1-1-2007

Are Chinese stock markets increasing integration with other markets in the greater China region and other major markets?

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Keywords

International Financial Markets, Causality testing in VARs, Cointegration

Disciplines

Business | Social and Behavioral Sciences

Publication Details

This paper was originally published as: Tian, G, Are Chinese stock markets increasing integration with other markets in the greater China region and other major markets?, Australian Economics Papers, 46(3), 2007, 240-53. The definitive version is available at www.blackwell-synergy.com.

Are Chinese stock markets increasing integration with other markets in the greater China region and other major markets?

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ABSTRACT:

This paper investigates the cointegrating and long-term causal relationships between the Shanghai A and B-share market, and between these two markets and the Hong Kong, the Taiwanese, the Japanese and the US market of two sub periods between July 1993 and March 2007. On the basis of a new Granger non-causality test procedure developed by Toda-Yamamoto (1995) and Johansen's (1988) cointegration test, my results suggest that a long-term equilibrium relationship measured by cointegration has been merged between the Chinese A-share market and the other markets in greater China region as well as the US market during the post-crisis period which covers the period since Chinese A-share market was opened to the Qualified Foreign Institutional Investors (QFII) in 2002. I also found that the Shanghai A-share market uni-directionally Granger-causes the other regional markets after the Asian financial crisis, while the A-share market and Hong Kong H-share market have had a significant feedback relationship since then. However, I found no evidence there has been cointegrating relationship between Shanghai B-share market and any other market ever since the B-share market was opened to the local retail investors in 2001.

JEL classification: C32; G15; F36
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1. INTRODUCTION

For recent years, Chinese equity markets have attracted increasing interest from both academics and practitioners. There are three main reasons for this increasing interest: the rapid growing size of the Chinese equity markets[2], the growing presence of China in the world economy particularly in the greater China economy (Mainland China, Hong Kong and Taiwan) and the acceleration of the influence of the Chinese markets, which is largely related to the recent Chinese government's relaxation of its capital restriction of equity investment.

In the past, a listed Chinese company could issue two types of shares in both Shanghai and Shenzhen markets, A or B-shares. In addition, H-shares are issued to Hong Kong residents and the shares are listed in the Stock Exchange of Hong Kong (SEHK)[3]. All these three types of shares are identical, except that local investors could only hold A-shares and foreign investors could hold either B-shares or H-shares. Starting from February 19 2001 local retail investors (not institutions) have been allowed to open foreign exchange accounts for trading B-shares, a significant premium of A-share prices over B-share prices has been reduced since then. A year later on 5 November 2002 the QFII (Qualified Foreign Institutional Investor) program relaxed some capital controls and allowed foreign institutions to invest in A-share and bond markets. It is expected that this QFII regulation, a bold development in China's financial markets, will allow for the progressive interaction between Chinese and global markets. In statistical term, it is expected that there will be a cointegrating and causal relationships being found between the Chinese stock markets and the regional stock markets as well as international stock markets.

[2] China's stock exchanges started as relatively new players in the region just recent years and have expanded rapidly in terms of capitalization, turnover, and the number of firms listed since their establishment; with the result being China's stock market becoming the second largest in Asia, behind only Japan (Groenewold, et al. 2004).

[3] Two types of stock are traded in these two markets: A-shares and B-shares. A-shares are restricted to Chinese citizens and denominated in Chinese currency, yuan or Renminbi (RMB), while B-shares can be bought and sold only by foreigners and settled in foreign currencies (US dollars for Shanghai, Hong Kong dollars for Shenzhen).

The integration and causal relationship between A, B and H-shares, and between the Chinese markets and the other markets particularly during the post capital market deregulation in the early 2000s deserves more attention and a vigorous empirical investigation. Essentially, I address the following questions:

(1) First, since the Chinese stock markets had been purposely segmented ever since they established[4], I will investigate the integration relationship between A, B and H-shares: whether or not Shanghai's A and B-share markets become more integrated, particularly since the opening of the B-share markets to local detail investors.

(2) Do Shanghai A or both A and B-share markets become more integrated with the Hong Kong or Taiwanese market forming an equilibrium market or even with the US and the Japanese markets due to the opening of the A-shares to foreign institutional investors?

(3) The related issue is whether Hong Kong H-share/Hong Kong Hang Seng index led Chinese markets, as research has found that the Hong Kong market leads emerging Asian markets. Or visor versa?

(4) Other international markets lead the Chinese markets, or recent ballistic risen Chinese markets lead other markets and a sell-off in Chinese markets affected international markets?

The growing interdependence of national stock markets has been the subject of extensive research over the last two decades. Owing to their growing importance, a study on interactions between the Chinese markets and the other markets within the region or with major international stock markets, including the US and Japan, is of paramount interest. This paper

[4] The problem of the segmentation between the A and B-share markets has also been compounded by the fact that dual listing is not allowed, i.e., a company officially listed in one exchange cannot be listed in the other exchange. However, I will not address the issue of the integration between the Shanghai and Shenzhen markets. First, the market capitalization for Shenzhen is rather small and the trading in Shenzhen markets is also thinner, particularly since there has been no permission of IPOs to be listed in Shenzhen markets since early 2000. Furthermore, although cross listing is not permitted, both Chinese exchanges are subject to the same macroeconomic and policy influence, particularly the political and policy decisions made by the Central Government. Therefore, the degree of the segmentation between both markets is much less severe than those between the A and B-share market within an Exchange. I therefore use both the Shanghai A and B-share indices as more closely capturing the dominant trends in these mainland stock markets.

