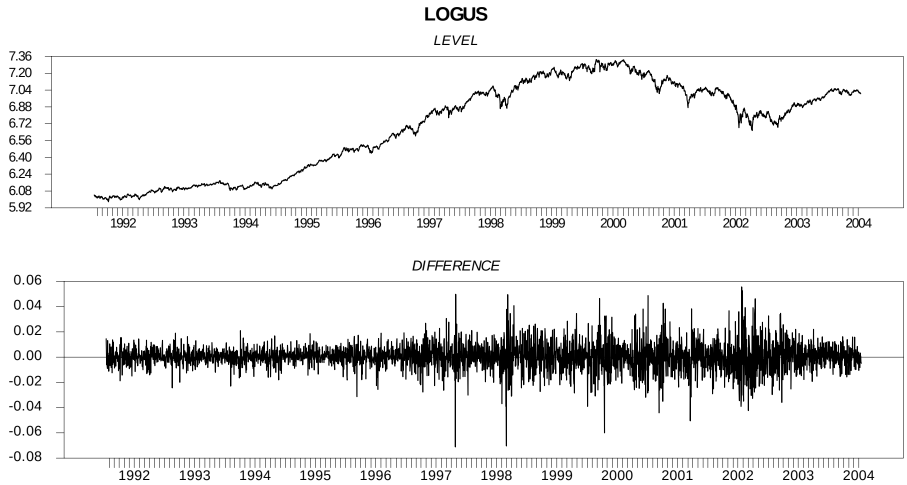
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