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INTEGRATION ANALYSIS OF THE PEOPLE'S REPUBLIC OF CHINA STOCK MARKETS

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Abstract

This study analyzes the integration between the People's Republic of China stock markets, namely Shanghai Stock Exchange (SSE), Shenzhen Stock Exchange (SZSE), and Hong Kong Exchanges and Clearing Limited (HKEx), in both long run and short run for the period from 3rd July 1997 to 30th June 2010. As Hong Kong rejoined China in 1st July 1997, this study would imply a view on economy development tendency particularly financial market trends after the twelve years. The result obtained from the tests indicates that there is no long-run stable relationship between the three stock markets, but short-run causality exists.

JEL Classification: *G14; G15*
Keywords: *Stock market; China; Hong Kong; Cointegration; Causality*

1. Introduction

As a result of economic globalization, more and more investors, portfolio managers, and policy makers concern more on long-run and short-run relationships between financial markets. The People's Republic of China is one of the most economic powerful countries, which achieves rapid economic growth, and its finance market keeps a high speed of development and globalization (Malkiel et al., 2008). After Hong Kong rejoining China in 1997, the connection between China mainland and Hong Kong financial markets is tighter day after day. Analyzing the stock markets' cointegration and causality would be helpful in carrying forward mainland China's capital market internalized stably and assisting the enterprises and investors being

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acknowledged the characteristics of financial markets in both mainland and Hong Kong, to make stable profit under lower risk. For the government regulation departments, proficiently managing the tendency of the three stock exchanges integration can contribute to the corporation and controlling risk, to promote mainland and Hong Kong's economies, especially financial markets developing harmoniously.

A few papers address the issue of the People's Republic of China stock markets' integration. However, the results are mixed, due to differences in methodologies, data, and time periods. Lu and Zhu (2001:7) investigated Hong Kong, Shanghai and Shenzhen stock exchanges and found that Hong Kong Exchanges and Clearing Limited (HKEx) is respectively independent to mainland. Wang and Zhou (2005:93) found that Shanghai Stock Exchange (SSE) influences Shenzhen Stock Exchange (SZSE) significantly but SSE is not able to predict the future of SZSE. He and Tan (2007:7) show that the rates of returns between SSE and SZSE are cointegrated and the rate of return of SZSE influences the rate of return of SSE significantly. The research by Qie (2008:144) suggests that Hong Kong and Shanghai stock exchanges are not cointegrated, which means that China mainland stock exchanges are not well developed. Conversely, Luo (2008) concludes that the two stock exchanges influence each other. This study examines the relationships between and the properties of SSE, SZSE, and HKEx. The cointegration and causality of those stock exchanges will be examined. At present, China mainland has two stock exchanges and Hong Kong is an international financial market which is nearest to mainland China.

The rest of this study is organized as follows. Section 2 provides the background, or some information of Shanghai, Shenzhen, and Hong Kong stock exchanges. Section 3 is a literature review. Section 4 presents the data and methodology used in this study. Section 5 reports the results and discussions of the results. Finally, the last section includes some discussions and conclusions.

2. The Stock Markets of the People's Republic of China and Their Indices: A Background

The three stock markets of the People's Republic of China have different stages of development. In 2008, mainland China has a market capitalization as a percent of Gross Domestic Product (GDP) of 40.37%, of which SSE is 32.35% and SZSE is 8.02%. Hong Kong is an international financial centre and offshore financial centre has a market capitalization and GDP ratio of 612.04%, which is significantly larger than the stock exchanges in mainland China (Table 1). The Hong Kong financial market can not be said seriously overvalued since a great deal of foreign or mainland capital flows into Hong Kong financial market each year. Nevertheless, it is clear that mainland stock markets are undervalued or still under developing (Wang, 2008).

SSE located at Shanghai Pudong New Area. It was built on 26th November 1990 and then opened on 18th December 2010. SSE is a non-profit organization administered directly by the China Securities Regulatory Commission, which is managed directly by the government of China. For the indices of SSE, the most widely used as well as the most considerable by investors is the SSE Composite Index. It is an index of all stocks (A-shares and B-shares[2]) that are traded at SSE. The base day for the SSE Composite Index is 19th December 1990 and the base period is the total market capitalization of all stocks of that day. The base value is 100. The samples of the SSE Composite Index are all the shares and stocks listed on SSE, where new stocks join the stock indices' calculation from the second day of listing. Because Mainland China's stocks have the division of circulation and non-circulation, the circulation amount is inconsistent with the total capital, therefore the stocks with greater capital impacts the stock indices more significantly. SSE Composite Indices and sector indices are weighted by shares (http://www.sse.com.cn/sseportal/en/home/home.shtml).