applies recent advances in time series statistical techniques: (i) Johansen's (1988) cointegration tests and (ii) augmented level VAR modeling with integrated and cointegrated processes of arbitrary orders (Dolado and Lutkepohl, 1996; Toda and Yamamoto, 1995). Toda and Yamamoto's procedure is useful because it allows tests of Granger causality between financial markets while still accounting for the long-term information often ignored in systems that require first differencing and pre-whitening prior to inference. This is the first paper which examines whether the Chinese markets have become more integrated by themselves and/or with other markets and whether the Chinese markets have more influenced to or have been more influenced by other markets during the period from 1993 to 2007 covering the opening of the A and B-share markets. The remainder of this paper is organized as follows: Section 2 sets out the data, model specification, methodology issues and briefly reviews the empirical literature; Section 3 demonstrates empirical results, and finally in Section 4, conclusions are presented.

2. Literature review and methodological issues

2.1 Financial integration literature

A number of empirical studies have examined long-term relationships and short-term dynamic causal linkages among major developed markets and emerging Asian markets, including studies by Eun and Shim (1993), Huang and Yang (2000), Masih and Masih (1999; 2001), Azaman-Saini (2002), Jang and Sul (2002), Khalid and Kawai (2003). Majority studies found that financial integration among international markets have increased since the Asian financial crisis in 1997. A number of researchers have applied cointegration tests and Granger no-causality tests to address the issue of equity market integration within mainland China as well as between the Chinese and Hong Kong markets. These studies include Laurence et al (1997), Sjoo and Zhang (2000) and Kim and Shin (2000).

Recently published articles extended their examination of lead-lag and cointegration relationships into the returns of the stock markets in the greater China region as well as relationships with the US and Japan. Chan and Lo (2000) investigated lead-lag relations among the returns of the four mainland Chinese markets and the Hong Kong and Taiwanese markets. Using the stock index daily returns up to 1997, they found that A-share markets in Shanghai and Shenzhen were closely related with each other but not with the other five stock markets. There is also evidence of significant lead-lag relations between Hong Kong, Shanghai (B-share) and Taiwan, with Hong Kong as the leading market in stock returns.

Huang et al (2000) also found that there exists no cointegration between the US, Japan, and markets in the greater China region. By applying the Granger causality test, they also found that stock price changes in the US (rather than Japan) can be used to predict those of the Hong Kong and Taiwanese markets, while price changes on the Hong Kong stock market lead the Taiwanese market by 1 day. Similar to the result by Chan and Lo (2000), Huang et al (2000) found that there is a significant feedback relationship between the Shanghai and Shenzhen A markets. Evidence from their cointegration tests in Groenewold et al.(2004) is consistent with that of Huang et al (2000) who found cointegration between the two mainland A-share indices for the period before the Asian crisis, which disappeared after the crisis. They also found a strong but relatively isolated lead-lag relationship between the two mainland A-share markets. Also, after the Asian crisis, there was evidence that Hong Kong had a weak predicative power from returns in the mainland. Although there are some differences among these researches, all studies concluded that Chinese stock markets are still relatively isolated within the greater China region. Despite the contributions they have made in demonstrating the interdependencies and lead-lag relationships among these stock markets, they suffer from the following limitations:

First, Groenewold et al. (2004) is only the article which covers the post Asian financial crisis period until the early 2001. It can be argued that using 3 or 4 years post crisis data is too short for testing cointegration because the tested cointegration can be just temporary phenomenal and disappeared quickly. I use much longer data (containing nine years) for cointegration test for the post crisis period, and what is greater importance is that the nine year period I used is just long enough to examine the effect of the recent government policy changes associated with the opening of the A and B-share markets.

Secondly, some previous studies only focused on Chinese A shares and ignore B shares and their relationship with A shares. Research on B shares is essential for us to understand an important issue about China's segmented A-B share regime. None of the previous papers has discussed the issue of the impact of the opening of the B market on the integration between A and B shares and between these Chinese markets and the rest of the world markets. The event of the opening of the B share markets can be more important than the Asian financial crisis on the Chinese markets, because the Chinese markets weren't affected by the Asian crisis as much as those of its neighboring countries due to the inconvertibility of its currency.

I use both Shanghai A and B share market indices rather than using a combined two indices of Shanghai and Shenzhen A-share markets into one portfolio index as did in (Groenewold et al 2004). I believe two separate indices reveal much more information than the one artificially combined in regarding to cointegration and causality relations. This paper also drops Shenzhen A and B-share market indices for both markets due to their negligibility in capitalization and much smaller liquidity in their daily trading.

Thirdly, previous research studied only short-term interactions by testing Granger causality on first-difference VARs. They were only able to use standard Granger F-tests in a first-difference VAR framework. Due to the absence of long-term equilibrium (cointegration) relationships between the markets they studied, it is impossible for them to run Granger no-causality tests based on the vector error correction model (VECM) model. As they do not take into account any presence of long-term relationships in the multivariate system, their research is only useful in capturing short-run temporal (dynamic) causality. This paper links long-term causality and cointegration more logically and more economically meaningfully than previous articles,

Lastly, this study uses averaged monthly price index data instead of daily data used in the previous studies in order to avoid a high level of noise of daily price data. The diagnostic tests on normality show that all indexes are normally distributed during these two sub-periods (in Section 3.1). Therefore both cointegration and Granger non-causality tests using VAR models based on monthly data are much more robust than those based on daily prices.

