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Non-tradable share reform and convergence between Chinese cross-listed A and H shares

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Keywords

Non, tradable, share, reform, convergence, between, Chinese, cross, listed, shares

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1. Introduction

Ownership restrictions have long been recognized as the main factors that hinder the progress of financial integration. Those barriers may reflect capital controls, tax codes, accounting and auditing differences, different bankruptcy law etc (Adam et al., 2002). There are generally two types of capital controls in emerging capital markets (Ma, 1996). The first is the limitations on foreign ownership of domestic equity. This type of legislated restriction ensures domestic control of local firms, especially in energy and financial sectors, and is motivated by a desire to preserve the independence of the local industries, possibly because of national defense concerns (Stulz and Wasserfallen, 1995). The second type of limitation is on the domestic investment constraint on foreign capital markets (Ma, 1996). For example, Bergstrom et al. (1993) reported that a capital-outflow restriction limiting the amount of capital that domestic investors could export was enforced in the United Kingdom until 1979. The existence of those barriers will constrain the portfolio choice of the individuals, and hence the resulting equilibrium may very well be different from that under no barriers (Eun and Janakiramanan, 1986). Furthermore, it might induce price premiums in the sense that the benefits of international diversification attract free capital to move across borders and prompt investors to pay higher prices for foreign stocks than what they would pay at home.

This paper contributes to the study of ownership restrictions effects on capital markets and financial integration with the evidence from China's two stock markets, i.e. Shanghai stock exchange and Shenzhen stock exchange. Chinese stock markets' ownership restrictions are evidenced in several aspects. First, if a company chooses to list in Shanghai's stock exchange, it is not eligible to list its shares in Shenzhen stock exchange at the same time, and vice versa. Second, there exists non-tradable shares which is

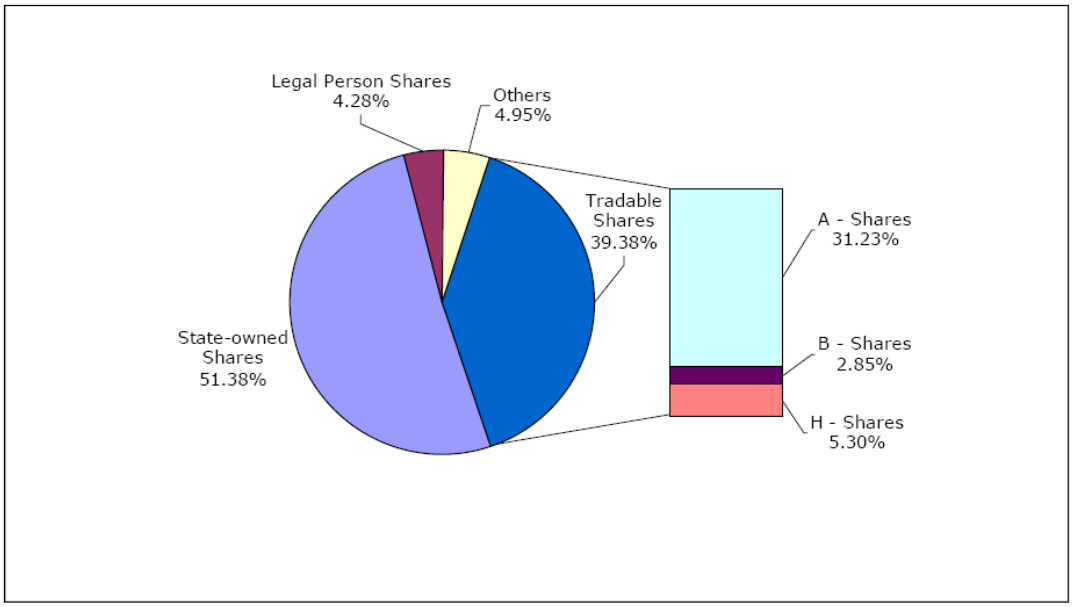
unparalleled in China. It means only one third of a listing company's shares are freely tradable in the stock market, while two thirds are only assessable to legal person and are state owned and non-tradable. Third, there are several classes of shares in China's stock markets. B shares were only assessable to foreign investors and A shares were only available to domestic investors before 2004. H shares are listed in Hongkong while the listing companies are based in China where domestic investors are inaccessible. A company can issue A and B shares or A and H shares at the same time but the ownerships are restrictedly regulated according to investors' trading locations (Grownewold, et al. 2004). These measures artificially create a segmented market. Meanwhile, the ownership restrictions in China differ from other countries historically. On one hand, investors can only trade a portion of the shares while the price of the other portion is not subject to pricing mechanism of an efficient market. Non-tradable shares pushes up the price of tradable shares, i.e. A shares in the way of reducing supply to the market (Beltratti and Bortolotti, 2006) On the other hand, investors are not free to choose which class of shares they perceive as profitable and is restricted to their trading locations. In face of these problems, two recent reforms are undertaken in China, which are the non-tradable share reforms and QFII procedures to tackle the problem of ownership restrictions, which this paper will be focus on.

Against this background, China's capital market provides an interesting scenario for the study of price relationships between cross-listed shares to uncover the degree of financial integration. Furthermore, China's cross-listed B and H shares are priced lower than the domestic A shares, which is different from other countries' experience and is in contrast with theoretical explanations offered by the capital asset pricing model (Chan et al., 2002;

Bailey et al., 1999). Hence, different hypothesis are offered in the literature to explain the puzzle, including differential valuation model, information asymmetry, liquidity and investor sentiments. (Chan et al, 2003; Wang and Jiang 2004; Sun and Tong 2000; Kim and Shin, 2000) Different from those approaches, this paper hypotheses that ownership restrictions have contributed to the segmented market between China and Hong Kong. However, with the reforms undertaking in China, some improvements in the long-run equilibrium relationship is expected.