SZSE located at Luohu District, Shenzhen. It was established on 1st December 1990. Same as SSE, SZSE is also a non-profit organization administered directly by the China Securities Regulatory Commission and almost runs the same function as SSE and provides A-shares and B-shares trading. The SZSE Component Index is the main index, which base day is 20th July 1994, although it was introduced on 23rd January 1995. It was calculated by selecting 40 stocks which are representative for the whole market based on the rule. The constituent stocks must represent their sectors and markets well. The base value of the SZSE Component Index is 100, and the evaluation of the constituent stocks is adjusted three times a year, to add and drop stocks. The constituent stock must be no less than 6 months' listed, top scale of capitalization and circulation, and top total volume of trading (http://www.szse.cn/main/en/).

[2] A share is the stock issued by the companies incorporated in mainland China and are traded in the mainland A-share markets. The prices of A-shares are quoted in Renminbi, and currently only mainlanders and selected foreign institutional investors are allowed to trade A-shares. B-share is the stock issued by the companies incorporated in mainland China and are traded in the mainland B-share markets (Shanghai and Shenzhen). B-shares are quoted in foreign currencies. In the past, only foreigners were allowed to trade B-shares. Starting from March 2001, mainlanders can trade B-shares as well. However, they must trade with legal foreign currency accounts (Chen, 2007).

Table 1
Market Capitalization and GDP Ratio

year	SSE MktCap (triRMB)	SZSE MktCap (triRMB)	Mainland MktCap (triRMB)	Mainland GDP (triRMB)	SSE MktCap/ GDP	SZSE MktCap/ GDP	Mainland MktCap/ GDP	HK MktCap (triHK$)	HK GDP (triHK$)	HK Mkt/GDP
1997	921.81	831.11	1752.92	7897.3	11.67%	10.52%	22.19%	3202.63	1365.02	234.62%
1998	1062.59	887.97	1950.56	8440.2	12.59%	10.52%	23.11%	2661.71	1292.76	205.89%
1999	1458.05	1189.07	2647.12	8967.7	16.26%	13.26%	29.52%	4727.53	1266.67	373.23%
2000	2693.09	2116	4809.09	9921.4	27.14%	21.33%	48.47%	4795.15	1317.65	363.92%
2001	2759.06	1593.16	4352.22	10965.5	25.16%	14.53%	39.69%	3885.34	1299.22	299.05%
2002	2536.37	1296.54	3832.91	12033.2	21.08%	10.77%	31.85%	3559.1	1277.31	278.64%
2003	2980.49	1265.28	4245.77	13582.2	21.94%	9.32%	31.26%	5477.67	1234.76	443.62%
2004	2601.43	1104.12	3705.56	15987.8	16.27%	6.91%	23.18%	6629.18	1291.92	513.13%
2005	2309.61	933.42	3243.03	18308.4	12.62%	5.43%	18.05%	8113.33	1382.59	586.82%
2006	7161.24	1779.15	8940.39	21087.1	33.96%	8.44%	42.4%	13248.82	1475.36	898.01%
2007	26983.89	5730.2	32714.09	24661.9	109.42%	23.24%	132.66%	20536.46	1615.46	1279.16%
2008	9725.19	2411.45	12136.64	30067	32.35%	8.02%	40.37%	10253.59	1675.32	612.04%

Sources: Shanghai Stock Exchange Statistics Annual 2009, Shenzhen Stock Exchange Fact Book (2000 and 2008), Hong Kong Exchange Fact Book (1999, 2004, and 2008), and Hong Kong Census and Statistics Department.

The founding of HKEx is a long story and securities trading in Hong Kong could be date back to the mid-19th century. Four stock exchanges were formed in these about 100 years. However, on 27th March 1986 they were ceased and the new exchange commenced trading through a computer-assisted system on 2nd April 1986. Prior to the completion of the merger with Hong Kong Futures Exchange in March 2000, the unified stock exchange had 570 participant organizations. HKEx is the holding company of The Stock Exchange of Hong Kong Limited, Hong Kong Futures Exchange Limited, and Hong Kong Securities Clearing Company. HKEx is committed to perform its public duty to ensure orderly and fair markets and that risks are managed prudently, consistent with the public interest and in particular, the interests of the investing public. The Hang Seng Index (HSI) is one of the earliest stock market indices in Hong Kong launched on 24th November 1969. HSI has become the most widely quoted indicator of the performance of the HKEx, which is used to record and monitor daily changes of the largest companies of the HKEx. It chooses blue chip stocks as constituents. The component stocks, adjusted quarterly, represent about 70% of capitalization of the HKEx. When HSI first published, its base of 100 points was set equivalent to the stocks' total value as of the market close on 31st July 1964 (http://www.hkex.com.hk/eng/index.htm).

