RELATIONSHIP BETWEEN THE SHANGHAI AND HONG KONG PROPERTY STOCK MARKETS

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ABSTRACT

This paper examines whether the Shanghai and Hong Kong property stock markets are closely related in the period 1993-2003. As two economically promising cities in Asia, Hong Kong and Shanghai are held tightly together, by social, cultural and business ties. Therefore, it is important for international real estate investors, who want to enter China markets, to understand the relationships between the two markets in order to develop the right investment strategy. In this research, we analyse risk-return performance and the dynamic relationships between these two markets. Furthermore, we employ cointegration with structural break, error-correction model (ECM) and Generalised Autoregressive Conditional Heteroscedasticity (GARCH) models to the property stock data of the two markets. The empirical results suggest strong evidence of long-run and short-run relationships between the two markets.

Keywords: Cointegration, Error Correction Model (ECM), GARCH.

INTRODUCTION

In recent years, real estate investors are becoming more interested in investment opportunities outside their own counties or regions. Among these opportunities, real estate stocks are gaining ground. In Asia, listed property companies make a significant contribution to the market capitalization of Asian stock markets (Newell and Chau, 1996; Steinert and Crowe, 2001). Similarly, listed property has became an increasingly important property investment vehicle in Asia and internationally (Steinert and Crowe, 2001), particularly through the success of REITs in the USA, LPTs in Australia, the recent establishment of equivalent REIT vehicles in Japan, Korea, Singapore and Hong Kong, and the long-established track record of listed property companies in Asia. Many investors have advocated an investment strategy that includes indirect real estate investment.

The issue of the linkage between real estate markets has generated considerable literature in the 1990s. Due to some similar factors, the performance of different real estate markets will impact each other, including direct and indirect markets. To date, research evidence supports that there is strong positive contemporaneous correlation and lead/lag linkages between the direct and indirect real estate markets, such as Giliberto (1990), Gyourko and Keim (1992), Myer and Webb (1993, 1994), and Acton and Poutasse (1997). Additionally, some researchers focus on different submarkets in the same country, such as Liow (2001) in Singapore and Tse (2001) in Hong Kong. Besides, Garvey, Santry and Stevenson (2001) investigate the inter-relationships between real estate securities markets in the Asia-Pacific.

The current study is primarily motivated by the following reasons. Firstly, at this moment, China is the engine of world economy, which would stimulate China's property market as a popular target for real estate investors in Asia and internationally. A range of foreign funds have entered China's property market to seek the opportunities, especially in Shanghai. Therefore, it is significant for real estate investors, both domestic and foreign, to understand the dynamic movements of two major property stock markets: Shanghai and Hong Kong, Secondly, in Asia, there is a trend of linking the real estate market and capital market currently. As two important securitized real estate markets in Asia, Shanghai and Hong Kong have a close partnership in many aspects, including the real estate stock market, but little research evidence has covered two specific property stock markets. Also, in the real estate literature, most of the evidence covers the US, Europe, but no specific evidence in the China context. This research will extend the empirical evidence on property stock markets by focusing on two major Chinese markets: Hong Kong and Shanghai.

In recent years, China's entrance into WTO and the CEPA (Closer Economic Partnership Agreement) have made Hong Kong and the China Mainland more integrated in economy. Increasing business across the two markets will lead to a close relationship between the two capital markets. This is the same case for real estate investment in these two markets. Some property companies on the China mainland have gone public on the Hong Kong Stock Exchange to attract new funding. Furthermore, some listed property companies in Hong Kong have moved their funds to the China real estate market in order to explore new opportunities. They construct in partnership with property companies in the China mainland.

Given the importance and dynamics of these two markets in Asia, this paper will develop the interrelationship of listed property companies' performance between their real estate stock markets. Through employing Johansen multivariate cointegration analysis, ECM and GARCH (1,1), we assess the long-term relationship, mean and volatility spillovers in the time period from 1993 to 2003 with weekly data. Our results show that there is a long-term relationship and short-term linkage between the two property stock markets.

The remainder of this paper is organized as follows. Section 2 provides a brief review of relevant empirical results. Section 3 introduces the Shanghai and Hong Kong property stock markets. Section 4 illustrates the empirical methods used in the study. This is followed by presentations of data summary statistics and investment performance of the two markets. Section 6 reports the test results from the cointegration test and mean and volatility spillover effects, as well as the investment implications. The final section concludes the paper.