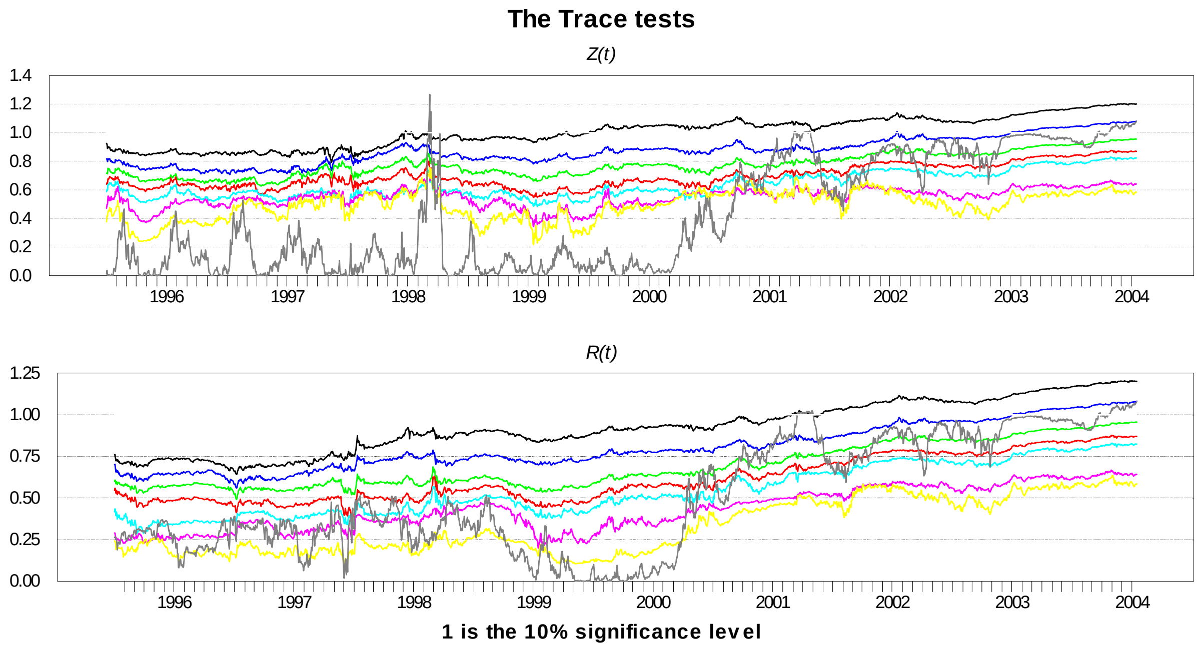
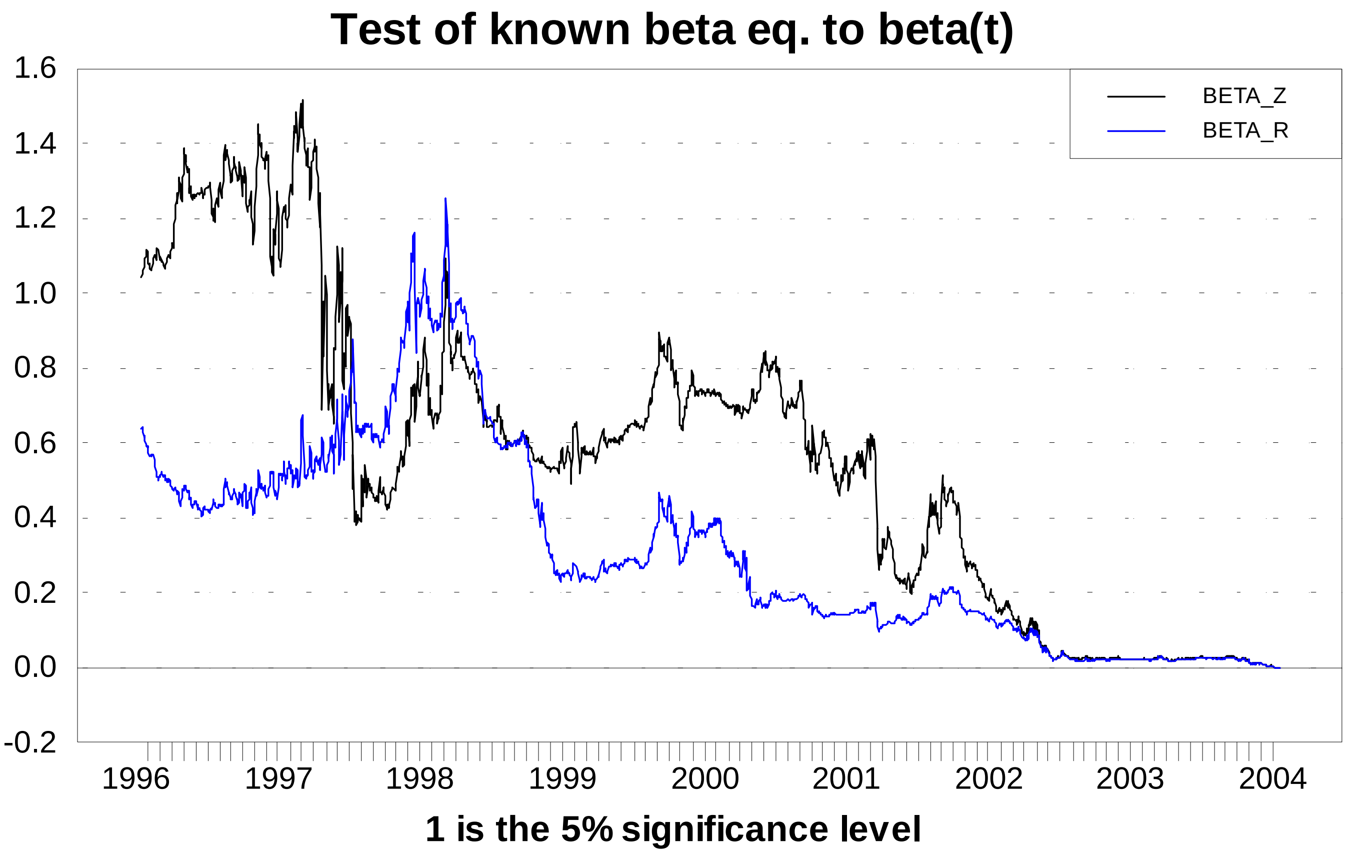
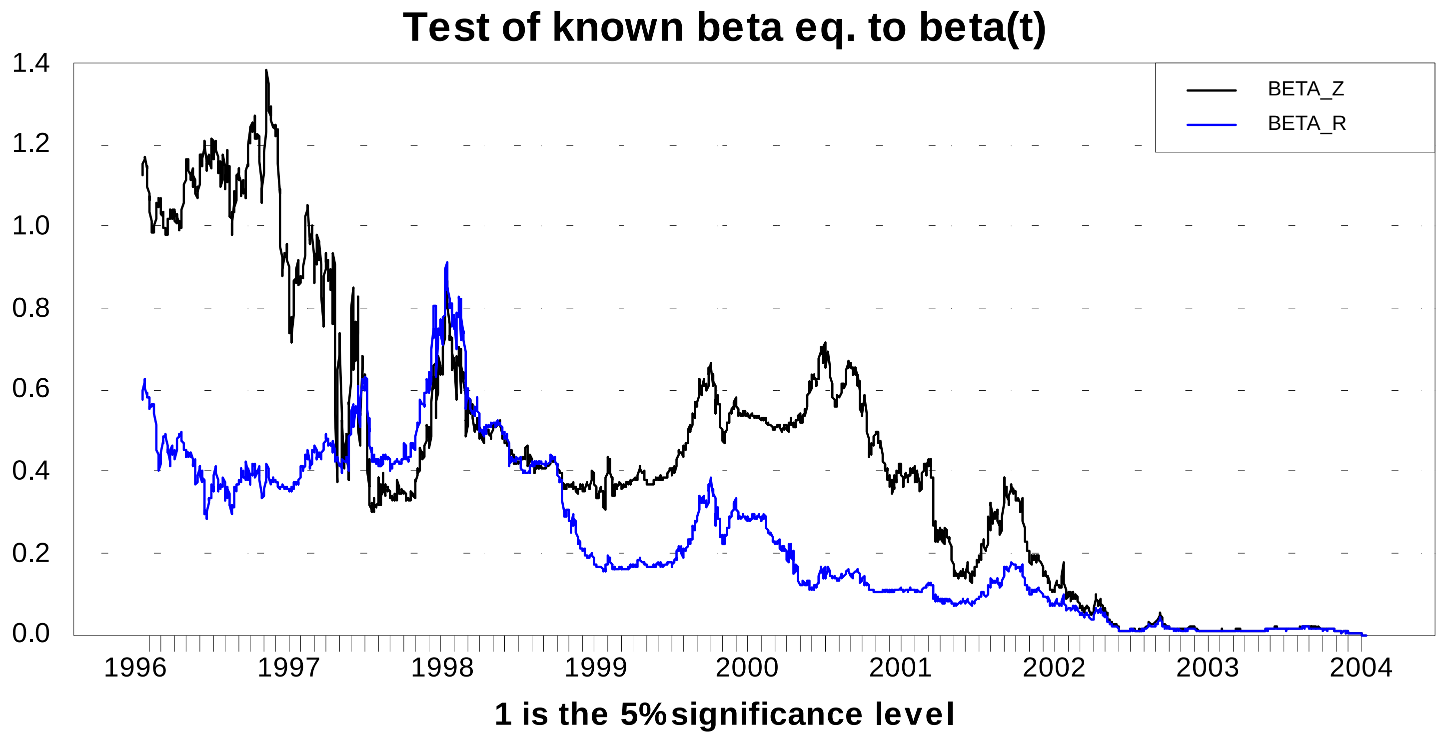