1.1 Non-tradable share reform

The Chinese government recognized that the non-tradable shares have brought many problems in the markets. According to Beltratti and Bortolotti (2006), these problems include the thinness of trading, where non-tradable shares overweight tradable shares as evidenced in figure 1; a fraction of capital was suppressed, reducing supply and pushing up the price of tradable shares Furthermore, the pricing mechanism of free market fails to work in the market, which leads to poor market efficiency. It also intensifies the agency problem, where the managers take excessive risk of project which is undesirable. In May 2005, the CSRC decided to carry on stock structure reform to solve the problem. The procedures are as follows: a few trials will be carried on some selected companies to evaluate different potential solutions; each company can have their own solutions as catered to their own situations; new listed companies will have not issue non-tradable shares any more (Beltratti and Bortolotti, 2006).



Source: *China Securities Regulatory Commission*

Figure 1. Outstanding shares of Chinese listed companies by class, February 2006

Figure 1 presents the proportions of each classes of shares and as it is shown, NTS turned out to be overwhelmingly important in Chinese stock markets. As February 2006, only 39.38% are freely tradable in the stock exchange while 56.66% of shares are non-tradable.

With the success of stock structure reform, it is believed that the Chinese stock market will be more liquid and efficient to be ready for big companies to list domestically instead of listing abroad (Beltratti and Bortolotti, 2006). A more regulated and robust domestic capital market will be able attract those big companies to list domestically, especially for H shares to cross-list in A share market. Those big companies are leading companies in their relevant sectors and if they choose to list domestically, it will improve the attractiveness of the domestic equity market. Secondly, big companies increase the supply of capital for investors to choose from, which better allocates resources and improves the structure of investors. Up till 2006, the institutional investors have been made up of 30%

of tradable share value (Beltratti and Bortolotti, 2006).

According to the market efficiency theory, the series of capital market reforms could be reflected in share prices. With the entry of WTO, NTS reform and increasing level of trade liberalization, China's market is perceived to better integrate into the world market. The study of A and H shares will provide good evidence of the degree of integration, and uncover the market pricing mechanism of the two markets.

In addition to the NTS reform, in November 2002, QFII measures promulgated and allowed the qualified foreign institutions to invest in the A share market under certain foreign exchange flow and disclosure requirements (Su et al., 2007). This measure is perceived to improve the pricing efficiency in A share market since the ownership restriction is lessened.

In this paper, we examine the market linkages of China's cross-listed A- and H-shares before and after those two reforms. The market linkages of the China's cross-listed A- and H- shares are assessed by the technique of cointegration. The test is carried out by first examining the whole sample period, and later the whole sample period is divided into two sub-samples for comparison. We argue that ownership restrictions have contributed to the market segmentation of Chinese and Hong Kong's stock markets. We found that there is stronger cointegration relationship between the markets after the implementation of NTS reform occurred during the period of study. Nevertheless, with the stronger price linkages between the shares, the integration process of China and Hong Kong seems to be a gradual progress. There are other factors that further hinder the integration of the two capital markets, which are information asymmetry and investor sentiments.

2. Data and Methodology

The shares of those companies which cross-listed on both markets are collected. Furthermore, in order to get an overview of the whole market performance, stock indices are selected from Shanghai stock exchange, Shenzhen stock exchange and Hong Kong stock exchange. Those indices are Shanghai SSE A index (000002.ss), Shenzhen SZE A share index (399107), and Hang Seng Index (HSI). All stocks' daily closing prices are collected from Yahool Finance website. The earliest starting date available is from 4 January 2000. Therefore, the studying period covers 4 January 2000 to 21 February 2008. There are a total of 50 companies cross-listing in both markets. The exclusive list of those companies is shown in Table 1 in Appendix. The price difference in the table confirms with other researches that find the price discounts in H shares.

In consideration of the methodology to be applied viz-a-viz the cointegration test, it provides more robust results a sample size with a longer time span. Therefore, only a portion of the 50 cross-listed shares are selected. Furthermore, Su et al (2007), conducted a cointegration analysis on A and H shares from the period 1 January 2002 to 30 November 2004. In their analysis, there are a total of 29 cross-listed A and H shares. The same sample period is selected in our analysis in order to assist in comparison with the results in Su et al (2007). Our sample period also include 1 December 2004 to 21 February 2008 when non-tradable reform is carried out. To our knowledge, this period has not been analysed before. The same 29 stocks are selected

in our analysis as well, except for Jilin Chemical Industrial Co. Ltd (Hong Kong code: 368) which was delisted in Hong Kong market and Guangdong Kelong Electrical Holdings Co. Ltd (Hong Kong code: 921), whose H share has stopped trading since 2005. Therefore, a total of 27 companies are selected. The relevant period for each company under study is the date where the share started trading later in either Hong Kong or China's market. The earliest data available is from 4 January 2000.

Furthermore, as the Hong Kong H share prices are quoted in terms of Hong Kong dollars and A shares are quoted in terms of yuan (Chinese currency RMB), their prices are not directly comparable. Therefore, the H share prices are converted to yuan, since the exchange rate is relatively stable (Su and Chong, 2006). All the series are turned into natural log form in our analysis.

Table 2 in Appendix displays the basic statistics for all the price series under study. The stocks are coded based on their Hongkong listing codes, for example the first stock 1033 refers to Sinopec Yizheng Chemical Fibre Co Ltd which can be cross-referenced in table 1. All shares in the following tables will be coded the shares the same way. Panel A exhibits the results for the individual indices. HSI seems to be more volatile in comparison with SSE A and SZE A in the period with reference to standard deviation. Panel B displays the descriptive statistics for individual shares. As the mean of share prices show, A shares are priced higher than H shares for all 50 cross-listed companies.

