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AUTHORS	Ai-Chi Hsu Shih-Jui Yang Show-Yen Lai

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Ai-Chi Hsu (Taiwan), Shih-Jui Yang (Taiwan), Show-Yen Lai (Taiwan)

Interactions of stock markets in the Greater China area

Abstract

This article examines the causality and cointegration relationship of the Greater China area stock markets. Yeh and Lee (2000) had examined the information transmission of contemporaneous and cross-period by exploring the interaction of unexpected returns within the Greater China area. We also check whether there exists a structural break during sample time. Many articles mentioned Hong Kong stock market played a very important role in the Greater China area before Asia financial crisis. This paper proves China stock market has gained a leading position in the Greater China area gradually after Asia financial crisis.

Keywords: cointegration, causality, Greater China area, structural break, Asia financial crisis.
JEL Classification: G15, C32.

Introduction

The thought of Economic Integration started from various European countries, and the economic regionalization was expanded in Europe in 1948. The European economic zone which was combined by EEC and EFTA worldwide was founded at the beginning and right now European Union is established as well. Moreover, the NAFTA which was formed by the U.S.A., Canada, and Mexico appeared. Though each country in Asian-Pacific Region has differences on the stages of politics and economic development, the economic interaction between those countries is getting close day by day. For this reason, the APEC was established in 1986. In the past 20 years, Asian-Pacific Region has been showing an amazing performance no matter on economic development or trade growth, and it also becomes an economic entity which cannot be ignored by countries all over the world. It makes global economy accept a situation in which Europe, North America, and East Asia are equal in strength.

Every country in Asia has realized the necessity of regional economic integration deeply, so every monetary system and capital innovation are promoted by them in order to step forward to liberalization and internationalization in a high speed and strengthen financial service and solid economic physique even more. It is obvious that the past trade development strategy which considers one country as a unit that pursues economic development in isolation is not workable any more. Thus, the international competitiveness of each specific country can be strengthened and the national economic benefits can be guaranteed only through more active participation in regional economic integration.

The physique of Asia financial market has become sounder after its reconstruction during Asia financial crisis, and the economic center of the whole world has been moved to Asian-Pacific Region gradually. The economic center of it will be concentrated on East Asia. As to foreign exchange reserves, China, Japan, and Taiwan in East Asia are the top three of global foreign exchange reserves so far, and Hong Kong occupies the sixth place. All these results show that the wealth may be moving eastward. Except China, Taiwan, and Hong Kong which belong to China area, the interaction between the Greater China area stock markets is getting closer than it is used to be before. Therefore, there are many scholars who have more frequent discussion on the Greater China area now. We analyze the stock markets interaction here, and try to understand what kind of changes on stock markets of the Greater China area will be observed at the end of the 20th century and the beginning of the 21st century. It is hoped that a very good direction for future development of the Greater China area can be offered.

Chan, Lo and Cheung (1999) development studied the return transmission among stock markets in the Greater China Area and mainly focused on the following countries: Mainland China (especially on Shanghai, Shenzhen), Hong Kong and Taiwan which had been enjoyed tremendous growth and expansion on economics and capital markets in the last decade. A multiple time series approach was adopted in this study and explicitly the lead-lag interaction among those markets was explicitly identified. The estimation results showed the significant multi-variate structures had been presented. These structures could reduce the residual standard error and improve the suitability over the univariate models.

Huang, Yang and Hu (2000) discovered the causality and cointegration relationships among the stock markets in the United States, Japan and the South China Growth Triangle (SCGT) region. Applying recent advanced unit root and cointegration techniques that allowed structural breaks during the sample period (October 2, 1992 to June 30, 1997), they found that no cointegration existed between

these markets except between Shanghai and Shenzhen. By invoking the Granger causality test and considering the non-synchronous trading problem, the result showed that the changes of stock price in the US had more impacts on SCGT markets than those of Japan. More specifically, price changes in the US could be used to predict those of Hong Kong and Taiwan markets the next day. Similarly, price changes of Hong Kong stock market led Taiwan market by 1 day. Furthermore, the stock returns of the US and Hong Kong markets were found to be contemporaneous. Finally, there was a significant feedback relationship between the stock exchanges in Shanghai and Shenzhen.

Yeh and Lee (2000) investigated the investors' response to unexpected returns and the information transmission in the stock markets of the Greater China area. First, we analyzed the asymmetric reaction of return volatility to good and bad news by utilizing generalized autoregressive conditional heteroskedasticity (GARCH) model. We found that the impact of bad news (negative unexpected return) on future volatility was greater than that of good news (positive unexpected return) on the same magnitude in Taiwan and Hong Kong, which was consistent with the previous literature. However, the opposite result was found in the markets of Shanghai and Shenzhen; implying good-news-chasing behavior of the investors. This phenomenon also indicated that behaviors of the investors in Mainland China might be inclined to support the trading noise hypothesis. Furthermore, this study had examined the information transmission of contemporaneous and cross-period by exploring the interaction of unexpected returns among those four markets. The results of a near vector autoregressions (VAR) model revealed that the stock market of Hong Kong played the most influential role (regional force) among the stock markets in Taiwan, Shanghai, and Shenzhen B-share. Finally, the stock returns in the stock market of Taiwan had been quite independent of the Mainland China stock markets, and it became negatively correlated with the Shanghai B-share market during the period of Taiwan Strait Crisis. The interaction among financial markets seemed to be strengthened by political incidents.