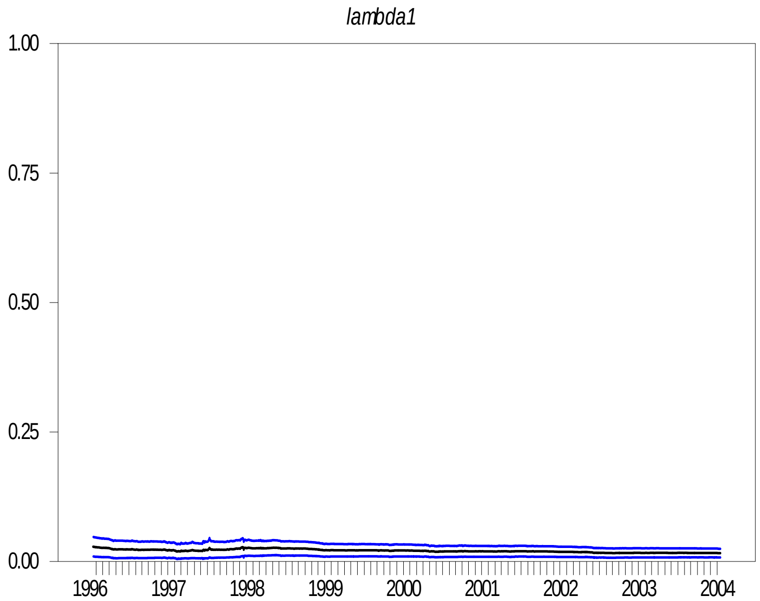
Graph 2. Eight International markets cointegration trace statistic