PREVIOUS EMPIRICAL EVIDENCE

Over the last ten years, the study of the relationship of direct and indirect real estate markets has produced many research results. Giliberto (1990) used equity REITs to investigate the relationship between direct and indirect property in the US, and found there was a lagged relationship between the two types of returns. Myer and Webb (1993) examined the US REITs and commercial property, and results showed REIT returns Granger-caused commercial property returns. In addition, Gyourko and Keim (1992, 1993) also reported strong positive contemporaneous correlation and lead/lag linkages between the real estate and equity market in the US.

Similar studies have also been conducted in other countries. In the UK, Barkham and Geltner (1995) identified lags of up to one year in the UK and two years in the US, with the property companies and REITs leading the respective direct property markets. Lizieri and Satchell (1997) investigated interactions between the property and equity markets; their causality analysis suggested that the wider economy leads the real estate market in the short term. In Australia, Jones Lang Wootton (1995), and Newell and MacFarlane (1995) found a one to two year lead by Listed Property Trusts (LPT) over the direct property market.

In Asian markets, Hong Kong and Singapore have been studied. Newell and Chau (1996) reported that the overall trend of Hong Kong property company price changes led changes in Hong Kong commercial property by one quarter. As for Singapore market, Ong (1995) gave evidence to suggest that the property stock index in Singapore led real estate by one quarter. Liow (1998) provided some corroborative evidence for the case that Singapore commercial real estate and property equity markets are closely related over a long-term period of more than twenty years. Also, that property equity performance leads commercial real estate by three months.

In international stock markets, Eun and Shim (1989) detected a reasonable degree of interdependence in volatilities between the stock markets of Japan, UK and US. Karolyi (1995) examined the US and Canadian markets, Ng et al. (1991) analysed major Pacific-Rim markets, while Theodossiou and Lee (1993) investigated a number of major international markets. Although these studies employ different

GARCH specifications, some general findings can summarized: (a) Volatility of stock returns is time varying; (b) Significant mean and volatility spillovers are found from the US market to other international stock markets; (c) Structure of information transmission seems to have changed since the 1987 stock crash; (d) there is evidence of asymmetric transmission of stock volatilities. Garvey, Santry and Stevenson (2001) examined the inter-relationships between real estate securities markets in Australia, Hong Kong, Japan and Singapore. They found little evidence of a long-term and short-term relationship among the markets. Bond et al (2003) found country-specific value risk-factors are unique and not subsumed by global or local market risks in the international real estate market. Worzala and Sirmans (2003) summarized the literature of international real estate stocks and concluded investors can gain the diversification benefits by real estate stocks in a mixed-asset portfolio or a real estate-only portfolio. However, few papers have covered China's real estate stock markets.

SHANGHAI AND HONG KONG PROPERTY STOCK MARKETS

Shanghai

As the major stock exchange in China, the Shanghai Securities Exchange (SSE) opened its doors to trade in late 1990. Since then, the market capitalization of the Exchange has grown rapidly. In 1997 , the market capitalization of the Shanghai Stock Exchange grew to US $111.5 billion. As of 2003, this number had reached US $ 360.4 billion[1]. One unique structure of the Shanghai Stock Exchange, as well as China's market stock system, is the classification of Share A and B. The listed companies, most are state-owned enterprises (SOEs), traded in RMB are called Share A, bought by domestic investors. Share B is transacted by US dollars and attracts foreign investors. The two segments, Share A and B are totally independent due to China's hard foreign exchange system. However, the Share B is the minority in the market, being only 2.5% of the A capitalization in 2003. Although the two share classes are identical with respect to shareholder rights, such as voting and profit-sharing rights, foreign investors pay only a small fraction of the prices that local investors pay for identical stocks (Wo, 1997; Chen and Su, 1998).