Groenewold, Tang and Wu (2004) in their paper investigated the interrelationships between prices on the mainland China share market and those in the neighboring markets of Hong Kong and Taiwan. They found a strong contemporaneous relationship between those two mainland markets, but the mainland markets were considered to be relatively isolated from the other two markets although they already passed the period of Asian crisis. There was evidence showed that Hong Kong had weak predictive power for returns in the mainland. Hong Kong also clearly Granger caused Taiwan although the reverse was not true. Both Hong Kong and Taiwan had strong contemporaneous relationships, and a feature which simply became more marked after the Asian crisis.

Wei, B. Liu and X. Liu (2005) had discovered the existing empirical literature on foreign direct investment (FDI) entry strategies tended to allow a binary choice between wholly owned enterprises (WOEs) and equity joint ventures (EJVs) or between Greenfield investment and acquisition only. That study had specified a multinomial logit model for the choice from all four FDI entry modes in China. Five hypotheses were developed based on transaction cost economics and tested on a data set covering 10,607 foreign investment projects in China. A foreign investor seemed to prefer the WOE mode which could be given a large investment commitment, while a high level country's experience was in attracting FDI, a good specific industrial location, and a high asset intensity in the major industry. If the conditions of major country experience and good specific location could not meet, the EJV and the joint stock company (JSC) modes seemed to be of greater use. A good specific location also made the contractual joint venture (CJV) a preferable entry mode. Compared with overseas Chinese investors from Hong Kong, Macao, and Taiwan, other foreign investors prefer EJVs to WOEs and CJVs. The results had important implications for managers.

Lai and Lau (2006) had examined the profitability of the applications of variable and fixed moving averages as well as trading range breakout (TRB) on nine popular daily Asian market indices from January 1, 1988 to December 31, 2003. The test results provided a strong support for variable moving averages (VMAs), in particular, and fixed moving averages (FMAs) in the stock markets of China, Thailand, Taiwan, Malaysia, Singapore, Hong Kong, Korea, and Indonesia. The length of 20 days and 60 days appeared to be the most profitable time for variable and fixed moving averages, respectively. The technical attractiveness of trading rules offered many profitable opportunities for market participants.

Globalization is a re-emerging trend since 1980's, and the trend of Globalization is built on production and division of work in the whole world or on operational system. Though financial globalization has undoubtedly improved the service efficiency of the global fund, it has increased range and uncertainty of fluctuations in the international financial market.

In addition, given that economic relationships between various countries are being closer and closer, the environmental consciousness of everlasting development keeps running high under a circumstance that the resource is limited in the whole world, and this facilitates the arrival of "Global Village". During the time of "Globalization", we also see the regional cooperation replace politics confront. The regional cooperation mechanisms of European Union, APEC, NAFTA, ASEAN..., etc. are all in the developing phase. In the 21st century, maintaining the peace, pursuing everlasting development and non-stop improvement of human civilization are the common responsibilities of every member in this global village. Promoting the collective security of the area, and prosperity and progress of regional and even global economy together is a common responsibility in the Greater China area. If the regional economic cooperation spirit of sharing resource and blooming economy can be supported together in the Greater China area, and bring its influence into economy in Asia or even the whole world, the relationship between both sides can not only be strengthened, but a more active and constructive role can also be played on the world stage.

1. Data description

Our data are collected from Taiwan Economic Journal (TEJ) database. The initial sample contains 2,531 stock index sources of Taiwan, Hong Kong, China stock markets and includes Shenzhen Component Index (Shtz) and Shanghai Composite Index (Sihi). We have selected samples from the years of 1996 to 2005.

2. Methodology

Vector autoregression; VAR (Noncointegration):

According to Sims (1980), who proposed VAR model the structural model could recognize the question.

$$Y_t = \alpha + \sum_{s=1}^{m} \beta_s Y_{t-s} + \mu_t,$$

where $t = 1, \ldots, T$, α is a $1 \times p$ unknown vector, $B_s (s = 1,\ldots,L)$ is an unknown $p \times p$ matrix, $\mu_1, \ldots, \mu_T$ are independently and identically distributed (iid) normal $N_p(0;\Sigma)$ errors, with a p×p unknown covariance matrix Σ.

Granger causality tests:

The Granger (1969) approach to the question of whether x causes y is to see how much of the current y can be explained by past values of y and then to see whether adding lagged values of x can improve the explanation. y is said to be Granger-caused by x if x helps in the prediction of y, or equivalently if the coefficients on the lagged x's are statistically significant. Note that two-way causation is frequently the case; x Granger causes y and y Granger causes x.