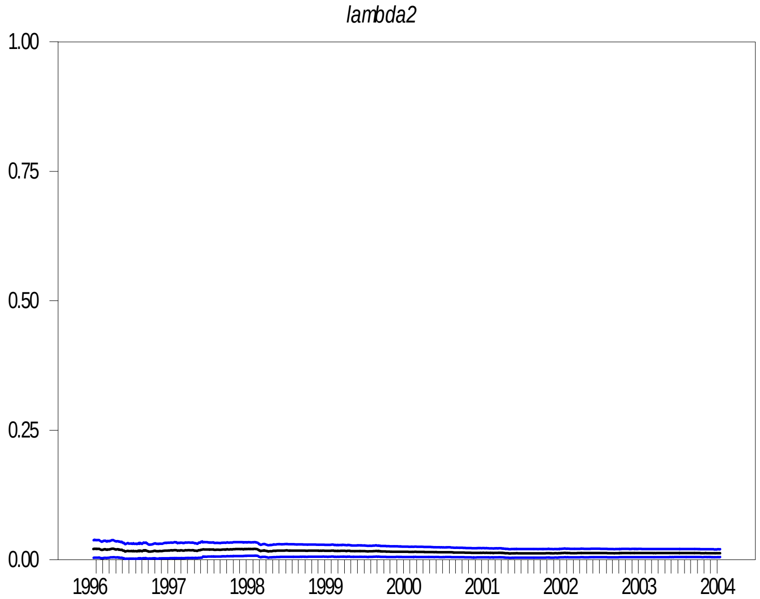


Graph 4 Beta stability test giving one cointegration vector



Graph 5 Beta stability test giving two cointegration vectors





Graph 6 The non-zero Eigenvalue

Table 1. Summary statistics for eight SPI

	SHANGHAI	AUSTRALIA	HK	JAPAN	KOREA	SINGAPORE	TAIWAN	US
Mean	7.018059	7.830142	8.4737	7.065098	6.555227	7.406646	8.681428	6.692235
Median	7.108874	7.890863	8.908876	7.074997	6.589848	7.463707	8.681127	6.822001
Maximum	7.715306	8.178302	9.738737	7.598179	7.037686	7.85668	9.230359	7.331362
Minimum	5.682729	7.212737	6.938566	6.546742	5.63479	6.690892	8.05056	5.977619
Std. Dev.	0.441793	0.245334	0.933263	0.186673	0.266606	0.205019	0.256925	0.427096
Skewness	-0.684855	-0.568868	-0.424315	-0.26295	-0.94918	-0.740991	-0.01021	-0.29612
Kurtosis	2.795149	2.170011	1.457278	3.348335	3.932791	2.922512	2.247511	1.598499
Jarque Bera	261.497	270.3934	422.6554	54.24775	609.9362	300.2435	77.25426	315.6041
Probability	0	0	0	0	0	0	0	0
Sum	22963.09	25620.23	27725.95	23117	21448.7	24234.55	28405.63	21896.99
Sum Sq. Dev.	638.4362	196.8769	2848.973	113.9842	232.4994	137.4892	215.9204	596.6675
Obs.no	3272	3272	3272	3272	3272	3272	3272	3272