2.2 Methodologies

The elaborate works developed by Johansen (1988) and Johansen and Juselius (1990) are summarized into VAR models with error correction representation given by

$$\Delta X_t = \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \Pi X_{t-k} + \mu + \Phi D_t + \varepsilon_{t,} \tag{1}$$

where X_t is a column vector of k variables, μ is a (k×1) vector of constant terms, Γ and Π represent coefficient matrices, Δ is a difference operator, k denotes the lag length, and ε_t ~N

(0,Σ). Johansen's methodology requires the estimation of the VAR equation (1) and residuals, which are then used to compute two likelihood ratio (LR) test statistics that can be used in the determination of the unique cointegrating vectors of X_t.

The procedure for Granger no-causality tests developed by Toda and Yamamoto (1995) utilizes a modified WALD test for restrictions on the parameters of a VAR (k), or MWALD procedure (where k is the lag length in the system). This test has an asymptotic χ^2 distribution when a VAR (k + d $_{\text{max, a}}$x) is estimated, where d $_{\text{max}}$ is the maximal order of integration suspected to occur in the system. Monte Carlo experiments presented by Zapata and Rambaldi (1997) provide evidence that the MWALD test has a comparable performance in size and power to the likelihood and WALD tests. Rambaldi and Doran (1996) proved that this method can use a seemingly unrelated regression (SUR) form. The advantage of this procedure is that it does not require precise knowledge of the integration properties of the system. In addition, a standard vector autoregression in the levels of the variables can be fitted into the model. It can be applied even when there is no integration and/or stability and rank conditions are not satisfied 'so long as the order of integration of the process does not exceed the true lag length of the model' (Toda and Yamamoto, 1995).

This technique allows us to examine the interrelated nature of stock prices in different securities markets by using a multivariate VAR model; I address whether a particular stock market influences, or is influenced by, another stock market while controlling all the other stock markets. When there is no cointegrating other than a causal relationship existing among the stock markets concerned, then the Granger no-causality tests with the Toda and Yamamoto procedure are certainly superior to the Granger no-causality tests based on the VECM, which requires all the series to be cointegrated. The following VAR (k + dmax) model is therefore made in investigating lead-lag relationships among these markets,

$$\begin{bmatrix} LSHA_t \\ LSHB_t \\ LHKH_t \\ LHKSI_t \\ LTOPIX_t \\ LTWII_t \\ LSP_t \end{bmatrix} = A_0 + \sum_{i=1}^{k} A_i \begin{bmatrix} LSHA_{t-i} \\ LSHB_{t-i} \\ LHKH_{t-i} \\ LHKSI_{t-i} \\ LTOPIX_{t-i} \\ LTWII_{t-i} \\ LSP_{t-i} \end{bmatrix} + \sum_{j=k+1}^{d\max} A_j \begin{bmatrix} LSHA_{t-j} \\ LSHB_{t-j} \\ LHKH_{t-j} \\ LHKSI_{t-j} \\ LTOPIX_{t-j} \\ LTWII_{t-j} \\ LSP_{t-j} \end{bmatrix} + \begin{bmatrix} \varepsilon_{LSHA_t} \\ \varepsilon_{LSHB_t} \\ \varepsilon_{LHKH_t} \\ \varepsilon_{LHKSI_t} \\ \varepsilon_{LTOPIX_t} \\ \varepsilon_{LTWII_t} \\ \varepsilon_{LSP_t} \end{bmatrix} \quad (2)$$

where A_0 is a (6×1) intercept vector respectively, $A_1 - A_{d\max}$ is (6×7) matrices of coefficients respectively and vector (ε) is white noise.

The lower-case letter denotes an averaged monthly log closing price over a period. To test the hypothesis that "no Granger causality from LSHB to LSHA", I test H_0: $\alpha_1^{(12)} = \alpha_2^{(12)} \alpha_3^{(12)} = 0$, where $\alpha_i^{(12)}$ are the coefficients of $LSHB_{t-1}$, $LSHB_{t-2,}$ $LSHB_{t-3}$ respectively in the first equation of the system formula (2) in case the system is being estimated as a VAR(3). The up case (12) for α indicates the number of the equation of the system and the number of the variable in that equation respectively.

The existence of causality from lshb to LSHA can be established by rejecting the above null hypothesis, which requires finding the significance of the MWALD statistic for the *group* of the lagged independent variables identified above. A similar testing procedure can be applied to the alternative hypothesis that "no Granger causality from LSHA to LSHB", i.e., to test H_0: $\alpha_1^{(21)} = \alpha_2^{(21)} \alpha_3^{(21)} = 0$, where $\alpha_i^{(21)}$ are the coefficients of $LSHA_{t-1}$, $LSHA_{t-2,}$ $LSHA_{t-3}$ respectively in the second equation of the system formula (2) where the system is being estimated as a VAR(3).