2.1 Unit root test

The test of cointegration requires that: (1) each price series is integrated in the same order, and (2) the linear combination of both non-stationary series is stationary (Harris, 1995, p22). We relied on the augmend Dickey-Fuller (ADF) test in our analysis for the test of integration.

The test in our research includes a constant in the formula and employs automatic lag length selection using information criteria of a Schwarz Information Criterion (BIC) and a maximum lag length of 25. The test is applied to individual indices and every A share and H share of the selected shares. If every series are found to be of the same order of I(1), they will be eligible to continue to be tested against cointegration tests.

Table 3 in appendix presents the unit root test results.

As the test results show, all of the time series under the time period studied, i.e. from January 2000 till February 2008, are strictly unit root series for 1 percent level. Therefore, cointegration tests can be used on them to examine the market linkages.

2.2 Cointegration Tests

The cointegration relationship is examined by a vector error-correction (VECM) form by the introduction of an error correction form and the variables are first differenced according to Brooks (2002, p403):

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + ... + \Gamma_{k-1} \Delta z_{t-k+1} + \Pi z_{t-k} + \mu_t \qquad (1)$$

Where $\Gamma_i = -(I - A_1 - ... - A_i)$, (i=1,…, k-1)

$$\Pi = -(I - A_1 - ... - A_k)$$

Δ is the first-difference lag operator, z_t is a (n×1) vector of I(1) process, which equals to ($P_t^{SSE\,A}, P_t^{HSI}$) and ($P_t^{SZE\,A}, P_t^{HSI}$) for indices, and ($P_t^{A}, P_t^{H}, P_t^{HSI}, P_t^{SSE\,A}$) for individual shares in our analysis. Π is the error correction form of a (n×n) matrix of parameters whose rank is equal to the number of independent cointegrating vectors, or cointegrating equations. According to Davies (2006), the long-run behavior of the system is contained in the Π matrix of estimated coefficients and the short run dynamic components of the system are in the Γ matrices.

The test of equation 1 will give us the result of the number of cointegrating equations by considering the rank of the Π. Johansen (1988) proposes two methods for estimating the number of cointegration vector, namely the trace test and the maximal eigenvalues test. The rank of a matrix is equal to the number of its eigenvalues denoted as λ_t.

Those two tests are formulated as follows (Brooks, 2002, p404):

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{g} \ln(1 - \hat{\lambda}_i) \qquad (2)$$

And

$$\lambda_{max\,(r,r+1)} = -T ln(1 - \hat{\lambda}_{r+1}) \qquad (3)$$

Where r is the number of cointegrating vectors under the null hypothesis and $\hat{\lambda}_i$ is

the estimated value for the ith ordered eigenvalues from the Π matrix. λ_{trace} is a joint test where the null hypothesis is that the number of cointegrating vectors is less than or equal to r against an unspecified or general alternative that there are more than r (Chen et al., 2002).

In application to our data analysis, the combination of A index and H index, there could be no cointegrating relationships among them or at most two cointegrating relations. For individual stocks, since we include four variables in the model, there can be at most three cointegration relations or no cointegrating relationship at all. If cointegration exists, if means that the two markets are not totally segmented and there exists a long-run relationship between the cross-listed shares.

3. Empirical results

As discussed above, China has undertaken major reforms in its capital market to improve its market efficiency. In the process, it inevitably opens up its market to the world gradually and hence it is assumed that it is more integrated with the world market. Two remarkable policy changes in the recent years in China and relevant in our time period study are: QFII and non-tradable share reform. As the policies of these two changes imply, they will improve the pricing efficiency of the mainland's share market, which means that the pricing mechanism in China is more efficient and similar with the more advanced markets, while QFII further opens up China's stock market to foreign traders. QFII is first introduced in 5 November 2002 while the non-tradable stock reform kicked off on 5 September 2005. In prior literature, it is

found that limited cointegration is documented between China's A share and Hong Kong's H share markets during the period of 1992 till 2004 (Groenewold et al, 2004; Su and Chong, 2006; Su et al, 2007). However, in Su et al (2007), A shares and H shares are reported to be more cointegrated in the year 2004 due to the launch of QFII.

Given a lapse of time, it is reasonable to argue that China is more integrated with the world markets, or at least with its surrounding area. This progress should also be reflected in the stock market, especially in cross-listing shares. Therefore, we assume that there is improvement in the degree of integration in China's market. When reflected in the share prices, they should exhibit increasing level of integration, or from no cointegration to existence of integration. Furthermore, to make a comparison of the results with Su et al (2007) for robustness, we replicate their results for the period 1 January 2002 to 30 November 2004. To further test for the new period, we continue to test the remaining period which is 1 December 2004 to 21 February 2008. To sum up, the cointegration testing is carried out for three time periods, i.e. 1 January 2000 to 21 February 2008 (full sample), 1 January 2002 to 30 November 2004 (replicate sample), and 1 December 2004 to 21 February 2008 (new period).

The test results for the cointegration tests for the three periods are presented in Table 4. In panel A, the test results for a system of equations where two variables are involved are presented. The first system of equations include SSE A and HSI, and the second system of equations include SZE A, and HSI. Panel B reports the cointegration test

results for the equity pairs of A shares, H shares, SSE A and HSI.

Table 4 Johansen cointegration test results

This table presents the Johansen (1988, 1991, 1995) cointegration test results whereby the number of cointegrating equation (or rank) is determined. Panel A presents the results for the combination of A, B ahd H share markets in Shanghai and Shenzhen indexes respectively. Panels B and C reports the test results for the twenty-seven individual cross-listing shares. The sample period covers from January 4 2000 to Feburary 21 2008. The asymptotic critical values for this test are taken from MacKinnon-Haug-Michelis (1999).