Assume a particular autoregressive lag length p, and estimate the following unrestricted equation by ordinary least squares (OLS):

$$x_t = c_1 + \sum_{i=1}^{p} \alpha_i x_{t-i} + \sum_{i=1}^{p} \beta_i y_{t-i} + \mu_t$$

for all possible pairs of (x, y) series in the group. The reported F-test are the Wald statistics for the joint hypothesis:

$$H_o : \beta_1 = \beta_2 = \ldots = \beta_p = 0.$$

Use an F-test of the null hypothesis by estimating the following restricted equation also by OLS:

$$x_t = c_t + \sum_{i=1}^{p} \gamma_i x_{t-i} + e_t.$$

Compare their respective sum of squared residuals.

$$RSS_1 = \sum_{t=1}^{T} \hat{u}_t^2 \quad RSS_0 = \sum_{t=1}^{T} \hat{e}_t^2 .$$

If the test statistic

$$S_1 = \frac{(RSS_0 - RSS_1 / p)}{RSS_1 / (T - 2p - 1)} \sim F_{p, T-2p-1}$$

is greater than the specified critical value, then reject the null hypothesis that y does not Granger-cause x.

It is worth noting that with lagged dependent variables, as in Granger-causality regressions, the test is valid only asymptotically. An asymptotically equivalent test is given by

$$S_1 = \frac{T(RSS_0 - RSS_1)}{RSS_1} \sim \chi^2(p).$$

Another caveat is that Granger-causality tests are very sensitive to the choice of lag length and to the methods employed in dealing with any non-stationarity of the time series.

Cointegration test:

In order to maintain the material long-term dynamic relation increases the explanatory ability of the model. Applying cointegration test to the stock index enables to confirm whether the cointegration rela-

tions exist. If there are cointegration relations, then this research uses VECM to make the empirical analysis. If cointegration does not exist, VAR would be adopted in this research for the empirical analysis. This research has adopted Johansen (1988) and Juselius' (1990) idea and put forward maximum-likelihood and traced test to examine whether the cointegration relations exist in each sub-period.

VECM model:

By using Unit root test and Cointegration test above, we confirmed that the stock index combined with cointegration. It was possible to use cointegration regression error (Eit) combined with a revise such as an error in ECM model in order to weigh the balanced relation and book the array parameter of the attitude for dealing with other parameters. This was divided into steps for a long time. It was used as a measurement of model in a short time. This research adopted VECM model for performing the truth analysis.

Unit root test:

In order to stroll (random walk) at random movement trend of the index of the stock price and nonstationarity, regression analysis on stock index was made which might produce spurious regression. In order to avoid the problems that would take place before truth analysis, we must probe into stock index of each country to see if it was still stationary. This could be examined if the phenomenon of unit root existed. This research adopted the ADF unit root test of Said and Dickey (1984) which put forward assay of parameter normality.

The result of the unit root test suggested that the stock index for nonstationarity was I (1) and the rate of returns (first order divide) showed competence 1% times; H_0 that refused nonstationarity was necessary, namely the parameter, and the first order divide made the stationary parameter, i.e. I (0). Therefore, all stock index data should cope with the rate of returns.

Quandt-Andrews breakpoint test:

Andrews (1993) and Ploberger (1994) designed the Quandt-Andrews breakpoint test which can be used for testing one or more unknown structural breakpoints in an equational sample. They used the analyzed structure with extensive and multi methods to change the question assay which included Wald, Lagrange multiplier, and Likelihood ration-like tests.