3. Empirical analysis and results

3.1 Data

The data includes logarithms of averaged monthly closing share price indices[5]. The indices that are collected include Shanghai's A-share index (DataStream code: CHSASHR), or ShA, Shanghai's B share index (CHSBSHR, ShB), the Hang Seng China enterprises index (HKHCHIE, HKH), the Hang Seng Index of Hong Kong (HNGKNGI, HKSI), Taiwan's value-weighted index (TAIWGHT, TWII), Tokyo Stock Exchange index (TOPIX, Topix) and Standard and Poor's 500 index (S&PCOMP, SP). To be consistent, a value-weighted index is chosen for the associated region in this paper. Data is obtained from DataStream International and covers the period between July 1993 and March 2007, the starting date being the earliest

[5] All share prices are taken logarithmically in order to improve their normality of distribution. This study uses monthly data instead of daily data. As pointed by Bailey and Stulz (1990), daily data contains a high level of noise which might cloud the true relationships between the variables. I am appreciated with referee's comment regarding this issue.

date for which the information of the Hang Seng H-share index was available. Accordingly, the seven log share price indices are expressed as LSHA, LSHB, LHKH, LHKSI, LTWII, LSP and LTOPIX respectively. Stock index monthly returns are calculated using the conventional first differences of logarithmic prices, i.e., are calculated by the formula [$r_t = \ln(p_t / p_{t-1}) \times 100$], where p_t and p_{t-1} represent the close price on month t and the close price on month t-1, respectively. To be consistent with the expression of log prices, return variables will be labeled as DLSHA, DLSHB, DLHKH, DLHKSI, DLTWII, DLSP and DLTOPIX respectively.

Table 1 provides some descriptive statistics of our sample. To analyze the extent of market integration over time, they are reported for the full sample as well as for the two subsamples: pre-financial crisis between July 1993 and June 1997, post-financial crisis between August 1998 and March 2007. Following Groenewold et al (2004), the period between July 1997 and July 1998 was omitted in order to isolate the effects of the Asian financial crisis. The trading over this period only reflected noise and overreaction trading. The diagnostic tests show that all indexes are normally distributed during these two sub-periods.

INSERT TABLE 1 HERE

A simple test for integration between stock indices is done by estimating the correlation coefficients of the stock index monthly returns across countries. The correlation matrixes for the pre and post-crisis sub-periods are reported in different panels in Table 2. As expected, the correlations among various stock index returns are mostly positive. A comparison of the correlation coefficients for most market pairs across the pre and post crisis period reveals an increase in correlations over the post crisis period. The most impressive and consistent pattern merged in the Shanghai A-share market. During the same period, the returns of Shanghai A shares became more positively correlated with those of all other markets. However, the correlation between Shanghai B-share return and those of all other markets except for both Shanghai A-share and the Taiwanese markets became much weaker.

INSERT TABLE 2 HERE

Prior to testing for cointegration and causal relations between the markets, it is necessary to establish the order of integration present. A necessary but not sufficient condition for cointegration is that each of the variables should be integrated of the same order (more than zero) or that both series should contain a deterministic trend. Both Augmented Dickey-Fuller (ADF) tests and Pillips-Perron tests were carried out on the time series in levels and differenced forms. Both ADF and PP statistics overwhelmingly exhibit nonstationary log stock indices at the significance level of 5% (Table 3). It is clear that all return (log difference) series are stationary for all periods whether a trend is included in the testing equation or not. Perron (1989) demonstrated that, in the existence of a structure break in time series, many perceived nonstationary series by using traditional tests were in fact stationary. Further elaborated work by Zivot and Andrew (1992) overthrew the presumed exogenous break point and develops a unit-root test with endogenous structure break, which has been regarded as a more suitable test for the order of integration of series (Nieh and Yau 2004). The results of the Zivot-Andrew tests, presented in Table 4, indicated that all seven series carry unit-root in the level and reject the null of "non-stationary" in the first difference. These results for all stock markets confirm the results of ADF and PP tests that all series are the $I(1)$ type.

INSERT TABLE 3 HERE

The time of the break for Shanghai A-share is found to be in 2002:8, while for the Shanghai B-share is in 2000:6. These breaks are found to be coinciding with the real events affecting both indices. The Shanghai A and B-share market has been affected by the opening of A- and B-share market in 2002 and 2001 respectively. The reason for the time of the break which was earlier than the real events is due to the fact that local investors started to invest in B-share by opening an unofficial foreign exchange account or increased their investment in A-shares few months or a year earlier for speculation of the official opening of these markets. The time of the break for both Hong Kong and the US market is found to be in 2001:3, which is coinciding with the 911 event in the year 2001. However, it is not quite sure the reason why the break actually happened in March 2001 which is about half year before the real event.

3.2 Cointegration tests

The next step is to specify the model, which involves determining the optimal lag length of the levels of own and other variables in the model. Two lag selection methods, e.g. Akaike Information Criterion (AIC) and Schwarz Criterion (SC) are used based on the recommendation in Giles and Mirza (1999). When the difference between the resulting lag orders is large, and because there is sufficient observations in this case, I proceed with AIC lag selection (Giles and Mirza, 1999). I then check to see whether the chosen orders of lags for each stock index pass the diagnostic tests. The number of the lag chosen, however, is not reported in Table 5 in order to save space.