	2000-2008		***2002-2004***		***2005-2008***	
	Trace	**Max**	**Trace**	**Max**	**Trace**	**Max**
Panel A: Indices						
SSE A, and HSI						
r=0	11.19080	11.08610	9.278320	9.059684	9.278320	9.059684
r ≤ 1	0.104705	0.104705	0.218637	0.218637	0.218637	0.218637
SZA, and HSI						
r=0	10.43636	10.30107	9.278320	9.059684	9.278320	9.059684
r ≤ 1	0.135293	0.135293	0.218637	0.218637	0.218637	0.218637
Panel B: Individual stocks						
1033						
r=0	37.23911	16.39190	65.52515*	35.54266*	30.61219	13.39622
r ≤ 1	20.84720	12.84260	29.98249*	19.79184	17.21597	9.335461
1055						
r=0	54.98523*	27.56487	54.04665*	26.72696	44.92965	20.32927
r ≤ 1	27.42036	16.26324	27.31969	17.72256	24.60038	14.96361
1065						
r=0	37.81543	19.89853	37.05025	23.00810	34.28653	15.51290
r ≤ 1	17.91690	10.43688	14.04215	8.365035	18.77363	14.08778
1072						
r=0	43.79907	30.98411*	38.69013	18.29262	32.78352	17.94843
r ≤ 1	12.81495	8.272886	20.39752	11.50037	14.83509	8.196329
1108						
r=0	40.40475	17.32311	36.27497	18.11643	32.20277	13.49032
r ≤ 1	23.08165	10.35520	18.15853	11.81867	18.71245	12.76748
1138						
r=0	53.76358*	27.05069	37.45639	21.33521	64.27479*	43.01840*
r ≤ 1	26.71289	15.47953	16.12117	9.947199	21.25639	13.37332
1171						
r=0	44.79353	28.76261*	33.44742	14.20762	52.45155*	28.30702*

Table 3 Cont'd

	2000-2008		*2002-2004*		*2005-2008*	
	Trace	**Max**	**Trace**	**Max**	**Trace**	**Max**
r ≤ 1	16.03092	9.168325	19.23981	11.15628	24.14452	14.99556
168						
r=0	57.07937*	41.84296*	35.79623	17.16507	51.19734*	22.67944
r ≤ 1	15.23641	9.589767	18.63116	11.68627	28.51790	19.94250
177						
r=0	46.61688	27.99187*	35.47552	15.31042	45.35636	32.62332*
r ≤ 1	18.62501	10.61700	20.16510	10.70892	12.73303	8.173443
187						
r=0	50.18271*	28.74101*	28.09530	12.80162	43.53039	20.84380
r ≤ 1	21.44170	11.68581	15.29368	8.524102	22.68659	15.72045
300						
r=0	41.08396	23.53147	32.65493	20.57799	47.41831	29.28665*
r ≤ 1	17.55249	10.03950	12.07694	6.049923	18.13166	11.06068
317						
r=0	47.20200	29.49620*	44.42553	23.57242	41.92688	21.68981
r ≤ 1	17.70580	11.04878	20.85311	14.60727	20.23707	13.11949
323						
r=0	34.19015	18.90036	45.34555	26.54030	36.59331	22.10257
r ≤ 1	15.28979	8.650901	18.80525	11.53273	14.49074	9.173120
338						
r=0	50.15481*	31.48053*	48.01281*	30.29452*	45.15234	26.02064
r ≤ 1	18.67428	10.18911	17.71829	11.91619	19.13171	12.15071
347						
r=0	46.01104	29.10063*	48.06380*	24.60403	48.72588*	30.86231*
r ≤ 1	16.91040	9.881788	23.45977	15.08162	17.86357	9.940143
350						
r=0	38.72507	19.22068	33.13767	17.09558	45.20415	25.88403
r ≤ 1	19.50439	11.61699	16.04208	10.10111	19.32012	15.32518
358						
r=0	37.42268	21.58128	29.64803	14.26567	42.48261	28.30098*
r ≤ 1	15.84140	10.94658	15.38236	9.706134	14.18163	8.357599
386						
r=0	45.29869	25.54804	33.67320	17.48244	58.14399*	35.48860*
r ≤ 1	19.75065	11.11381	16.19076	9.525037	22.65539	16.10480
42						
r=0	37.03559	21.10247	40.80911	20.87107	36.88560	18.02490
r ≤ 1	15.93312	8.920005	19.93804	11.99347	18.86071	14.12027
548						
r=0	34.53810	20.91958	24.30861	12.22251	43.64516	22.31097
r ≤ 1	13.61852	7.931746	12.08609	8.004218	21.33419	14.46091

Table 3 Cont'd

	2000-2008		*2002-2004*		*2005-2008*	
	Trace	Max	Trace	Max	Trace	Max
553						
r=0	46.64541	28.48605*	27.97190	15.92852	44.45870	21.11821
r ≤ 1	18.15935	10.78466	12.04339	6.466577	23.34049	14.43590
670						
r=0	50.05239*	27.98599*	45.39326	24.59546	51.53083*	25.12724
r ≤ 1	22.06640	11.21868	20.79780	13.67445	26.40359	15.64577
719						
r=0	41.07706	19.95808	28.32600	15.24928	53.35744*	29.12441*
r ≤ 1	21.11898	11.24338	13.07672	7.257418	24.23303	15.50625
874						
r=0	67.11915*	51.02324*	26.16311	12.30634	40.13491	21.26919
r ≤ 1	16.09591	11.17061	13.85677	7.332345	18.86572	11.90053
902						
r=0	51.29151*	34.82938*	40.08224	22.24201	36.58449	20.94689
r ≤ 1	16.46213	12.37269	17.84023	12.15900	15.63760	10.67587
914						
r=0	33.01952	18.70903	27.63907	12.96634	64.84285*	23.93159
r ≤ 1	14.31049	7.841420	14.67273	9.706994	40.91126	19.91639
995						
r=0	30.13722	15.85890	30.37219	14.72796	35.93257	20.30420
r ≤ 1	14.27832	9.157733	15.64423	8.756241	15.62837	10.61881