3. Empirical results

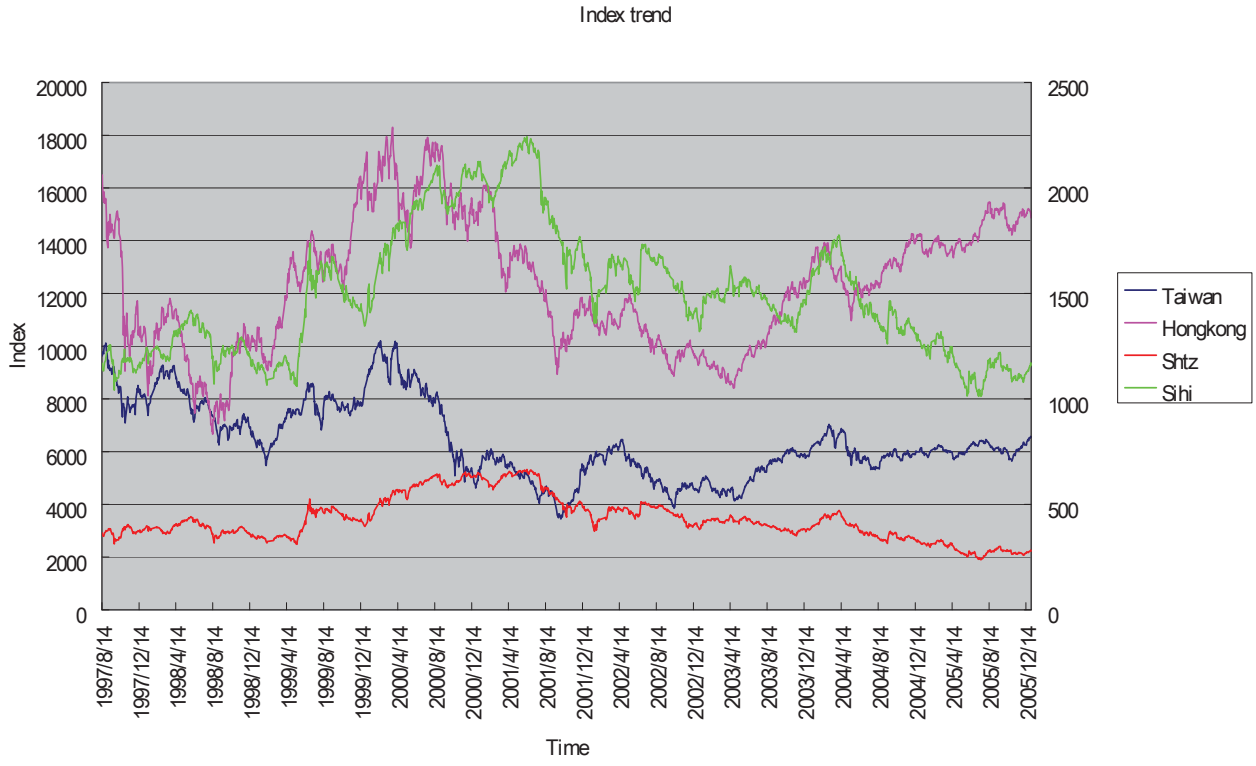

Fig. 1. The Greater China Area Index Trend

From Figure 1 above, it was found that there was an obvious fall between the Hong Kong and Taiwan stock markets during 1997 and 1998. Hong Kong had exceeded 50% falling, and Taiwan had dropped nearly 40%. The obvious fluctuating situation had not taken place in the markets of Shenzhen and Shanghai instead, it was actually the period of Asia Financial Crisis.

Moreover, stock markets of Hong Kong and Taiwan went through greater amount of falling within years of 2000 to 2001. Hong Kong had dropped nearly 60%, and Taiwan had exceeded 60% falling. Meanwhile, Shenzhen and Shanghai had gone through a fall in their stock markets which also had exceeded 20% as well. During this period of time, the network High-tech stock which was caused by The Burst of Internet Bubbles in 2000 brought a huge fall, and it also caused the falling of stock market of the Greater China Area.

From Table 1, it was found that Hong Kong and Taiwan play a role of causal relationship. As to Taiwan and Shtz, Taiwan is a cause, while Shtz is an effect. Taiwan and Sihi played a role of causal relationship. Hong Kong and Shtz played a role of causal relationship. Hong Kong and Sihi played a role of causal relationship. This finding is unexpected since Hong Kong has played a leading position in the Greater China Area in the most research documents, and Taiwan comes after that. The stock market of Hong Kong is considered to have greater influence on the stock market of the Greater China Area, but the result of Granger Causality Tests reveals that the stock market of Hong Kong and other markets in the Greater China area seem to influence each other. There is no causal relationship while it does exist in SHTZ and Taiwan. Taiwan is a cause while Shtz is an effect which stands for different views from most papers. A more detailed analysis and discussion about the interactive influence in the Greater China area will be seen in the Variance Decomposition later.

Table 1. Granger causality tests

Null hypothesis:	Obs	F-statistic	Probability
H_0: HONGKONGR does not Granger cause TAIWANR	2075	9.38571*	8.8E-05
H_0: TAIWANR does not Granger cause HONGKONGR		0.46397	0.62885
H_0: SHTZR does not Granger cause TAIWANR	2078	2.19552	0.11156
H_0: TAIWANR does not Granger cause SHTZR		0.61410	0.54123
H_0: SIHIR does not Granger cause TAIWANR	2078	2.82376*	0.05961
H_0: TAIWANR does not Granger cause SIHIR		0.48135	0.61802
H_0: SHTZR does not Granger cause HONGKONGR	2075	2.18469	0.11277
H_0: HONGKONGR does not Granger cause SHTZR		1.21132	0.29802
H_0: SIHIR does not Granger cause HONGKONGR	2075	2.22201	0.10865
H_0: HONGKONGR does not Granger cause SIHIR		4.00228*	0.01842
H_0: SIHIR does not Granger cause SHTZR	2078	1.16682	0.31156
H_0: SHTZR does not Granger cause SIHIR		3.60787*	0.02728

Note: * 10% significance level.

From Table 2, we found that cointegration exists in Taiwan, Shtz and Sihi and so does in Shtz and Sihi. In order to solve cointegration problem, VECM is adopted for analyzing.

Regarding stock price of Taiwan and Hong Kong, as dependent variable changed, the measurement has stored unit root separately and finally found that there is unit root. Regarding stock price of Shtz, as dependent variable changes, the measurement has stored unit root separately and finally found that there is unit root in residual. The unit root situation is needed in order to make China's residual examined in Table 3.

Result that has been found in Shtz states that the residual does not have unit root, so we can keep going to the next step. Regarding Taiwan as a dependent variable, Hong Kong, Shtz and Sihi's residuals are considered to be the independent variables and all are at *t*-1 stages. The result shows that residual still does not have unit root in Table 4, so VECM model, Impulse Response, Variance Decomposition are exercised.