Wang (2008) shows four differences between Mainland and Hong Kong stock exchanges. First of all, Hong Kong is richer than mainland in the transaction varieties. The variety of securities' transactions in mainland mainly includes stocks, bonds, securities investment funds, and warrants. Hong Kong's securities market is relatively abundant, that is, stocks, bonds, the HSI futures, options, covered warrants, stock split-linked notes, Exchange Traded Funds, unit trusts, and hedge funds are traded. The second difference is trading system. Mainland's trading time and holidays is not same as Hong Kong. In HKEx, it launches T+0 trading rule, different from Mainland's T+1, which means that in Hong Kong, you can buy and sell the same stock in the same day, but in mainland, it is not allowed, you must wait until the next day. China mainland regulates stock price at most increase or decrease 10% per day, whereas HKEx does not have such rules. The majority of investors are also different. Hong Kong is mostly leaded by institutional investors. Oppositely, Inland markets are mainly personal investors, which hold more than 60%, the other 35% are institutional investors. Finally, the investment ideas are not identical as well. Hong Kong is an international financial centre, which is "exocentric" and greatly impacted by global economy changes. Mainland China is closed and "endocentric".

3. Literature Review

The integration of capital markets is firstly studied by Grubel (1968:1299) on the theoretical issue. Lessard (1973:619) initiated empirical research. Grubel (1968:1299) uses mean-variance analysis to test international stock market integration. Afterwards, researchers apply multiple methods, but only have limited achievements. Since the globalization of economy and finance, great amount of researches use various methods to test the cointegrations and causalities of multinational, multiregional, or uniregional stock markets.

In the 1990's, a group of researchers find a lot of evidences for integration of stock markets, whereas some other researchers build the causality between stock indices. Kasa (1992:95) supplies the evidence which was the presence of a single common stochastic trend that drives the quarterly stock price indices of five developed financial markets. Corhay, Tourani, and Urbain (1993:385) conduct a study to test long-run relationship among five European countries' stock markets. Evidences of cointegrations are found. Blackman, Holden, and Thomas (1994:297) conduct a widest research which contained 17 different major exchanges over the world. They recognize that in the 1970s the cointegrations between international major stock exchanges were not significant, whereas after 1980s international major markets show a significant long-run co-movement. Cheung and Mak (1992:43) investigate the relationship between the United States and Japan, and eight Asian-Pacific markets. The United States market is found to lead most of the Asian-Pacific markets. Arshanapalli and Doukas (1993:193) find that the degree of international co-movements among stock price has substantially increased after the 1987 crash.

After entering 21st century, more and more tests were made on both cointegration and causality between international stock markets, not only in developed markets, but also more in emerging markets. Georgoutsos (2001) updates Kasa's work by testing the four stock markets of the United States, the United Kingdom, Germany, and Japan. The stability results indicate that cointegration has been established in the early 1990s. Fan (2002) tests both long-term cointegration and short-run causality and finds evidence that the Asian financial crisis has a statistically significant impact on the relationships among Asia-Pacific stock markets. In the long run, fluctuations in the United States market dominant the co-movement of the Asia-Pacific market indices. Click and Plummer (2004:5) investigate the degree of integration for the five stock markets in the original Association of Southeast Asian Nations (ASEAN), namely Indonesia, Malaysia, the Philippines, Singapore, and Thailand in post-crisis period. The result is that the stock markets are cointegrated and not completely segmented by national borders. Ahmed (2008) finds that the Egyptian stock exchange appears no long-run cointegration relationships with the G7 countries.

Furthermore, researchers start to focus on the integration between Shanghai, Shenzhen and Hong Kong stock exchanges since Hong Kong's reunification, because the high developing speed of China mainland and large opening scale. It has become a hot spot in both theoretical fields and security fields. The study by Shi (2002:103) finds that the SSE Composite Index is cointegrated with the SZSE Composite Index. Li (2009:A15) publishes an article shows that SSE Composite Index is cointegrated with the SZSE Component Index, which means that they have long-term stationary relationship. The SZSE Component Index is able to influence the SSE Composite Index's changing in logarithm term. Different from the other researchers, Guo (2008) launched a study on the two stock exchanges and the consistent conclusion shows that Shanghai stock market has no long-run equilibrium relationship to Shenzhen stock market.