The results of the cointegration tests are reported in Table 5, which include results for the full sample and for the two subsamples. Given the unimportance of the trend in the stationary tests, The Johansen statistics with a model without a trend are computed. Similar to Groenewold et al (2004), I began with a test involving just the two Shanghai share price indices in order to examine the relationship between these two markets in isolation. I next add one more index each time until a full seven market indices is reached. Each time, if any added index results in no cointegration, this added index will be dropped from the next cointegration test. The results of all these six cointegration tests are reported in Table 5. I found there is no evidence of a cointegration relationship between these two Shanghai markets at 5% level of significance and between the Shanghai A-share market and any other market before the financial crisis. I also found that there is no evidence of a cointegration relationship between Shanghai A-share and B-share markets and between the A-share and the Hong Kong H-share market even after the opening of the A and B-share markets during the post crisis period[6]. However, during the post crisis period when the A and B-share markets had been opened up, I do find there is clear evidence that cointegration exists among the Chinese A-share, the Hong Kong main market and the Taiwanese Market and to less extent the US market, which implied that the four series are bound by some relationship in the long run. The estimated cointegrating vector reported in Panel B of Table 5 indicates that all four markets are strongly related each other: all the long-term coefficients in the cointegrating vector are significant at a 5% confidence level. There exists no cointegration between Chinese A-share market and Japanese market during the post crisis.

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INSERT TABLE 5 HERE

In order to isolate the impact of the Shanghai A-share market, I also combine only the Shanghai B-share market with the price index of Hong Kong and further add one more index each time in order to investigate the possibility of the Shanghais B-share market integrated with markets in other economies. Because the B-share market was only allowed invested by

[6] This result is consistent with the results from the publication in Chinese by Cheng and Duan (2004). Using a sample of 74 companies (including 38 companies listed in Shanghai and 36 in Shenzhen) issuing both A and B shares, they found majority of the A and B shares was not cointegrated even after the opening of the B share market to locals in June 1 2001.

foreign investors at least before June 1 2001, it could integrate more with those of markets in other economies. However, I found there exists no cointegration between the Shanghai B-share market and any other market at a 5% confidence level during all the periods. The results will be provided upon request.

3.3 Causality tests based on Toda-Yamamoto level VAR

Following the literature (Rambaldi and Doran, 1996; Toda and Yamamoto, 1995; Zapata and Rambaldi, 1997), a VAR (k + dmax) model is set up in order to examine whether the lead-lag relationships between all these markets differ over the various periods.

Given that the orders of integration for all these time series of log prices are I (1), i.e., the order of *dmax* is chosen to be one, the next step is to augment the VAR by the maximum order of integration in the series. A VAR (k + $dmax$) model is then tested for non-causality by using MWald test statistics, which has a standard asymptotic distribution. The results of the Granger no causality are presented in Table 6.

INSERT TABLE 6 HERE

I find the following results. First, evidence from Table 6 reveals that there was no causal relationship existed between the Chinese A-share market and any other market, indicating that the Shanghai A-share market was isolated during the pre crisis period. This finding supports the results I found from cointegration tests. During the post crisis period, the Chinese A-share market became influenced by other markets and also exerted influence to other markets within Asian region. I found evidence that the Shanghai A-share market led both the Taiwanese and Japanese markets during the same period, although I only find relatively weak evidence that the Shanghai A-share market uni-directionally Granger-caused the Hong Kong main market after the crisis. I also found evidence that the Shanghai A and Hong Kong H-share markets had a significant feedback relationship. Overall, the long-term causal relationships existed between the Shanghai A-share market and other Asian markets is evidence for supporting cointegration relations found between the Chinese A-share market and the other markets within greater China region during the same period in the last section. The causal link between the Shanghai A-share market and the US market was pretty weak even during the post crisis period. This result supports finding in cointegration tests some weak evidence showing that the Shanghai A-share market cointegrated with the US market, i.e., there is only Maximal Eigenvalue statistics significance at a 5% level.

The Hong Kong market influenced the Taiwanese and the US market as it uni-directionally Granger-causes these two markets after the financial crisis. This result partially supports the notion that Hong Kong, being the most developed and least regulated capital market in the Greater China region, has its leadership in the region since 1998. Contrary to the previous research based on pre-crisis period (Huang et al (2000)), I found that the US market, on the other hand, only exerted influence on the Japanese market. This result indicates that the influence of the US market has been declined since the financial crisis.

IV. CONCLUDING REMARKS.

The object of this paper was to examine long-term causality and cointegration between the Shanghai A and B-share markets and between these markets and the Hong Kong and the Taiwanese markets and the US and Japanese markets. I examined these relationships over two important periods: before and after the Asian crisis of 1997-98. This late period covered the period of the opening of the Chinese A and B-share markets.

I found evidence that cointegrating relations have been merged between the Shanghai A-share market and the other markets in the greater China region and between these markets and the US market, although this later cointegration is based on rather weak evidence, since the opening of the A and B share markets. The Hong Kong main market has become integrated with the Shanghai A-share markets but not the B-share market in the long-term, since economic relationships through trades and direct foreign investment in general and equity market interactions in particular have by large improved recently. In addition to the existence of a cointegrating relationship existing between the Shanghai A-share and other markets, I also found some supporting evidence from my causality tests. I found there is evidence that the Chinese A-share market have not only been influenced by the Hong Kong H-share market but also has exerted influence other markets including the Hong Kong, the Taiwanese and the Japanese markets since the Chinese market opened to foreign investors in 2002. This influence can be observed by the recent worldwide stock plunge which was triggered by a sell-off in the Shanghai A-share market on February 27, 2007.