Table 2. Cointegration test

Taiwan & Hong Kong		
	Max-L	Trace
$H_0 : \gamma = 0$	4.468732	4.502905
$H_1 : \gamma = 1$	0.034173	0.034173

Table 2 (cont.). Cointegration test

Taiwan & Shtz		
	Max-L	Trace
$H_0 : \gamma = 0$	10.37576	13.94856*
$H_1 : \gamma = 1$	3.572797*	3.572797*
Taiwan & Sihi		
	Max-L	Trace
$H_0 : \gamma = 0$	11.90373	15.09031*
$H_1 : \gamma = 1$	3.186577*	3.186577*
Hong Kong & Shtz		
	Max-L	Trace
$H_0 : \gamma = 0$	6.784743	7.624237
$H_1 : \gamma = 1$	0.839494	0.839494
Hong Kong & Sihi		
	Max-L	Trace
$H_0 : \gamma = 0$	6.474567	7.526083
$H_1 : \gamma = 1$	1.051516	1.051516
Shtz & Sihi		
	Max-L	Trace
$H_0 : \gamma = 0$	7.296556	10.48848
$H_1 : \gamma = 1$	3.191924*	3.191924*

Table 3. Unit root test

			t-statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3.616430	0.0286
Test critical values:	-3.962755		-3.962321	
	-3.412114		-3.411902	
	-3.127974		-3.127848	

Table 4. Unit root test

			t-statistic	Prob.*
Augmented Dickey-Fuller test statistic			-43.34557	0.0000
Test critical values:	-3.962618		-3.962321	
	-3.412047		-3.411902	
	-3.127935		-3.127848	

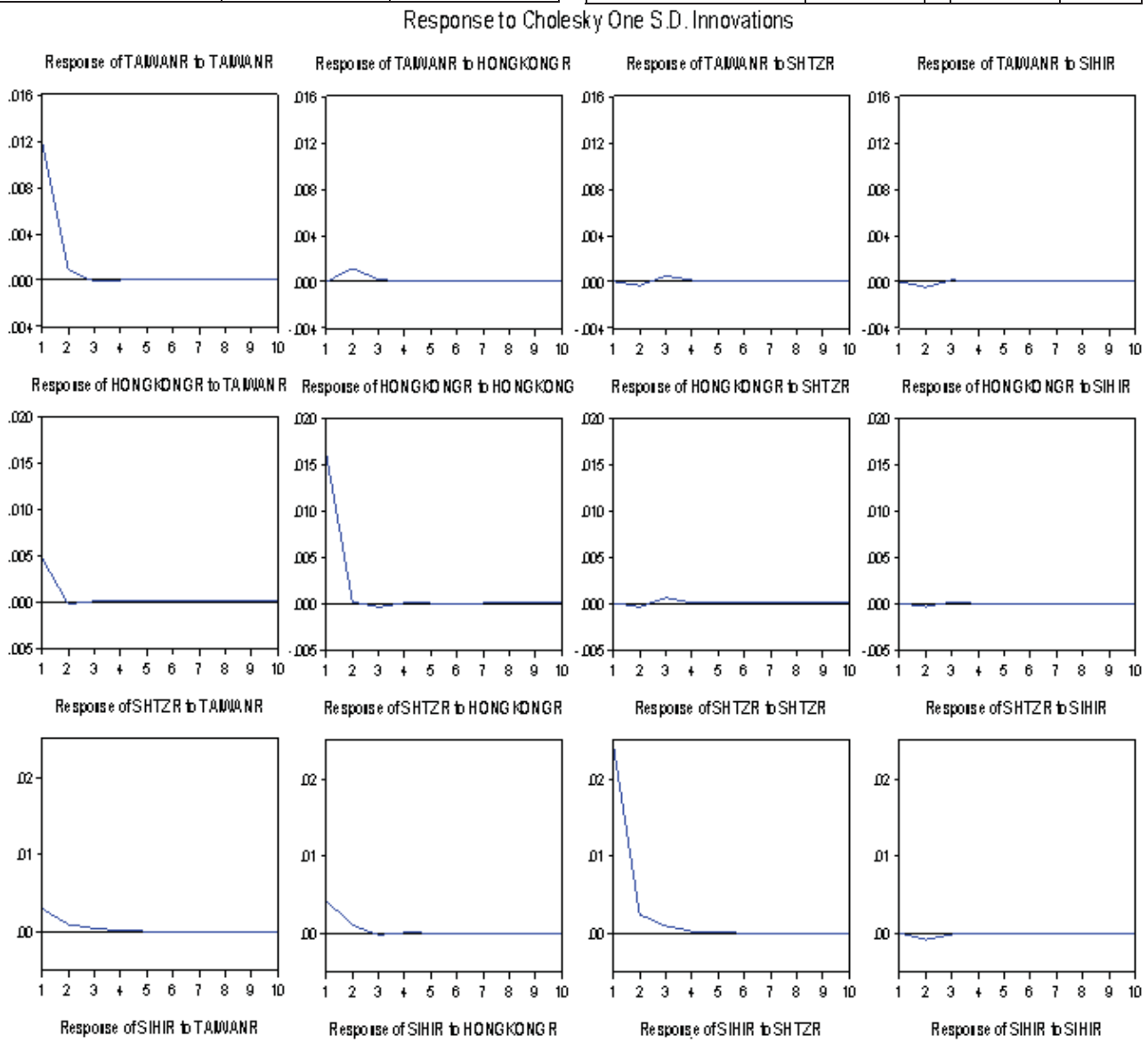

Fig. 2. Impulse response

From Figure 2 we have found some conditions as follows:

1. Taiwan will receive influence from Hong Kong and itself, but others will not be influenced.
2. Hong Kong will receive influence from Taiwan and itself, but others will not be influenced.
3. Shtz will receive influence from Taiwan, Hong Kong and itself, but Sihi will receive few influences.
4. Sihi will receive influence from Taiwan, Hong Kong, Shtz and itself.

From Table 5, we have gained greater insigth into the Variance Decomposition on the following relationships:

1. In the variance decomposition of Taiwan's stock index return, we find that it is influenced by itself accounting for 98.77935%, and the influence by other areas is very low, so we do not need to consider these regional impacts on stock index return of Taiwan.
2. In the variance decomposition of Hong Kong index stock return, the biggest influence comes from itself which is 91.87452% and the second influence which is 7.877654% comes from Taiwan. Though influence from Shtz and Sihi is just a little, it should not be neglected.
3. In the variance decomposition of Shtz stock return, the biggest influence comes from itself which is 95.41356%, the second influence is 3.153489% from Hong Kong and the influence from Taiwan is 1.312449%. At this moment, Sihi stock return does not really influence it.
4. In the variance decomposition of Sihi index stock return, the biggest influence comes from itself which is 38.33867% and it also brings a tremendous influence (the greatest one) which is 56.35864% and comes from Shtz, 4.110378% from Hong Kong, and 1.192312% from Taiwan.

Table 5. Variance decomposition

Variance decomposition of TAIWANR:					
Period	S.E.	TAIWANR	HONGKONGR	SHTZR	SIHIR
1	0.011974	100.0000	0.000000	0.000000	0.000000
10	0.012066	98.77935	0.816302	0.251848	0.152498
Variance decomposition of HONGKONGR:					
Period	S.E.	TAIWANR	HONGKONGR	SHTZR	SIHIR
1	0.016911	7.895170	92.10483	0.000000	0.000000
10	0.016938	7.878654	91.87452	0.197833	0.048993
Variance decomposition of SHTZR:					
Period	S.E.	TAIWANR	HONGKONGR	SHTZR	SIHIR
1	0.024746	1.324271	3.040845	95.63488	0.000000
10	0.024912	1.312449	3.153489	95.41356	0.120502
Variance decomposition of SIHIR:					
Period	S.E.	TAIWANR	HONGKONGR	SHTZR	SIHIR
1	0.023137	1.208541	3.662360	56.19480	38.93430
10	0.023351	1.192312	4.110378	56.35864	38.33867

From 1996 to 2005, the sample is relatively big and there may be structural questions. In order to solve the problem that has been mentioned above, namely, Cointegration, we should probe into the structural changes. If the return of Shtz stock is regarded as dependent variable separately now, stock index return of Sihi is independent variable. Making structural breakpoint test, we find that Shtz has some structural changes that have emerged after Asia financial crisis of Sihi. Take Table 6 for example, no matter Maximum LR F-statistic or Maximum Wald F-statistic is in its value which is 142.4716 in total or not, there are still structural changes on July 28th, 1997 which is very apparent.

If the return of Hong Kong stock is regarded as dependent variable separately now, stock index return of Taiwan is independent variable. Making structural breakpoint test, we find that Shtz has some structural changes that have emerged after Asia financial crisis of Taiwan. Take Table 6 for example, no matter Maximum LR F-statistic or Maximum Wald F-statistic is in its value which is 38.51414 in total or not, there are still structural changes on December 2th, 1997 which is very apparent.

If the return of Hong Kong stock is regarded as dependent variable separately now, stock index return of Sihi is independent variable. Making structural breakpoint test, we find that Hong Kong has some

structural changes that have emerged after Asia financial crisis of Sihi. Take Table 6 for example, no matter Maximum LR F-statistic or Maximum Wald F-statistic is in its value which is 14.65054 in total or not, there are still structural changes on October 20th, 1998 which is very apparent.

If the return of Sihi stock is regarded as dependent variable separately now, stock index return of Taiwan is independent variable. Making structural breakpoint test, we find that Sihi has some structural changes that have emerged after Asia financial crisis of Taiwan. Take Table 6 for example, no matter Maximum LR F-statistic or Maximum Wald F-statistic is in its value which is 23.86084 in total or not, there are still structural changes on August 10th, 1999 which is very apparent.

Table 6. Quandt-Andrews breakpoint test

	Shtz causes Sihi		Hong Kong causes Taiwan		Hong Kong causes Sihi		Sihi causes Taiwan	
Statistic	date	value	date	value	date	value	date	value
Maximum LR F-statistic	7/28/1997	142.4716*	12/02/1997	38.51414*	10/20/1998	14.65054*	8/10/1999	23.86084*
Maximum Wald F-statistic	7/28/1997	142.4716*	12/02/1997	38.51414*	10/20/1998	14.65054*	8/10/1999	23.86084*

Note: * 1% significance level.