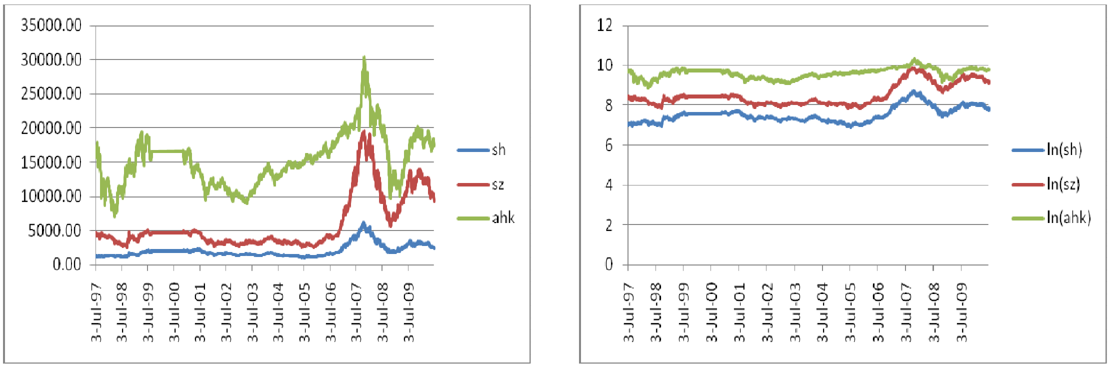
Lu and Zhu (2001:7) conduct one of the earliest studies of Hong Kong and mainland's stock markets' interaction. The conclusion is that HKEx is respectively independent to mainland, no matter on rate of return or volatility. Wang and Xu (2003:49) conclude that the volatility of HKEx is mainly cause by itself and other stock markets around the world. Inland effects are very light, but there is a tendency of becoming stronger. What's more, SZSE is mainly influenced by SSE. Wang and Yu (2004) find that Hong Kong and inland stock markets' co-movement is tighter after the Asia financial crisis in 1997. Before the crisis, Mainland markets influence Hong Kong market; after the crisis, inland and Hong Kong markets influence with each other. Hu and Lv (2008:93) introduce the use of cointegration in stock market. They draw a conclusion that Shanghai and Hong Kong stock exchange are separated and isolated. Shao and Wang (2009:72) test daily data of the HSI and the SSE Composite Index. The conclusion is that the HSI and the SSE Composite Index are cointegrated. The volatility of the HSI significantly influences the SSE Composite Index. Guo and Wang (2009:118) argued that Hong Kong stock market and inland stock markets are highly integrated, and the degree is higher when the markets increasing.

From previous studies, the global stock markets' integration becomes a more and more popular topic, especially in recent 20 years, by the introduction of many econometric methodologies. The test is become more and more accurate. But, economy as well as stock market is dynamic. Consequently, the empirical evidence could be updated. The mainland's stock exchanges are also founded newly relative to the world, as well as growing fast. Thus to show Chinese economic opening degree, mainland's influences on Hong Kong economy, and giving suggestions to investors and regulators, it is important to test the integration between the China mainland's stock markets and Hong Kong stock market.

4. Data and Methodology

The data used are the SSE Composite Index, the SZSE Component Index, and the HSI, daily data from 1st July 1997 to 30th June 2010, totally 3043 data sets. The indices are collected from Yahoo Finance, closed indices are used[3]. This paper tests the integration of Hong Kong and China mainland stock exchanges after Hong Kong reunification to China on 1st July 1997 for the first twelve years. Furthermore, since the exchange rate between Renminbi (SSE and SZSE dominated currency) and Hong Kong Dollar (HKEx dominated currency) are changing over the time, to make the test more accurate, HSI will be transferred into Renminbi terms, which means HSI adjusted by RMB/HK$ is used. The exchange rates are obtained from Bank of China's official website. All the indices and adjusted indices are tested by transferring into logarithm forms.

Figure 1
Data Trend



According to Jones (2007), the risk of financial assets can be measured with an absolute measure of dispersion, or variability of returns, called the variance. An equivalent measure of total risk is the square root of the variance, the standard deviation, which measures the deviation of each observation from the arithmetic mean of the observations. The standard deviation is a measure of the total risk of an asset or a portfolio. It captures the total variability in the asset's or portfolio's return whatever the sources of that variability.

Unit root test is taken mainly for two important reasons. The first one is concern about the fundamental tests on the data to test cointegration. Meanwhile, the second one is to get the trend of the time series data.

3 The opening days vary among SSE, SZSE, and HKEx, and thus the data collected is only on the trading days that all the three stock exchanges open.

Dickey and Fuller (1979:427, 1981:1057) found a procedure to test for non-stationary, which is equivalent to testing for the existence of unit root. The test is as following which is based on the simple autoregressive (AR) model of the form:

$$y_t = \phi y_{t-1} + u_t \tag{1}$$

By subtracting y_{t-1} on both sides of the equation to a version which consists of first difference as follows:

$$\Delta y_t = \theta y_{t-1} + u_t \tag{2}$$

where $\theta = \phi - 1$. The model above is the basic equation of the Dickey-Fuller (DF) test.