I found, however, that there is no evidence to support that these two Shanghai markets have become cointegrated. The A and B-share markets have not reached long-term integration yet and they have still remained separate. The remaining A-share's premium is an approval for this. Although the Chinese A-share market has established their long-term equilibrium relations with other markets, the Chinese B-share market remains independent from the A-share market and any other markets ever since the B-share market has been opened to local retail investors. The reasons for the segmentation between the A and B-share markets may include factors such as that a lack of mainland institutional investors allowed to invest in B shares, and that the B-share markets have been increasingly marginalized as many overseas investors fled them after domestic investors entered the market and qualified foreign institutional investors were allowed to invest Chinese A shares. A merge between A and B-share markets now became the government's top priority (Economic Information Daily, June 6, 2007). A thorough investigation of these issues show further research could be rewarded.

As a major step after China's WTO accession, the Chinese QFII program introduced in 2001 not only further opened China's securities markets, but also gave foreign investors opportunities to take positions on those markets and buy stakes in Chinese companies, thus sharing in China's phenomenal growth. This QFII regulation is a bold development in China's financial markets and has allowed for the progressive interaction between the Chinese and global markets as suggested by evidence of a cointegration relationship found between Chinese markets and other regional financial markets. Meanwhile, the QFII's supply of long-term and stable capital and their targeting of companies with strong fundamentals, fiscal transparency and good governance, could contribute to the further development of the Chinese markets.

Though Chinese markets have recently undergone rapid growth and have the potential for more in the future, the nature of still-emerging Chinese markets (there is segmentation between Chinese markets and these markets still relatively isolated from other markets) could pose challenges to investors. However, our results also suggest that investors could benefit from investing in Chinese equity markets. Compared with other more matured markets such as Hong Kong and Taiwan, the potential diversification benefits from investing in Chinese markets may still be quite large due to its relatively weak linkage with international markets. In this context, the B-shares may offer the better diversification potential among the Chinese stock markets since this market is less integrated with other markets.

ACKNOWLEDGEMENTS

Financial assistance from the College of Law and Business at the University of Western Sydney is gratefully acknowledged.

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Table 1Descriptive statistics of log-prices

	LSHA	LSHB	LHKH	LHKSI	LTWII	LSP	LTOPIX
Sample: 1993M07 - 2007M03							
Mean	7.1622	4.3107	8.1256	9.3837	8.7362	6.8490	7.1814
Median	7.2394	4.2835	8.2348	9.3632	8.7290	6.9936	7.2252
Maximum	8.0700	5.3635	9.1963	9.9251	9.1923	7.3077	7.4756
Minimum	6.0410	3.1850	7.0672	8.8455	8.2302	6.1043	6.6729
Std. Dev.	0.3969	0.4748	0.5059	0.2377	0.2144	0.3691	0.2011
Skewness	-0.52	-0.02	-0.02	0.06	-0.10	-0.84	-0.55
Kurtosis	2.80	2.57	1.93	2.29	2.61	2.38	2.38
Jarque-Bera	7.67	1.30	7.83	3.60	1.36	21.84*	11.13*
p-value	0.02	0.52	0.02	0.17	0.51	0.00	0.00
Observations	165	165	165	165	165	165	165
Sample: 1993M07 – 1997M06							
Mean	6.6603	4.1369	8.4195	9.2188	8.6783	6.3362	7.3259
Median	6.6306	4.1252	8.3820	9.1763	8.7033	6.3097	7.3500
Maximum	7.2605	4.5303	9.0524	9.5977	9.0718	6.7877	7.4363
Minimum	6.0410	3.8789	8.0866	8.8455	8.2569	6.1043	7.1069
Std. Dev.	0.2606	0.1966	0.2278	0.1798	0.1993	0.2081	0.0830
Skewness	0.26	0.38	0.77	0.13	-0.24	0.48	-0.71
Kurtosis	2.98	1.86	3.10	2.47	2.68	1.89	2.59
Jarque-Bera	0.56	3.76	4.80	0.70	0.66	4.26	4.41
p-value	0.76	0.15	0.09	0.70	0.72	0.12	0.11
Observations	48	48	48	48	48	48	48
Sample: 1998M08 – 2007M03							
Mean	7.3934	4.4247	7.9970	9.4692	8.7252	7.0773	7.1180
Median	7.3805	4.4987	7.7275	9.4901	8.7118	7.0909	7.0758
Maximum	8.0700	5.3635	9.1963	9.9251	9.1923	7.3077	7.4756
Minimum	7.0079	3.1850	7.1059	8.9085	8.2493	6.7312	6.6729
Std. Dev.	0.2185	0.5457	0.5547	0.2215	0.2008	0.1438	0.2148
Skewness	0.6080	-0.5465	0.4902	-0.1863	-0.0532	-0.5803	-0.0568
Kurtosis	3.39	2.44	1.92	2.42	2.74	2.70	2.01
Jarque-Bera	7.07	6.51	9.17	2.04	0.34	6.23	4.33
p-value	0.03	0.04	0.01	0.36	0.84	0.04	0.11
Observations	104	104	104	104	104	104	104

Notes: The mnemonics are as follows: SHA=Shanghai A, SHB=Shanghai B, HKH=Hong Kong H, HKSI=Hong Kong's Heng Seng, SP=The America's Standard & Poor, TOPIX=Japan's Topix, TWII=Taiwan's Twii. * indicates Jarque-Bera's tests for normality is significant at 1% level.