We have discovered four breakpoints on July 28th, 1997, December 2nd, 1997, October 20th, 1998 and August 10th, 1999. There is an interesting discovery here which is that these four breakpoints can be discussed as one stage before Asia financial crisis takes place, three stages while it is happening, and five stages after it is finished. There is some interesting information found in the discussion.

From Table 7 we discovered that before the financial crisis occurs, except Shtz brings influence on Sihi, other markets all act as a causal relationship in the Greater China Area.

At the earlier stage of Asian financial crisis (see Table 8) Taiwan brings influence on Hong Kong, Shtz brings influence on Hong Kong, Sihi brings influence on Hong Kong, and other markets act as a causal relationship in the Greater China Area.

At the middle stage of Asian financial crisis (Table 9) Hong Kong brings influence on Sihi, and other markets act as a causual relationship in the Greater China Area.

At the later stage of Asian financial crisis (see Table 10) Taiwan brings influence on Shtz, Taiwan brings influence on Sihi, other markets act as a causal relationship in the Greater China Area.

After Asian financial crisis is finished (see Table 11) Hong Kong brings influence on Taiwan, Shtz brings influence on Taiwan, Shtz brings influence on Hong Kong, Sihi brings influence on Hong Kong, and other markets act as a causal relationship in the Greater China Area.

Table 7. Granger causality tests (before Asian financial crisis)

Before Asian financial crisis (1/04/1996~7/25/1997)			
Null hypothesis:	Obs	F-statistic	Probability
H_0: HONGKONGR does not Granger cause TAIWANR	322	0.00800	0.99204
H_0: TAIWANR does not Granger cause HONGKONGR		1.95104	0.14383
H_0: SHTZR does not Granger cause TAIWANR	322	0.10341	0.90179
H_0: TAIWANR does not Granger cause SHTZR		0.24438	0.78334
H_0: SIHIR does not Granger cause TAIWANR	322	0.12459	0.88291
H_0: TAIWANR does not Granger cause SIHIR		0.03715	0.96354
H_0: SHTZR does not Granger cause HONGKONGR	322	1.06266	0.34676
H_0: HONGKONGR does not Granger cause SHTZR		0.09248	0.91169
H_0: SIHIR does not Granger cause HONGKONGR	322	0.97612	0.37790
H_0: HONGKONGR does not Granger cause SIHIR		0.01732	0.98283
H_0: SIHIR does not Granger cause SHTZR	322	0.25670	0.77376
H_0: SHTZR does not Granger cause SIHIR		4.92749*	0.00781

Note: * 1% significance level.

Table 8. Granger causality tests (the first stage of Asia financial crisis)

The first stage of Asia financial crisis (7/28/1997~12/01/1997)			
Null hypothesis:	Obs	F-statistic	Probability
H_0: HONGKONGR does not Granger cause TAIWANR	73	1.53671	0.22246
H_0: TAIWANR does not Granger cause HONGKONGR		3.40657*	0.03891
H_0: SHTZR does not Granger cause TAIWANR	73	0.00221	0.99780
H_0: TAIWANR does not Granger cause SHTZR		0.82361	0.44317
H_0: SIHIR does not Granger cause TAIWANR	73	0.07001	0.93245
H_0: TAIWANR does not Granger cause SIHIR		0.73098	0.48518
H_0: SHTZR does not Granger cause HONGKONGR	73	7.34725**	0.00129
H_0: HONGKONGR does not Granger cause SHTZR		0.37692	0.68740
H_0: SIHIR does not Granger cause HONGKONGR	73	4.50831*	0.01450
H_0: HONGKONGR does not Granger cause SIHIR		0.57446	0.56572
H_0: SIHIR does not Granger cause SHTZR	73	0.24142	0.78618
H_0: SHTZR does not Granger cause SIHIR		1.24897	0.29330

Notes: ** 1% significance level; * 5% significance level.

Table 9. Granger causality tests (the middle stage of Asia financial crisis)

The middle stage of Asia financial crisis (12/2/1997~10/19/1998)			
Null hypothesis:	Obs	F-statistic	Probability
H_0: HONGKONGR does not Granger cause TAIWANR	180	1.34876	0.26225
H_0: TAIWANR does not Granger cause HONGKONGR		0.31525	0.73002
H_0: SHTZR does not Granger cause TAIWANR	180	2.00684	0.13749
H_0: TAIWANR does not Granger cause SHTZR		1.78092	0.17152
H_0: SIHIR does not Granger cause TAIWANR	180	1.98060	0.14107
H_0: TAIWANR does not Granger cause SIHIR		0.26803	0.76520
H_0: SHTZR does not Granger cause HONGKONGR	180	0.71713	0.48958
H_0: HONGKONGR does not Granger cause SHTZR		1.29336	0.27696
H_0: SIHIR does not Granger cause HONGKONGR	180	1.75465	0.17600
H_0: HONGKONGR does not Granger cause SIHIR		4.96449*	0.00800
H_0: SIHIR does not Granger cause SHTZR	180	0.96083	0.38458
H_0: SHTZR does not Granger cause SIHIR		0.28694	0.75091

Note: * 1% significance level.