Table 2. Unit root test results for seven international daily series

	ADF		Zivot & Andrews			Perron test(1997)		
	Levels	*Returns*	T_B	*k*	t_a	T_B	*k*	t_a
Shanghai	-3.182**	-10.6339***	1996:06:04	28	-5.46235**	1996:05:29	12	-5.08940**
Hong Kong	-1.072	-12.9396***	2002:01:17	5	-4.36358	2001:02:13	10	-3.58705
Taiwan	-2.252	-12.9396***	2000:08:22	15	-4.47492	2000:08:18	12	-4.19577
Singapore	-2.343	-52.7958***	1997:02:18	1	-2.67476	1992:10:21	7	-2.85549
Japan	-2.263	-51.6529***	1999:03:03	1	-3.59433	1999:03:01	6	-3.36523
Korea	-2.29	-54.0229***	1996:05:08	1	-3.13246	1996:05:06	5	-2.95172
Australia	-1.188	-55.1845***	1998:10:16	1	-4.02099	2002:05:29	12	-3.97860
US	-1.4	-15.8872***	1998:10:09	13	-3.7554	1998:10:07	11	-3.71800
1% Critical Value	-3.4447	-5.57	-5.57					
5% Critical Value	-2.8671		-4.91			-5.08		
10% Critical Value	-2.5697		-4.59			-4.82		

T_B denotes the break date suggested by t_a. *k* means the optimal lag number. *** significant at 1 percent and ** significant at 5 percent.

Table 3 Bivariate Cointegration Test Results

	Eigenvalue	Trace Statistic	Max-Eigenvalue Statistic
Shanghai & Hong Kong			
None	0.0052	18.3901*	17.0841*
At most 1	0.0004	1.306	1.306
Shanghai & Taiwan			
	Eigenvalue	Trace Statistic	Max-Eigenvalue Statistic
None	0.0034	15.1493	11.0124
At most 1	0.0013	4.1368	4.1368
Shanghai & Singapore			
	Eigenvalue	Trace Statistic	Max-Eigenvalue Statistic
None	0.0033	15.4019	10.6521
At most 1	0.0015	4.7498	4.7498
Shanghai & Japan			
	Eigenvalue	Trace Statistic	Max-Eigenvalue Statistic
None	0.003	14.7341	9.8252
At most 1	0.0015	4.9089	4.9089
Shanghai & Korea			
	Eigenvalue	Trace Statistic	Max-Eigenvalue Statistic
None	0.0035	16.1187*	11.5339*
At most 1	0.0014	4.5847	4.5847
Shanghai & Australia			
	Eigenvalue	Trace Statistic	Max-Eigenvalue Statistic
None	0.0056	20.2375*	18.2449*
At most 1	0.0006	1.9926	1.9926
Shanghai & US			
	Eigenvalue	Trace Statistic	Max-Eigenvalue Statistic
None	0.0071	24.7147*	23.1861*
At most 1	0.0005	1.5286	1.5286

Notes: The optimal lag structure for each of the VAR models was selected by minimising the Akaike's Information criteria(see table 4). Critical values used are sourced from Johansen & Nielsen(1993). * indicates rejection at the least at the 95% critical values for cointegration tests.

Table 4 Residual Tests for Bivariate VAR Models

	Shanghai & Hong Kong	Shanghai & Taiwan	Shanghai & Singapore	Shanghai & Japan	Shanghai & Korea	Shanghai & Australia	Shanghai & US
Lag Length	4	5	2	2	2	5	4
Log-likelihood	12670.02	15773.58	16330.92	16744.2	15172.53	18314.11	17304.16
	Serial Correlation LM Test H0: No serial correlation at one and four lags						
LM(1)	7.093(0.13)	5.918(0.21)	6.922(0.14)	8.153(0.09)	7.951(0.09)	4.197(0.38)	5.868(0.21)
LM(4)	6.520(0.16)	5.031(0.28)	4.487(0.34)	4.160(0.33)	5.358(0.25)	5.074(0.28)	6.223(0.18)
	Normality Test H0: Residuals are multivariate normal						
CHISQ(4)	13746.51(0.00)	6838.74(0.00)	17939.25(0.00)	6627.88(0.00)	6865.18(0.00)	7556.94(0.00)	6787.8(0.00)
	Heteroskedasticity Test H0: No Heteroskedacity with degrees of 24						
WHITE	67.61(0.00)	91.99(0.00)	243.89(0.00)	108.34(0.00)	240.36 (0.00)	165.05(0.00)	250.07(0.00)
	Univariate ARCH LM test H0: no ARCH effects at the corresponding lags						
	SH HK	SH TW	SH SI	SH JP	SH KR	SH AUS	SH US
LM	11.931 725.06	13.48 114.4	4.23 431.29	4.18 115.65	4.23 147.19	4.25 222.58	11.26 263.91