Table 2 Correlation coefficients between returns:

	DLSHA	DLSHB	DLHKH	DLHKSI	DLTWII	DLSP	DLTOPIX
Sample: 1993M07 – 2007M03							
DLSHA	1.00	0.47	0.21	0.03	0.15	0.03	-0.01
DLSHB	0.47	1.00	0.53	0.22	0.19	0.01	0.02
DLHKH	0.21	0.53	1.00	0.56	0.36	0.30	0.11
DLHKSI	0.03	0.22	0.56	1.00	0.48	0.58	0.32
DLTWII	0.15	0.19	0.36	0.48	1.00	0.39	0.28
DLSP	0.03	0.01	0.30	0.58	0.39	1.00	0.38
DLTOPIX	-0.01	0.02	0.11	0.32	0.28	0.38	1.00
Sample: 1993M07 – 1997M06							
DLSHA	1.00	0.36	0.14	0.02	0.13	0.02	-0.13
DLSHB	0.36	1.00	0.74	0.46	0.28	0.10	-0.08
DLHKH	0.14	0.74	1.00	0.69	0.25	0.28	-0.15
DLHKSI	0.02	0.46	0.69	1.00	0.41	0.53	0.11
DLTWII	0.13	0.28	0.25	0.41	1.00	0.10	0.09
DLSP	0.02	0.10	0.28	0.53	0.10	1.00	0.26
DLTOPIX	-0.13	-0.08	-0.15	0.11	0.09	0.26	1.00
Sample: 1998M08 – 2007M03							
DLSHA	1.00	0.68	0.38	0.16	0.21	0.08	0.12
DLSHB	0.68	1.00	0.39	0.05	0.15	0.02	0.08
DLHKH	0.38	0.39	1.00	0.48	0.41	0.37	0.24
DLHKSI	0.16	0.05	0.48	1.00	0.51	0.70	0.44
DLTWII	0.21	0.15	0.41	0.51	1.00	0.47	0.38
DLSP	0.08	0.02	0.37	0.70	0.47	1.00	0.45
DLTOPIX	0.12	0.08	0.24	0.44	0.38	0.45	1.00

Note: The mnemonics are as follows: DL=change in logs, SHA=Shanghai A, SHB=Shanghai B, HKH=Hong Kong H, HKSI=Hong Kong's Heng Seng, SP=The America's Standard & Poor, TOPIX=Japan's Topix, TWII=Taiwan's Twii.

Table 3 Tests of the unit root hypothesis: pre- and post-crisis samples

	Aug. Dickey-Fuller			Phillips-Perron		
	τ	τ_μ	τ_τ	τ	τ_μ	τ_τ
Pre-crisis				1993:07 to 1997:06		
				Levels		
LSHA	0.44	-0.93	-2.36	0.43	-1.16	-1.78
LSHB	0.68	-1.96	-1.38	0.58	-1.76	-1.89
LHKH	-0.38	-1.99	1.14	0.12	-1.87	-3.15
LHKSI	1.22	-1.44	-2.58	1.88	-1.3	-2.22
LTWII	1.74	-1.11	-1.37	1.58	-1.23	-1.58
LTOPIX	-0.26	-2.78	-2.83	-0.25	-2.04	-1.96
LSP	4.08	1.91	-1.14	3.93	1.91	-1.18
				First differences		
LSHA	-5.74	-5.71	-4.61	-5.7	-5.64	-6.35
LSHB	-5.33	-5.24	-5.28	-5.28	-5.18	-5.35
LHKH	-3.99	-4.15	-5.51	-5.27	-5.3	-5.23
LHKSI	-4.46	-4.06	-5.92	-4.33	-4.47	-4.29
LTWII	-5.09	-5.31	-5.26	-5.09	-5.32	-5.27
LTOPIX	-5.12	-5.07	-5.06	-5.14	-5.09	-5.08
LSP	0.15	-1.49	-1.86	-4.55	-5.55	-6.28
Post-crisis				1998:08 to 2007:03		
				Levels		
LSHA	0.99	-0.96	-0.86	1.11	-0.78	-0.63
LSHB	0.88	-1.66	-1.72	1.23	-1.62	-1.59
LHKH	1.91	0.39	-2.91	2.61	-0.13	-1.71
LHKSI	1.22	-1.19	-1.33	1.47	-1.93	-1.88
LTWII	0.09	-2.19	-2.1	0.06	-1.48	-1.62
LTOPIX	0.77	-1.15	-1.17	0.59	-1.04	-1.1
LSP	0.77	-1.44	-1.03	0.7	-1.23	-1.2
				First differences		
LSHA	-6.7	-6.78	-6.84	-6.7	-6.77	-6.83
LSHB	-7.31	-7.4	-7.37	-7.33	-7.43	-7.36
LHKH	-6.75	-7.09	-5.66	-6.27	-6.4	-6.52
LHKSI	-7.92	-8.02	-7.97	-7.18	-7.28	-7.23
LTWII	-7.14	-7.11	-7.11	-6.87	-6.83	-6.81
LTOPIX	-7.4	-7.43	-7.39	-7.46	-7.48	-7.45
LSP	-8.54	-8.56	-8.51	-8.55	-8.58	-8.53
				Critical values		
Sig. level						
1%	-2.59	-3.5	-4.05	-2.59	-3.5	-4.05
5%	-1.94	-2.89	-3.45	-1.93	-2.89	-3.45
10%	-1.61	-2.58	-3.15	-1.61	-2.58	-3.15

Notes: τ, τ_μ, and τ_τ are the test statistics for a unit-root in the level (or the difference) without constant, with constant, and with both constant and trend, respectively. The optimal lag used for conducting the augmented Dickey-Fuller test statistic was selected based on an optimal criteria (Akaike's final prediction error), using a range of lags. Relevant test equations and related technical descriptions for all unit root testing are available upon request.