Dickey and Fuller (1979) extended their test procedure and suggested an augmented version of the test, which includes expanded lagged terms of the dependent variable to help to overcome autocorrelation. The lag length of the model can be determined by the Akaike Information Criterion (AIC) as well as Schwarts Bayesian Criterion[4] (SBC). The three possible forms of the Augmented Dickey-Fuller (ADF) test are:

$$\Delta y_t = \theta y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \tag{3}$$

$$\Delta y_t = \alpha_0 + \theta y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \tag{4}$$

$$\Delta y_t = \alpha_0 + \alpha_2 t + \theta y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \tag{5}$$

The last two models concern the existence of the elements α_0 and α_0 and $\alpha_2 t$, respectively. Additionally, when p is zero, the models become the DF tests. The critical values for each of the models can be found in MacKinnon (1996). If the ADF statistical value is smaller in absolute terms than the critical value then the null hypothesis of a unit root can be rejected and conclude that y_t is a stationary process.

The DF test is based on the assumption that the error terms are independent and they have a constant variance. So if there are serial correlation problems or heteroskedasticity in the error terms, the test may be inaccurate. Phillips and Perron (1988:335) developed a unit root

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[4] The AIC and SBC are computed, respectively as follows:
$AIC = (RSS / T)e^{2k/T}$
$SBC = (RSS / T)e^{k/T}$
where T is the number of observations, k is the number of parameters, RSS is sum of the square residuals, and e is exponential.

test method that has become popular in the analysis of financial time series. The Phillips-Perron (PP) unit root test differs from the ADF test in how it deal with the assumptions in the error terms, which has a wider assumption and concerns the distribution of errors. The test is the AR model as follows:

$$\Delta y_t = \alpha_0 + \beta y_{t-1} + e_t \quad (6)$$

This model is a modification of the ADF test which considers non restrictive properties of the error terms. From the description of ADF test, it corrects the autocorrelation problem simply by adding more and more lags, whereas the PP test making adjustment on the parameter β to adjust the autocorrelation in e_t. The expressions of the PP test are extremely difficult, nevertheless, many statistical packages have the function to launch the PP test. Consequently, it is better to test both the ADF and PP tests to double confirm the unit root test result. What's more, the critical values provided by MacKinnon (1996) are also available for the PP test.

Engle and Granger (1987:251) initially give the definition of cointegration. Cointegration refers to some linear combination of two or more series is stationary even though each of the serious is non-stationary and some long-run equilibrium relation ties the individual series together. Even though the individual variables can be non-stationary, a linear combination of the two or more time series can be stationary.

A vector autoregressive (VAR) model could be constructed and estimated for a large number of lags and variables. Assume that there are n variables, which are endogenous and I(1) variables. The VAR model can be expressed as:

$$X_t = A_1 X_{t-1} + \ldots + A_p X_{t-p} + \varepsilon_t \quad (7)$$

where X_t is $n \times 1$ vector and A_1 *to* A_p are $n \times n$-order's correlation matrix. Model (7) can be reformulated into a vector error-correction model (VECM) as follows:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots + \Gamma_{p-1} \Delta X_{t-p-1} + \Pi X_{t-p} + \varepsilon_t \quad (8)$$

where Γ_i and Π are $n \times n$ dimension parameter matrix, $\Pi = A_1 + A_2 + \ldots + A_{p-1}$ The rank of matrix $r(\Pi)$ equals to the number of independent cointegration relationships in the system. If $r(\Pi)$ equals to n, there are n independent cointegration relationships, so that X_t is an I (0) random vector. If $r(\Pi)$ equals to 0, Π is an zero matrix and there is no cointegration relationships. Besides these two opposite extremes, the most valuable for studying and analyzing is the situation that $0 < r(\Pi) < n$ The matrix Π can be separated into short-term components α and long-term components β'. Consequently, Π can be written as:

$$\Pi = \alpha\beta' \tag{9}$$

where α include the speed of adjustment to equilibrium coefficients while β' is the long-run matrix of the coefficients and α and β are $n \times r$ order matrix of full rank matrix (Johansen, 1995).

Assume that the number of cointegrating vectors is r. Then one of the most characteristic of Johansen cointegration test is that the number of cointegrating vectors (r) is not pre-determined, but assuming the result of testing. According to Asteriou and Hall (2007), two ways can be utilized to calculated r, the first one is likelihood ratio trace statistic. The trace statistic considers whether the trace is increased by adding more eigenvalues beyond the r-th eigenvalue. The null hypothesis is that the number of cointegrating vectors is smaller than or equal to r. When all $\lambda_i = 0$, the trace statistic is equal to zero as well. On the other hand, the closer the characteristic roots to the unity, the $\ln(1\text{-}\lambda_i)$ term smaller (negative), and the larger the trace statistic. The trace statistic is calculated by:

$$\lambda_{Trace}(r) = -T\sum_{i=r+1}^{n}\ln(1-\lambda_{r+1}) \tag{10}$$

where λ_{r+1} is the $(r + 1)$th term's estimated eigenvalue and T is the number of observations.