Note: SH, HK, TW, SI, JP, KR, AUS and US represent the test statistics for the index level of Shanghai, Hong Kong,Taiwan, Singapore ,Japan,Korea,Australia and United State respectively.

Table 5 Granger Causality Tests

null hypohesis of direction of causality	total Period (01/90-07/04)
SH→TW	0.89002
TW→SH	16.20799***
SH→SI	0.13879
SI→SH	15.16748***
SH→JP	0.23056
JP→SH	20.57673***

Note: SH, TW, SI and JP represent the test statistics for the index level of Shanghai, Taiwan, Singapore and Japan respectively. Optimal lag number for each bivariate VAR model (SH&TW, SH&SI, SH&JP) are 5,2,2 respectively.SH→TW indicates that changes in SH contains leading information for changes in TW(changes in SH Granger causes changes in TW, or changes in TW lags is influenced by changes in SH). The optimal lag structure for each of the VAR models was selected by minimising the Akaike's Information criteria. *** indicates rejection at the least at the 95% critical values for cointegration tests.

Table 6. Johansen Tests for Multiple Cointegrating Vectors for Eight Markets

Hypotheses H0 and H1	Eigenvalues	Trace Statistic	0.05 Critical Value	Max Eigenvalue Statistic	0.05 Critical Value
$r = 0$ $r > 0$	0.0161	180.15*	159.5297	52.86*	52.36261
$r \leq 1$ $r > 1$	0.0127	127.28*	125.6154	41.84	46.23142
$r \leq 2$ $r > 2$	0.0089	85.44	95.75366	29.10	40.07757
$r \leq 3$ $r > 3$	0.0062	56.34	69.81889	20.22	33.87687
$r \leq 4$ $r > 4$	0.0058	36.12	47.85613	18.99	27.58434
$r \leq 5$ $r > 5$	0.0029	17.12	29.79707	9.33	21.13162
$r \leq 6$ $r > 6$	0.0015	7.79	15.49471	4.87	14.26460
$r \leq 7$ $r = 8$	0.0009	2.92	3.841466	2.92	3.841466

Notes: The optimal lag structure for each of the VAR models was selected by minimising the Akaike's Information criteria. In the final analysis we use a lag of 8. Critical values used are sourced from Johansen & Nielsen(1993). * indicates rejection at the least at the 95% critical values for cointegration tests.

Table 7 Residual Tests for Multivariate VAR Models

VAR in error correlation form	
Optimal Lag Length	8
Log-Likelihood	124.3840
Serial Correlation LM Test H0:	
No serial correlation at 9 lags	
Df	64
LM(1) statistics	79.065
Probability	0.10
LM(4) statistics	65.109
Probability	0.44
Normality Test H0:	
Residuals are multivariate normal	
Df	16
Jacque-Bera Statistic	34924.022
Probability	0.0000
Heteroskedasticity Test H0:	
No Heteroskedasticity	
Df	1152
White Statistic	3467.615
Probability	0.0000

Table 8 TEST FOR EXCLUSION: LR TEST CHISQ(r)

R	CV.	SH	HK	TW	SI	KR	AUS	JP	US
1	3.84	4.23	9.50	4.34	10.66	9.98	1.54	0.18	0.77
2	5.99	4.66	21.77*	6.88*	21.90*	18.59*	9.21*	10.39*	0.84
3	7.81	12.45	27.24	7.02	28.73	21.69	9.66	14.09	2.82
4	9.49	13.8	28.37	7.41	28.83	22.90	10.32	14.69	3.39
5	11.07	21.74	38.00	16.83	38.14	32.34	17.65	23.88	12.80
6	12.59	26.13	41.85	19.83	42.54	36.67	19.48	26.24	14.83
7	14.07	27.92	43.75	21.70	44.48	38.47	21.40	28.10	15.88

Notes: The optimal lag structure for each of the VAR models was selected by minimising the Akaike's Information criteria. Critical values used are sourced from Johansen(1988,1991,1994b). * indicates rejection at the least at the 95% critical values for cointegration tests. Note: SH, HK, TW, SI, JP, KR, AUS and US represent the test statistics for the index level of Shanghai, Hong Kong,Taiwan, Singapore ,Japan,Korea,Australia and United State respectively.