*** Denotes rejection at the 0.05 level**

The second and third column of table 4 report the cointegration test results for the whole sample period. For the purpose of cointegration test, the rank of r is examined which equals the number of cointegrating vectors. If the rank of r is zero, it implies no cointegration is found. If the r is between zero and full rank, cointegration is suggested. The trace test results are used as the major criterion while max test results are able to further confirm the trace test results. (Chan et al, 2001; Su et al, 2007) According to Siklos and Ng (2001), the number of cointegrating vectors reported based on the trace test is thought to have more power than the max test. Therefore, the decision of detecting cointegration relationship is mainly carried on the analysis of

trace test. The null hypothesis of $r \leq 1$ is not rejected in all cointegration tests cases. Hence, the trace statistics of the null hypothesis of up to $r \leq 1$ is reported. The critical values are provided in Johansen and Juselius (1990). In this study, *n* equals two for indices and four for individual price series. The 95 percent critical values for indices are 15.494, 3.841 for λ_{trace}, and 14.264, 3.841 for λ_{max}, corresponding to *r* of zero, one, or two, respectively. The 95 percent critical values for individual shares are 47.856, 29.797, 15.494, 3.841 for $\lambda_{trace,}$ and 27.584, 21.131, 14.264, 3.814 for $\lambda_{max,}$ corresponding to r of zero, one, two or three, respectively.

Before we examine the results of the full sample period, the replicate period is compared first with Su et al (2007). In their paper in regard to the period from 1 January 2002 to 30 November 2004, there are a total of six shares that found cointegrated out of 29 sample shares according to trace test. Excluding the two shares they found cointegrated but not including in our sample, which are share Jilin Chemical Industrial Co. Ltd (368.HK) and Guangdong Kelon Electrical Holdings Co. Ltd (921.HK), there are a total of four shares. In our replicate sample period, there are four shares cointegrated out of 27 sample shares. Comparing the results with Su et al. (2007)'s paper, the results are consistent and hence, it is suggested that our test results are robust.

In regard to our full sample period, our first hypothesis is that China's market is still segmented with Hong Kong's market, as per discussed before. For the test results presented in panel A, either Shanghai's A share index are cointegrated with Hong Kong's market, nor do Shenzhen's A share index. Therefore, China's A share market

is segmented with Hong Kong's market as suggested by market indices. For the result presented in panel B, there are a total of six shares found cointegrated confirmed by both trace test and max test at 5 percent level. The hypothesis of more than one cointegration vectors are rejected for all of them. Therefore, those six shares are cointegrated with one cointegrated relationship. Additionally, according to trace test criterion alone, there are a total of eight shares cointegrated, which implied that the cointegration has become stronger during the whole sample period, while the earlier period under study, i.e. the replicate period, there are only four shares found cointegrated with trace test criterion. However, as the majority of the shares are not cointegrated as well as for the indices, our first hypothesis is confirmed, that China and Hong Kong's stock markets are not cointegration due to ownership restrictions (Laurence et al. 1997; Su et al. 2007).

Hence, it is intuitive to suggest that China's market has been slowly integrated with its surrounding capital markets, in particular the Hong Kong market. Nevertheless, due to its ownership restrictions and institutional features, it is still segmented. Therefore, we undertake cointegration test on the cross-listed shares in the third sample time period, 1 December 2004 to 21 February 2008. If the two institutional changes are successful, it follows that China's market will be more efficient and hence A share price should be closer to the fundamental values. Therefore, A- and H- share prices should move more closely. For example, limited cointegration relationship is found in the early period and there are increased shares that are cointegrated in the third sample period.

However, the failure to establish improved cointegration does not necessarily imply that the institutional changes are unsuccessful. The results of for the period of 2004 to 2008 are presented in Table 4.

As the results shown in panel A of Table 4, the evidence shows rejection of cointegration relationship for the indices in the third sample period and hence rejection of improved cointegration in the third period for the market indices. With regard to panel B, there are a total of five shares found cointegration with one cointegration vector according both tests. In reference to trace test, there are a total of eight shares cointegrated with one cointegrated vectors. Compared with the replicate sample period, which has approximately same number of observations, there are stronger cointegrated relationships between the cross-listed shares. Compared with the whole sample period, the improvement is not obvious.

It is concluded on the basis of the cointegration analysis that prices for the two stock markets are not cointegrated so that there is no long-run equilibrium relationship between them. It is consistent with Su and Chong (2005) and Su et al (2007). However, for the replicate sample period, which is the earlier period, there is weak evidence of cointegrated, which seems to have become stronger in the later sample period. Our evidence supports our second hypothesis, that non-tradable share reforms and QFII has contribute to market linkages of China and Hong Kong's stock markets.

4. Conclusions

This paper addresses the above literature gap by analyzing the relative new time period security data using cointegration technique. To distinguish the period before and after the policy change, the sample period is further divided into two sub-periods. It is found that there are improvement in the number of shares that found cointegrated, which confirms with Su et al. (2007)'s paper. It can be concluded that those policy changes have taken effect in the markets. However, China's market is still segmented with Hong Kong, since most shares are not cointegrated.

Appendix

Table 1 Summary information for China's Cross-listed A- and H- shares

Table 1 lists the exclusive companies that trade their shares both in A share market and H share market by the end of February 2008. The last column indicate the price difference of the same class of shares in two markets, i.e. price difference=price of A share market/Chinese yuan equivalent of H share market price. As can be seen from the table, by the end of February 2008, H shares have been trading at a large discount to A shares. There are a total of 50 companies cross-listed both in A and H share markets.