The second is the maximum eigenvalue statistic. The test is based on characteristic roots. It consists of ordering the largest eigenvalues in descending order and considering whether they are significantly different from zero. This method tests the null hypothesis that rank $(\Pi) = r$ against the hypothesis that the rank is $r + 1$. So the null hypothesis is that there is cointegrating vectors and that we have up to the r cointegrating vectors, with the alternative suggesting there is $r + 1$ vectors. To test how many of the numbers of the characteristic roots are significantly different from zero this test uses:

$$\lambda_{Max}(r, r+1) = -T\ln(1-\lambda_{r+1}) \tag{11}$$

Granger (1969:424) developed a relatively simple test that defined causality as follows. A variable y_t is said to Granger cause x_t, if x_t can be predicted with greater accuracy by using past values of the y_t. The

Granger causality test for the case of two stationary variables Δy_t and Δx_t involves the estimation of the following VAR models:

$$\Delta y_t = \alpha_1 + \sum_{i=1}^{p} \beta_i \Delta x_{t-1} + \sum_{j=1}^{q} \gamma_j \Delta y_{t-i} + e_{1t} \tag{12}$$

$$\Delta x_t = \alpha_2 + \sum_{i=1}^{p} \theta_i \Delta x_{t-1} + \sum_{j=1}^{q} \delta_j \Delta y_{t-i} + e_{2t} \tag{13}$$

where e_{1t} and e_{2t} are disturbance terms, respectively. Firstly, estimate the VAR model given by (12) and (13). Then check the significance of the coefficients and apply variable deletion tests in the lagged Δx terms in (12) and also in lagged Δy terms in (13). According to the F-test statistic for the sum of the lagged Δx terms in (12) or the sum of the lagged Δy terms in (13), the direction of causality can be concluded.

5. Empirical Results and Discussions

Table 2 shows standard deviations. On average, the standard deviations of logarithms of the SSE Composite Index, the SZSE Component Index, and the adjusted HSI are 0.4036, 0.5445, and 0.2594, which means that the risk of SZSE is the highest, whereas the risk of HKEx is the lowest, with SSE is the middle.

Table 2
Standard Deviations

	ln(sh)	ln(sz)	ln(ahk)
Standard Deviation	0.4036	0.5445	0.2594

Table 3 shows, at level, all the t-values are lower than the critical value at the 1%, 5% or 10% level whatever utilizing the ADF or PP test. Thus logarithms of the SSE Composite Index, the SZSE Component Index, and the adjusted HSI can be concluded not stationary at level or I(1) variables. Through first difference testing, all the t-values are greater than 1% critical value. Thus all the variables are stationary at first difference or I(0) variables.

Table 4 shows the cointegrating test results. The lag length used is four, which is acquiescent. For logarithm of the SSE Composite Index (ln(sh)) and logarithm of the SZSE Component Index (ln(sz)), the trace statistic of non-cointegrating vector is 10.10, whereas the 5% critical value is 15.49, which is larger than trace statistic. What's more, the probability is 0.27, which is not reported in the table is larger than 5% (0.05). So, from trace statistic, there is no cointegrating relationship. By observing the maximum eigenvalue statistic result, the same conclusion can be made. The result indicates that there is no long-run relationship between ln(sh) and ln(sz) with zero cointegrating vector that exist at 5% level. There is no cointegrating relationship between ln(sh) and logarithm of the adjusted HSI (ln(ahk)), ln(sz) and ln(ahk), and ln(sh), ln(sz) and ln(ahk). All the results indicates that there is no cointegration relationship between the SSE Composite Index, the SZSE Composite Index, and the adjusted HSI for the sample period 1997:7:1 to 2010:6:30. Thus the Granger causality shall be in the VAR mode.

Table 3
Unit Root Test Results

	ADF - Intercept	ADF - Intercept and Trend	PP - Intercept	PP - Intercept and Trend
ln(sh)	-1.3754(6)	-1.5289(6)	-1.3619(3)	-1.5208(4)
Δ ln(sh)	-22.4342*(5)	-22.4327*(5)	-54.5311*(2)	-54.5237*(2)
ln(sz)	-0.7463(4)	-1.6605(4)	-0.6896(8)	-1.6875(8)
Δ ln(sz)	-25.8660*(3)	-25.8758*(3)	-52.4059*(6)	-52.4106*(6)
ln(ahk)	-1.9659(8)	-2.7080(8)	-2.0162(3)	-2.7058(4)
Δ ln(ahk)	-19.4377*(7)	-19.4427*(7)	-55.6867*(0)	-55.6811*(0)

Notes: Values in the parentheses are the lag length used in the estimation of the unit root tests. * denotes significant at the 1% level.