Table 10 TEST FOR WEAK-EXOGENEITY: LR TEST CHISQ(r)

R	CV	. SH	HK	TW	SI	KR	AUS	JP	US
1	3.84	0.93	0.09	0.03	8.15	1.18	0.22	0.02	1.26
2	5.99	1.49	10.97*	0.03	20.87*	1.27	0.27	0.46	8.35*
3	7.81	10.36	12.71	0.57	24.95	2.63	0.33	0.77	12.89
4	9.49	11.56	13.63	0.82	25.01	3.13	0.43	1.43	13.72
5	11.07	18.67	19.08	5.42	32.62	8.04	6.83	10.94	16.03
6	12.59	21.03	22.30	7.73	36.11	11.37	8.37	12.51	19.30
7	14.07	21.93	22.54	7.75	37.15	13.32	10.28	14.46	19.35

Note: SH, HK, TW, SI, JP, KR, AUS and US represent the test statistics for the index level of Shanghai, Hong Kong,Taiwan, Singapore, Japan, Korea, Australia and United State respectively.

Table 9. Johansen Tests for Multiple Cointegrating Vectors for Six Markets (without Shanghai & US)

Hypotheses H0 and H1	Eigenvalues	Trace Statistic	0.05 Critical Value	Max Eigenvalue Statistic	0.05 Critical Value
$r \leq 1$ $r > 1$	0.0145	107.37*	95.75366	47.66*	40.07757
$r \leq 2$ $r > 2$	0.0094	59.71	69.81889	30.81	33.87687
$r \leq 3$ $r > 3$	0.0042	28.90	47.85613	13.86	27.58434
$r \leq 4$ $r > 4$	0.0022	15.04	29.79707	7.30	21.13162
$r \leq 5$ $r > 5$	0.0015	7.74	15.49471	4.99	14.26460
$r \leq 6$ $r > 6$	0.0008	2.76	3.841466	2.76	3.841466

Notes: The optimal lag structure for each of the VAR models was selected by minimising the Akaike's Information criteria. In the final analysis we use a lag of 8. Critical values used are sourced from Johansen& Nielsen(1993). * indicates rejection at the least at the 95% critical values for cointegration tests.

Table 11 Model specifications for the deterministic components

r	Model 1				Model 2			Model 3	
	E	Trace	CV	Ei	Trace	CV	Eig	Trace	CV
0	0.0161	187.738	159.736	0.0161	180.146	149.991	0.0169	201.091	176.126
1	0.0129	134.801	126.713	0.0127	127.281	117.732	0.0129	145.398	141.308
2	0.0092	92.266	97.170	0.0089	85.437	89.371	0.0099	103.074	109.997
3	0.0062	62.204	71.659	0.0062	56.338	64.742	0.0078	70.447	82.680
4	0.0060	41.909	49.915	0.0058	36.116	43.844	0.0061	44.736	58.958
5	0.0037	22.240	31.883	0.0029	17.123	31.883	0.0041	24.658	26.699
6	0.0021	9.985	17.794	0.0015	7.789	13.308	0.0025	11.163	22.946
7	0.0009	3.028	7.503	0.0009	2.918	2.706	0.0009	2.924	10.558

Note: a deterministic trend in the levels is allowed in model 1.Only intercepts in the cointegration relations includes is referred model 2. Allowing a deterministic trend in the level as well as in the cointegration relations is defined as model 3. The optimal lag structure for each of the VAR models was selected by minimising the Akaike's Information criteria. In the final analysis we use a lag of 8. Critical values used are sourced from Johansen& Nielsen(1993). * indicates rejection at the least at the 95% critical values for cointegration tests.

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