No.	CN Code	HK Code	Name	HK Listing	CN Listing	China Exchange	Price Difference*
1	600871	1033	Sinopec Yizheng Chemical Fibre Co Ltd	29/03/1994	11/04/1995	SSE	4.73
2	600029	1055	China Southern Airlines Co Ltd	31/07/1997	25/07/2003	SSE	3.16
3	600874	1065	Tianjin Capital Environmental Protection Co	17/05/1994	30/06/1995	SSE	3.19
4	600875	1072	Dongfang Electrical Machinery Co Ltd	06/06/1994	10/10/1995	SSE	2.07
5	600876	1108	Luoyang Glass Co Ltd	08/07/1994	31/10/1995	SSE	N/A
6	600026	1138	China Shipping Development Co Ltd	11/11/1994	23/05/2002	SSE	1.85
7	600188	1171	Yanzhou Coal Mining Co Ltd	01/04/1998	01/07/1998	SSE	1.65
8	600600	168	Tsingtao Brewery Co Ltd	15/07/93	27/08/1993	SSE	1.69
9	600377	177	Jiangsu Express	27/06/1997	16/01/2001	SSE	1.37
10	600860	187	Beiren Printing Machinery Holdings Ltd	06/08/1993	06/05/1994	SSE	4.32
11	600806	300	Shenji Group Kunming Machine Tool Co	07/12/1993	3/01/1994	SSE	2.74
12	600685	317	Guangzhou Shipyard International Co Ltd	06/08/1993	28/10/1993	SSE	1.98
13	600808	323	Maanshan Iron & Steel Co Ltd	03/11/1993	06/01/1994	SSE	2.23
14	600688	338	Sinopec Shanghai Petrochemical Co Ltd	26/07/1993	08/11/1993	SSE	3.95
15	000898	347	Angang Steel Co Ltd	24/07/1997	25/12/1997	SZE	1.51
16	000666	350	Jingwei Textile Machinery Co Ltd	02/02/1996	10/12/1996	SZE	3.83
17	600362	358	Jiangxi Copper Co Ltd	12/06/1997	11/01/2002	SSE	2.86
18	600028	386	China Petroleum & Chemical Corporation	19/10/2000	08/08/2001	SSE	2.27
19	000585	42	Northeast Electric Development Co Ltd	06/07/1995	13/12/1995	SZE	4.81
20	600548	548	Shenzhen Expressway Co Ltd	12/03/1997	25/12/2001	SSE	1.75
21	600775	553	Nanjing Panda Electronic Co Ltd	02/05/1996	18/11/1996	SSE	5.35
22	600115	670	China Eastern Airlines Corporation Ltd	05/02/1997	05/11/1997	SSE	3.19
23	000756	719	Shandong Xinhua Pharmaceutical Co Ltd	31/12/1996	06/08/1997	SZE	3.92
24	600332	874	Guangzhou Pharmaceutical Co Ltd	30/10/1997	6/02/2001	SSE	2.81
25	600011	902	Huaneng Power International, Inc	06/12/2001	06/12/2001	SSE	2.05
26	600585	914	Anhui Conch Cement Co Ltd	21/10/1997	07/02/2002	SSE	1.3
27	600012	995	Anhui Expressway Co Ltd	13/11/96	7/01/2003	SSE	1.43
28	000921	921	Hisense Kelon Electrical Holdings Co Ltd	23/07/1996	13/07/1999	SZE	N/A
29	601398	1398	Industrial and Commercial Bank of China	27/10/2006	27/10/2006	SSE	1.38

Table 1 Cont'd

No.	CN Code	HK Code	Name	HK Listing	CN Listing	China Exchange	Price Difference
30	600036	3968	China Merchants Bank Co, Ltd	22/09/2006	09/04/2002	SSE	1.31
31	601088	1088	China Shenhua Energy Co Ltd	15/06/2005	09/10/2007	SSE	1.54
32	601628	2628	China Life Insurance Co Ltd	18/12/2003	09/01/2007	SSE	1.44
33	601857	857	PetroChina Co Ltd	07/04/2000	05/11/2007	SSE	2.23
34	601600	2600	Aluminium Corporation of China Ltd	12/12/2001	30/04/2007	SSE	2.43
35	601318	2318	Ping An Insurance (Group) Co of China Ltd	24/06/2004	01/03/2007	SSE	1.36
36	601328	3328	Bank of Communications Co, Ltd	23/06/2005	15/05/2007	SSE	1.43
37	601998	998	China CITIC Bank Corporation Ltd	27/04/2007	27/04/2007	SSE	2.24
38	601919	1919	China COSCO Holdings Co Ltd	30/06/2005	26/06/2007	SSE	1.82
39	601390	390	China Railway	03/12/2007	07/12/2007	SSE	N/A
40	601111	753	Air China Ltd	15/12/04	18/08/2006	SSE	2.92
41	601991	991	Datang International Power Generation Co,	21/03/1997	20/12/2006	SSE	3.4
42	601808	2883	China Oilfield Services Ltd	20/11/2002	28/09/2007	SSE	2.26
43	601939	939	China Construction Bank Corporation	27/10/2005	25/09/2007	SSE	1.52
44	000063	763	ZTE Corporation	09/12/2004	18/11/1997	SZE	1.76
45	601333	525	Guangshen Railway Co Ltd	14/05/1996	22/12/2006	SSE	1.68
46	600027	1071	Huadian Power International Corporation	30/06/1999	3/02/2005	SSE	3.31
47	601588	588	Beijing North Star Co Ltd	14/05/1997	16/10/2006	SSE	3.85
48	000338	2338	Weichai Power Co Ltd	11/03/2004	30/04/2007	SZE	2.18
49	601005	1053	Chongqing Iron & Steel Co Ltd	17/10/1997	28/02/2007	SSE	2.85
50	601988	3988	Bank of China Ltd	07/12/2006	05/07/2006	SSE	1.87

*Denotes: The price difference in Table 1 is defined as price of A shares divided by price of H shares, as of the date of February 21 2008.