Table 10. Granger causality tests (the later stage of Asia financial crisis)

The later stage of Asia financial crisis (10/20/1998~8/9/1999)			
Null hypothesis:	Obs	F-statistic	Probability
H_0: HONGKONGR does not Granger cause TAIWANR	168	2.17251	0.11718
H_0: TAIWANR does not Granger cause HONGKONGR		0.77565	0.46210
H_0: SHTZR does not Granger cause TAIWANR	168	0.08919	0.91472
H_0: TAIWANR does not Granger cause SHTZR		2.85076*	0.06069
H_0: SIHIR does not Granger cause TAIWANR	168	1.79707	0.16905
H_0: TAIWANR does not Granger cause SIHIR		2.89403*	0.05820
H_0: SHTZR does not Granger cause HONGKONGR	168	1.88309	0.15541
H_0: HONGKONGR does not Granger cause SHTZR		0.40179	0.66978

Table 10 (cont.). Granger causality tests (the later stage of Asia financial crisis)

Null hypothesis:	Obs	F-statistic	Probability
H_0: SIHIR does not Granger cause HONGKONGR	168	0.39049	0.67735
H_0: HONGKONGR does not Granger cause SIHIR		0.57473	0.56399
H_0: SIHIR does not Granger cause SHTZR	168	0.52379	0.59327
H_0: SHTZR does not Granger cause SIHIR		1.17596	0.31113

Note: * 10% significance level.

Table 11. Granger causality tests (after Asia financial crisis)

After Asia financial crisis (8/10/1999~12/29/2005)			
Null hypothesis:	Obs	F-statistic	Probability
H_0: HONGKONGR does not Granger cause TAIWANR	1324	2.67808*	0.06907
H_0: TAIWANR does not Granger cause HONGKONGR		0.02314	0.97712
H_0: SHTZR does not Granger cause TAIWANR	1327	3.91746**	0.02012
H_0: TAIWANR does not Granger cause SHTZR		0.08827	0.91552
H_0: SIHIR does not Granger cause TAIWANR	1327	2.14041	0.11801
H_0: TAIWANR does not Granger cause SIHIR		0.34824	0.70599
H_0: SHTZR does not Granger cause HONGKONGR	1324	3.27169*	0.03825
H_0: HONGKONGR does not Granger cause SHTZR		1.39716	0.24766
H_0: SIHIR does not Granger cause HONGKONGR	1324	5.16710****	0.00582
H_0: HONGKONGR does not Granger cause SIHIR		2.29696	0.10097
H_0: SIHIR does not Granger cause SHTZR	1327	1.67729	0.18728
H_0: SHTZR does not Granger cause SIHIR		0.30309	0.73859

Notes: *** 1% significance level; ** 5% significance level; * 10% significance level.

1. Before Asia financial crisis (1/4/1996 ~ 7/27/1997):

China, Hong Kong and Taiwan influence each other in the Greater China area, but Shtz brings influence on Sihi in China's stock market at this moment. Shtz has a leading position in China's stock market.

2. The first stage of Asia financial crisis (7/28/1997 ~ 12/1/1997):

Asia financial crisis begins to take place and brings impacts on Hong Kong stock market in the Greater China area at this moment. Thus, no matter Taiwan or China has influence on Hong Kong.

3. The middle stage of Asia financial crisis (12/2/1997 ~ 10/19/1998):

Due to the proper policy that Hong Kong government is persuing at this moment, Hong Kong is prevented from falling into a more serious impact. Meanwhile, Hong Kong brings immediate influence on Sihi while other markets influence each other in the Greater China area.

4. The later stage of Asia financial crisis (10/20/1998 ~ 8/9/1999):

The stock markets in the Greater China area roughly reveal steady growth and recovery at the later stage of Asia financial crisis. Taiwan occupies a leading position in China's stock market at this moment because Taiwan suffers less from Asia financial crisis. Therefore, the Greater China area has a leading position at this moment.

5. After Asia financial crisis (8/10/1999 ~ 12/29/2005):

Asia financial crisis is finished at this moment, and the financial order of the Greater China area goes back to normal. Shtz and Sihi in China have suitable leading positions obviously in the Greater China area at this moment. And the situation of Hong Kong leaded-status before 1996 has been replaced by China after Asian financial crisis, and the Greater China area has marched toward another brand new direction led by China.

Conclusions

Since recent articles for the Greater China area seldom discussed the leading position of Hong Kong stock market after 1996, people may still think Hong Kong stock market has its leading status. But the result found

in the research shows that China stock market has already the significance of the Chinese market that has begun to increase in the Greater China area before Asia financial crisis. After Asia financial crisis happens, China stock market has very obvious influence on the Greater China area, which takes place of Hong Kong stock market. On the other hand, the Greater China area has already regarded China as its center and the development of the Greater China area takes China as the core. The results of this paper surely are informative for the investors intending to invest in the Greater China area.

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