Table 4
Cointegration Test Results

Hypothesized No. of CE(s)	None	At most 1	At most 2
ln(sh) and ln(sz)			
λ_{Trace}	10.10	0.42	
λ_{Max}	9.68	0.42	
ln(sh) and ln(ahk)			
λ_{Trace}	12.10	1.68	
λ_{Max}	10.41	1.68	
ln(sz) and ln(ahk)			
λ_{Trace}	9.86	0.73	
λ_{Max}	9.13	0.73	
Critical value (5%) - λ_{Trace}	15.49	3.84	
Critical value (5%) - λ_{Max}	14.26	3.84	
ln(sh), ln(sz), and ln(ahk)			
λ_{Trace}	19.85	8.43	0.58
λ_{Max}	11.42	7.85	0.58
Critical value (5%) - λ_{Trace}	29.80	15.49	3.84
Critical value (5%) - λ_{Max}	21.13	14.26	3.84

Note: CE denotes cointegrating equation.

One of the most important factors that influence the Granger causality is lag selection. Here we use the lags one to ten to test the Granger causality between Δ ln(sh) and Δ ln(sz), Δ ln(sh) and Δ ln(sz), and Δ ln(sz) and Δ ln(ahk) to decide if there is short-run relationship between them or not. The results of Granger causality test are shown in Table 5.

The null hypothesis that Δ ln(sz) does not Granger cause Δ ln(sh) can be rejected at lags 1, 6, and 7. But in all the other lags cannot reject that Δ ln(sz) does not Granger cause Δ ln(sh). Thus, there is no Granger causality from Δ ln (sz) to Δ ln(sh). For the null hypothesis that Δ ln(sh) does not Granger cause Δ ln(sz), can be rejected at all lags from 1 to 10. Thus, there is Granger causality from Δ ln(sh) to Δ ln(sz). Next, Δ ln(sh) does Granger cause Δ ln(ahk) whereas Δ ln(ahk) does not cause Δ ln(sh). Finally, Δ ln(sz) does Granger cause Δ ln(ahk), however, Δ ln(ahk) does not Granger cause Δ ln(sz). As shown in Figure 2, it is clear that the change in the SSE Composite Index does Granger cause both the changes in the SZSE Component Index and the adjusted HSI. The change in the SZSE Component Index does only Granger cause the change in the adjusted HSI. While the change in the adjusted HSI can neither Granger cause on the change of the SSE Composite Index nor the change of the SZSE Component Index.

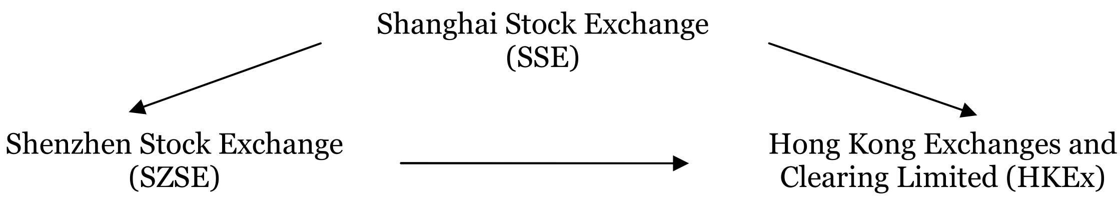
The result that SSE and SZSE have no long-run relationship is consistent with finding of Guo (2008), but different from the findings of Shi (2002:103) and Li (2009:A15). Additionally, mainland and Hong Kong stock markets are not cointegrated. This is consistent with the findings of Lu and Zhu (2001:7) and Hu and Lv (2008:93). However, it is inconsistent with the finding of Shao and Wang (2009:72). The Granger causality result is partially similar to the finding of Wang and Xu (2003:49) that Shanghai stock market influences Shenzhen stock market. This study finds that Shanghai becomes a centre of the three stock markets and its change influences the other two markets. While Hong Kong, the famous international finance centre, is influenced by both of the mainland stock markets. This result supports the result of Wang and Xu (2003:49) that mainland's effects on Hong Kong are becoming stronger.