Table 4 Results of ZA unit-root tests with structural break (period July 1993 to March 2007)

	Break	Levels	First differences
LSHA	Aug-02	-3.31 (3)	-7.47 (3)
LSHB	Jun-00	-3.79 (1)	-11.39 (0)
LHKH	Oct-97	-3.54 (3)	-8.55 (3)
LHKSI	Mar-01	-3.76 (0)	-13.02 (0)
LTWII	Sep-00	-4.88** (0)	-12.62 (0)
LTOPIX	Dec-04	-2.37 (0)	-11.74 (0)
LSP	Mar-01	-3.60 (0)	-13.18 (0)

Notes: (a) The critical values are -5.43 and -4.80 at the 1 % and 5% significance level, respectively. (b) The notation *** and ** implies at the 1% and 5% significance level. (c) The numbers in parentheses indicates the number of lags required in the ZA tests.

Table 5 Cointegration tests

Variable	Test	H_0	H_a	Full period	1993M07-1997M06	1998M08-2007M03
Panel A: Cointegration tests between A shares and others						
LSHA-LSHB	Trace-	r=0	r=1	7.87	7.69	10.33
	statistics	r≤1	r=2	2.76	3.05	3.21
	Max-Eigen-	r=0	r=1	5.05	4.64	7.21
	statistics	r≤1	r=2	2.76	3.05	3.21
LSHA-LSHB-LHKH	Trace-	r=0	r=1	2.49	8.46	2.73
	statistics	r≤1	r=2	0.48	0.86	0.98
	Max-Eigen-	r=0	r=1	2.00	7.59	1.75
	statistics	r≤1	r=2	0.48	0.86	0.98
LSHA-LSHB-LHKH-LHKSI	Trace-	r=0	r=1	11.61	13.23	15.73*
	statistics	r≤1	r=2	1.28	0.29	7.00*
	Max-Eigen-	r=0	r=1	10.33	12.93	8.73
	statistics	r≤1	r=2	1.28	0.29	7.00*
LSHA-LSHB-LHKH-LHKSI-LTWII	Trace-	r=0	r=1	16.11*	11.26	36.08*
	statistics	r≤1	r=2	1.04	0.00	12.64
	Max-Eigen-	r=0	r=1	15.07*	11.26	23.44*
	statistics	r≤1	r=2	1.04	0.00	8.97
LSHA-LSHB-LHKH-LHKSI-LTWII-LSP	Trace-	r=0	r=1	33.39*	8.61	47.22
	statistics	r≤1	r=2	12.13	1.49	19.40
	Max-Eigen-	r=0	r=1	21.27*	7.11	27.83*
	statistics	r≤1	r=2	6.77	1.49	10.60
LSHA-LSHB-LHKH-LHKSI- LTWII-LSP-LTOPIX	Trace-	r=0	r=1	59.74*	6.37	68.73
	statistics	r≤1	r=2	33.44*	1.14	39.31
	Max-Eigen-	r=0	r=1	26.30	5.23	29.42
	statistics	r≤1	r=2	17.79	1.14	17.51

Panel C: long term coefficients in cointegration among all share indices:

	LHKSI(-1)	LTWII(-1)	LSP(-1)
LSHA(-1)	2.06	-20.60	14.27
Standard error	(1.57)	(4.03)	(7.08)

Notes: All the mnemonics are as same as those in the note in Table 1 except L=logs. Each time if any added index results in no co-cointegration, this added index will be dropped from the next cointegration test. Critical values used are taken from (Osterwald-Lenum, 1992). * indicates significance at the 5% levels.

Table 6 Long-term causality results based on Toda-Yamamoto procedure

	LSHA	LHKH	LHKSI	LTWII	LTOPIX	LSP
full period						
LSHA		0.29	0.78	0.60	0.49	0.15
LHKH	0.34		0.77	0.24	0.95	0.25
LHKSI	0.61	0.15		0.27	0.11	0.00**
LTWII	0.07	0.08	0.18		0.28	0.51
LTOPIX	0.01*	0.30	0.86	0.03*		0.05*
LSP	0.34	0.33	0.87	0.20	0.50	
1993M07 - 1997M06						
LSHA		0.21	0.36	0.02*	0.67	0.15
LHKH	0.37		0.55	0.63	0.23	0.95
LHKSI	0.36	0.51		0.23	0.24	0.71
LTWII	0.10	0.33	0.98		0.01*	0.47
LTOPIX	0.73	0.23	0.06	0.00**		0.00**
LSP	0.06	0.00**	0.22	0.01*	0.00**	
1998M08 – 2007M03						
LSHA		0.03*	0.25	0.67	0.49	0.31
LHKH	0.02*		0.71	0.54	0.42	0.77
LHKSI	0.09	0.04*		0.81	0.49	0.22
LTWII	0.00**	0.15	0.00**		0.47	0.29
LTOPIX	0.01*	0.27	0.11	0.20		0.04*
LSP	0.25	0.50	0.02*	0.25	0.32	

Notes: All the mnemonics are as same as those in the note in Table 3. Reported above are significance levels associated with asymptotic Wald statistic for testing exclusion restrictions. * and ** indicates significance at 5% and 1% levels respectively.