Table 2 Descriptive statistics for stock price series

	Mean	Maximum	Minimum	Kurtosis	Jarque-Bera	Standard Deviation
Panel A						
SSE A	2058.707	6395.76	1062.45	7.533	333.898	1082.208
SZE A	561.456	1659.61	119.23	6.449	2199.358	305.8191
HSI	14570.51	31638.22	8409.01	4.814	775.094	4326.331
Panel B:	**Individual Stocks**					
1033 A share	5.529	16.110	1.840	6.501	1911.976	2.357
H share	1.779	10.590	0.679	26.81605	51262.740	1.311
1055 A share	6.483	28.730	2.240	6.500	1317.597	6.402
H share	3.672	13.416	1.644	6.865	1377.161	2.148
1065 A share	7.198	12.830	2.830	2.093	69.178	2.477
H share	1.940	5.854	0.287	4.240	376.881	1.042
1072 A share	17.096	96.020	4.520	8.049	3988.835	19.908
H share	9.275	71.333	0.286	7.576	3353.452	15.516
1108 A share	6.288	13.220	2.170	2.059	87.516	2.696
H share	0.943	2.866	0.329	7.047	1523.619	0.341
1138 A share	10.409	43.390	3.730	6.619	1787.670	8.626
H share	7.106	26.275	1.243	4.455	618.294	5.665
1171 A share	10.097	26.950	4.990	6.609	2111.861	3.709
H share	5.695	17.176	0.956	2.758	228.751	3.696
168 A share	11.225	43.290	5.91	9.244	5216.658	7.364
H share	7.201	33.803	0.797	5.691	1394.275	6.144
177 A share	7.652	11.680	4.360	1.812	104.590	1.981
H share	3.505	9.693	0.945	3.167	201.127	1.900
187 A share	7.086	14.250	2.680	2.374	62.654	2.562
H share	1.838	4.198	0.393	2.933	2.408	0.759
300 A share	10.241	36.140	2.840	5.649	1362.623	6.367
H share	2.982	22.411	0.372	10.495	6781.692	3.883
317 A share	12.654	97.390	2.260	10.144	6697.818	18.710
H share	6.457	64.963	0.339	8.939	4996.861	12.682
323 A share	3.853	15.100	2.090	9.463	5395.591	2.107
H share	1.969	8.373	0.233	4.014	540.125	1.771
338 A share	5.400	21.840	2.660	9.601	5549.819	3.290
H share	2.181	6.843	0.435	2.363	166.778	1.443
347 A share	6.341	38.200	2.390	10.209	6642.21	6.749
H share	4.42	34.389	0.287	7.747	3367.45	5.879
350 A share	6.469	14.010	2.420	2.383	64.004	2.424
H share	2.105	6.797	0.511	6.066	1585.321	1.177
358 A share	11.189	75.190	3.830	9.230	3875.750	13.214
H share	5.348	29.912	0.616	6.932	1774.578	5.266
386 A share	6.038	28.490	2.690	7.947	2933.632	4.986

Table 2 Cont'd

	Mean	Maximum	Minimum	Kurtosis	Jarque-Bera	Standard Deviation
H share	3.488	12.605	0.775	4.107	497.675	2.598
42 A share	4.463	9.940	1.49	2.255	95.281	1.725
H share	0.900	3.732	0.254	8.087	3607.317	0.578
548 A share	6.547	14.860	2.820	3.433	16.919	2.377
H share	3.096	9.134	1.020	3.746	396.321	1.822
553 A share	10.445	20.990	2.630	2.082	88.561	4.391
H share	2.190	4.998	0.835	2.977	159.544	0.791
670 A share	5.106	22.810	2.130	14.750	13781.25	3.149
H share	1.607	9.405	0.681	16.058	16884.19	1.266
719 A share	8.234	24.850	2.480	2.521	136.858	4.319
H share	1.608	3.883	0.478	3.293	72.881	0.621
874 A share	9.343	18.010	3.990	0.341	99.987	3.434
H share	3.064	9.008	0.849	3.448	448.055	1.856
902 A share	9.814	20.900	4.200	2.426	6.335	3.848
H share	6.634	15.505	3.612	5.014	814.613	2.111
914 A share	17.284	91.270	5.080	6.092	1548.895	19.824
H share	15.104	84.716	1.743	6.259	1553.144	16.817
995 A share	5.924	10.950	4.150	3.499	324.838	1.518
H share	4.222	7.133	1.509	1.683	81.454	1.642

Table 3 Augmented Dickey-Fuller Test Results

Panel A:

	Lag Length	Level	First Difference
SSE A	2	0.621705	-43.82353*
SZE A	1	-0.829615	-15.43060*
HSI	-	0.491640	-44.35169*

Panel B:

	Lag Length	Level	First Difference
1033 A share	1	-1.205392	-41.27915*
H share		-0.802230	-42.79710*
1055 A share	1	1.009076	-29.85614*
H share		-0.741997	-28.68629*
1072 A share	1	1.243051	-41.06367*
H share		0.116558	-41.51318*
1065 A share	1	-1.474585	-41.46341*
H share		-1.845590	-45.65580*
1108 A share	1	-0.851931	-39.00928*
H share		-2.560585	-43.35444*
1138 A share	1	0.378881	-35.33728*
H share		-0.683262	-27.98621*
1171 A share	1	-1.318278	-44.65444*
H share		-1.103817	-41.50980*
168 A share	2	0.716223	-43.37210*
H share		-0.408624	-44.57789*
177 A share	1	-1.517829	-42.32843*
H share		-1.416793	-30.97440*
187 A share	1	-1.459026	-42.47882*
H share		-2.297985	-45.33221*
300 A share	1	-0.593531	-39.81354*
H share		-1.063419	-46.16111*
317 A share	1	0.913896	-41.04972*
H share		0.291445	-44.39348*
323 A share	1	-0.754098	-41.77306*
H share		-0.865331	-43.62189*
338 A share	1	-0.494652	-39.12670*
H share		-1.030592	-42.52938*
347 A Share	1	0.695625	-40.90644*
H share		-0.315754	-42.67348*
350 A share	1	-1.312595	-41.72612*
H share		-1.974253	-42.86944*

Table 3 Cont'd

	Lag Length	Level	First Difference
358 A share	1	0.817735	-34.78173*
H share		-0.515536	-34.92683*
386 A share	1	0.642460	-38.60937*
H share		-0.679926	-39.11061*
42 A share	1	-1.652887	-35.70871*
H share		-2.149160	-38.43543*
548 A share	1	-1.262999	-42.84632*
H share		-0.437436	-43.50230*
553 A share	1	-1.617679	-40.34456
H share		-2.900644	-38.55286*
670 A share	2	-0.034135	-37.56606*
H share		-0.782557	-41.82772*
719 A share	1	-1.279536	-40.20278*
H share		-2.266721	-45.75946*
874 A share	1	-1.118917	-41.01097*
H share		-1.722786	-39.81443*
902 A share	1	-1.355449	-37.22760*
H share		-2.460863	-37.83459*
914 A share	1	1.059674	-37.26624*
H share		-0.307423	-35.29069*
995 A share	1	-1.432856	-37.10527*
H share		-1.588821	-33.98685*

*denotes rejection at 1% level

Reference

Adam, K.;T.Jappelli;A.Menichini;M.Padula;M.Pagano 2002 'Analyse, compare, and apply alternative indicators and monitoring methodologies to measure the evolution of capital market integration' University of Slaerno

Bailey W. 1994 'Risk and return on China's new stock markets: some preliminary evidence' *Pacific-Basin finance journal* Vol.2 pps243-260

Beltratti, A.; B.Bortolotti 2006 'The nontradable share reform in the Chinese stock market' Bocconi University

Brooks, C. 2002 Introductory econometrics for finance Cambridge University Press

Chan,K.C.; L.T.W.Cheng and J.K.Fung 2001 'Ownership restrictions and stock-price behavior in China' *The Chinese economy* Vol.34 No.1 pps29-48

Chan, K.;A.J.Menkveld and Z.S.Yang 2002 'Evidence on the foreign share discount puzzle in China: Liquidity or information asymmetry?' National Center for Economic Research Working Paper

Chong, T.T.;Q.Su 2006 'On the comovement of A and H shares' *The Chinese economy* Vol.39 pps68-86

Eun, C.S.;S.Janakiramanan 1986 'A model of international asset pricing with a constraint on the foreign equity ownership' *Journal of finance* Vol.41

Eun,C.S.;S.Sabherwal 2003 'Cross-border listings and price discovery: evidence from U.S.-listed Canadian Stocks' *The journal of finance* No.2 April

Groenewold,N.;S.Tang and Y.Wu 2004 'The dynamic interrelationships between the greater China share markets' *China Economic Review* Vol.15 pps45-62

Harris, R.D. 1995 Using cointegration analysis in econometric modeling Pearson Education

Johansen,S. 1988 'Statistical analysis of cointegration vectors' *Journal of economic dynamis and control* Vol.12 pgs231-54

Johansen,S.; K. Juselius 1990 'Maximum likelihood estimation and inference on cointegration-with applications to the demand for money' *Oxford bulletin of economics and statistics* Vol.52 pgs 169-210

Kang,H. 1999 ‘The applied cointegration analysis for the open economy: a critical review’ *Open economies review* Vol.10

Kim, Y.;J.Shin 2000 ‘Interactions among China-related stocks Asia-Pacific financial markets’ *Asia-Pacific financial markets* Vol.7 pps97-115

Laurence, M.;F. Cai; S.Qian 1997 ‘Weak form efficient and causality tests in Chinese stock markets’ *Multinational finance journal* Vol.1 pgs291-307

Lok E.;P.S.Kalev 2006 ‘The intraday price behavior of Australian and New Zealand cross-listed stocks’ *International review of financial analysis* Vol.15 pgs377-397

Ma, X.H. 1996 ‘Capital controls, market segmentation and stock prices: evidence from the Chinese stock market’ *Pacific-Basin financial journal* Vol.4 pps219-239

Prasad,E. 2004 ‘China’s growth and integration into the world economy Prospects and challenges’ International Monetary Fund Occasional Paper 232

Siklos,P.;P.Ng 2001 ‘Integration among Asia-Pacific and international stock markets: common stochastic trends and regime shifts’ *Pacific economic review* Vol.6 No.1

Su, Q.S;T.Chong and I.Yan 2007 ‘On the convergence of the Chinese and Hong Kong stock markets: a cointegration analysis of the A and H shares’ *Applied Financial Economics* Vol.17

Sun, Q.; W.H.Tong 2000 ‘The effect of market segmentation on stock prices: the China syndrome’ *Journal of banking and finance* Vol.24 pps1875-1902

Wang, S.S.;L.Jiang 2004 ‘Location of trade, ownership restrictions, and market illiquidity: examining Chinese A- and H-shares’ *Journal of banking and finance* Vol.28