Table 5
Granger Causality Test Results

	Δln(sz) -/-> Δln(sh)	**Δln(sh) -/-> Δln(sz)**
lag1	4.4640**	13.7388*
lag2	2.3577	8.2076*
lag3	2.1000	5.6309*
lag4	1.7424	5.3200*
lag5	2.1075	5.3090*
lag6	2.4540**	5.2645*
lag7	2.1078**	4.4223*
lag8	1.8876	3.8644*
lag9	1.6833	3.5376*
lag10	1.5724	3.1560*
	Δln(ahk) -/-> Δln(sh)	**Δln(sh) -/-> Δln(ahk)**
lag1	4.9237**	17.6079*
lag2	2.2195	8.7946*
lag3	1.6611	7.2640*
lag4	1.7725	5.3344*
lag5	2.0381	5.2147*
lag6	1.6318	5.1106*
lag7	1.5279	5.5419*
lag8	1.3454	4.8774*
lag9	1.4094	4.3806*
lag10	1.3834	4.3457*
	Δln(ahk) -/-> Δln(sz)	**Δln(sz) -/->Δln(ahk)**
lag1	1.1764	12.9399*
lag2	0.4618	6.2978*
lag3	0.4631	5.2752*
lag4	0.9236	3.8301*
lag5	1.2317	3.5987*
lag6	0.9701	3.0986*
lag7	0.9082	3.8414*
lag8	0.8063	3.4552*
lag9	0.8512	3.1966*
lag10	0.8485	3.3665*

Note: * (**) denotes significant at the 1% (5%) level.

Figure 2
Granger Causality



6. Conclusion and Suggestions

China mainland's stock exchanges, namely Shanghai and Shenzhen stock exchanges still have not achieved internationalized because there are no long-run equilibrium relationship between Hong Kong stock market and the two mainland stock exchanges. China mainland's security market has been under financial regulation for a long time. Shanghai and Shenzhen stock exchange are also relatively independent in the long run. Hong Kong has reunified to China for 12 years, even though officially, China mainland government gives Hong Kong free finance developing privilege, Hong Kong stock market is influenced by the mainland stock markets in the short run. Shanghai stock exchange acts as an influencer among the three stock exchanges of the People's Republic of China. Although China mainland stock markets is able to affect Hong Kong stock market in the short run, the way for Shanghai and Shenzhen stock exchanges to be internationalized or cointegrated with worldwide stock markets is still long.

China mainland's government intervention makes the investors misunderstand that the government pushes the stock market up, and the investors' psychology is biased, finally causes the markets cannot internationalized and even cannot has cointegration between themselves. Classically, the government encourages the national enterprises listed in stock markets to raise capital, to expanding their business using public's saving as well as leasing the fiscal and banks' stress. Hence, the government uses Securities Regulatory Commission as a tool to adopt the stock markets using "visible hand", which leads to speculating behavior among investors and fraud such as inside-trades in enterprises. Therefore, if China mainland want to develop and integrate its markets with those in other countries, the first thing that need to do is bringing less "intervention policy" in to efforts to allow the stock market works by more economic factors but not politic.
China mainland has the strict category for A-shares and B-shares. Foreigners (including Hong Kong, Macau, and Taiwan residents) can merely invest in B-shares. Among B-shares, the stocks is not all the same as A-shares and under different currency domination (US$). As a result, to gear China mainland stock market to Hong Kong and further to international conventions, the second suggestion is opening A-shares to foreign investors. Despite at the moment it is hard to open totally at one time, it can be launched step by step.

Some basic properties (opening, closing time and date, limitations on stock price go up and down per day, and so forth) need to adjusted based on international common laws. China has its own traditional festival, which causes its stock markets has long closed duration (normally about 10 days) during Chinese New Year, whereas in most other countries, the trading is continuing. Furthermore, to prevent speculation and fraud, China inland stock markets have the limitation that stock prices can never go up or down for 10% within a trading day. In order to go to the world, China mainland markets need to study from the world first.

Hong Kong government needs to help the inland market's developing and pay attention on the impacts from mainland markets. Inland market is still under discovering and developing age, where is existing great amount of short comings such as speculation. On the other hand, Hong Kong needs to attract the capital from inlands, which is one of the biggest economies and has great amount of potential funds. Therefore, in the national level, Hong Kong needs to both help inlands market to be advanced, prevent the negative impact from inland, and finally try best to attract inland enterprise listing in the stock exchange and investors' capital inflow.

Investors must not be hided from the truth that China mainland stock exchanges are very risky, although in the short run, it would be more profitable. It does not has long-run relationship and does not influence in short run by internationalized stock market – HKEx, the government policy makes great intervention in it and there may be great bubble. So be very careful when investing in the China inland stock markets. Nonetheless, for the investors who want to choose a best portfolio, it is a good portfolio to invest in all the three stock markets because they have not long-run stable relationship with each other so that the risk can be minimized.

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