China has been a hot spot for real estate investment in the Pacific-Asian region. Real estate development and investment in China has seen significant changes in recent years. In China, the real estate market was founded in the 1980s. In the 1990s, the real estate industry increased rapidly, especially in the end of the 1990s. Between 1994 and 1999, the average increasing rate of capital investing in the real

[1] There is another stock exchange, Shenzhen Stock Exchange in China. But Shanghai Stock Exchange is dominant currently and its volume is more than twice of Shenzhen's. Moreover, the index of Shanghai Stock Exchange is referred as the country's stock index.

estate sector was 16.35%. From 1991-1998, the average increasing rate of real estate sale area was 22.02%. The proportion that real estate investment amounted to in GDP has been 4%-5% for many years. The real estate sector has been an important support sector in China's macro economy. In 1998, China's economy increased at a rate of 7.8%, in which the real estate sector contributed 2%. And in 1999, the economy increased at 7.1%, and real estate's contribution was 1.5%[2].

The China real estate stock market appeared in the beginning of the 1990's, when China's stock market began to take off. At the initial stage, some large real estate companies began to enter the capital market through public offering. By 1993, listed real estate investment companies had accounted for about 10% of the total capital market. But because of the real estate bubble around 1993, the government stopped authorizing real estate companies to issue the stock in the following five years, which greatly affected the real estate stock market. The proportion of real estate stock in the whole stock market has decreased since then. There are more than 20 real estate companies that have issued their stocks on the Shanghai Stock Exchange. In this category, Lujianzui and China Merchant get the highest ranks according to their performance. These companies concentrate on real estate investments and developments in the major cities of China, such as Beijing, Shanghai, Shenzhen and Guangzhou. The proxy of real estate listed companies performances is the Shanghai SE Real Estate Index. It includes all of listed property companies on the Shanghai Stock Exchange[3]. Exhibit 1 summarizes the economic fundamentals and property stock data of the two markets in 2003. As the property stock weight in the whole stock market, Shanghai's weight is much smaller than Hong Kong's weight. This is because the Chinese government has not encouraged property companies to trade on the stock market since the real estate bubble in 1993.

Hong Kong

Since the 1986, Hong Kong stock market has experienced fast development in both market capitalization and liquidity. The market capitalization of the Hong Kong overall stock market went from HK$419.3 billion in 1986 to HK$3,476 billion in 1996[4]. The increase was up to 729%. Both finance and properties were two important sectors that accounted for more than 50% of the stock market capitalization. Before 1995, property and construction company stocks contributed approximately 25 per cent to Hong Kong's total stock market capitalization, with this being significantly greater than that seen in other South-East Asian and western countries. After partially including consolidated enterprises that were involved in

[2] Data come from China Statistics Department

[3] The Shanghai general stock and property data comes from the website of Shanghai Stock Exchange, http://www.sse.com.cn/

[4] The Hong Kong stock data comes from the website of Hong Kong Stock Exchange, http://www.hkex.com.hk/

property development and investment, the contribution of property and construction company stocks increased to approximately 45 per cent of total stock market capitalization. The major significance of property companies to the Hong Kong stock market was also reflected in six of the top ten companies listed, and ten of the top 20 companies listed, being property or strongly property-related companies (see Walker et. al., 1995). The share of the properties sector increased from about 25% to 31% due to a rapid increase in property prices in 1996. According to Tse (2001), real estate-related firms accounted for over 30 percent of Hong Kong's stock market capitalization. The significant contributions of listed property company shares to the stock market capitalization may come from heavy capital investment expenditure in property.

Compared to the China stock market, the Hong Kong stock market has a longer history and larger market capitalization. But since 1997, Hong Kong has suffered from speculative attacks and loss of investor confidence. And the Hong Kong total stock market capitalization declined from around US$600 billion in mid-1997 to US$300 billion in late 1998. The performance of the two markets over the past five years provides an indication that the Chinese stock market has the potential to surpass the value of the Hong Kong stock market.

Exhibit 1: Economic & stock market statistics (2003)

Factor	Units	Hong Kong	Shanghai (China Mainland)
Long -term sovereign rating		AA-	A+
Exchange rate*	Local per USD	7.787	8.277
Lending rate*	%	5.08	5.31
Consumer Price Index*		98.4	101.2
Unemployment rate*	%	7.9	NA
GDP*	US $ Billion	158.60	1409.86
Stock Market Captilization	US $ Million	463,108	360,093
Value Traded	US $ Million	210,622	99,083
Value Traded (/market cap)		0.45	0.28
No. of companies		968	780
Average firm size	US $ Million	478.4	461.7
Real estate % of stock market**	%	22.87	4.50

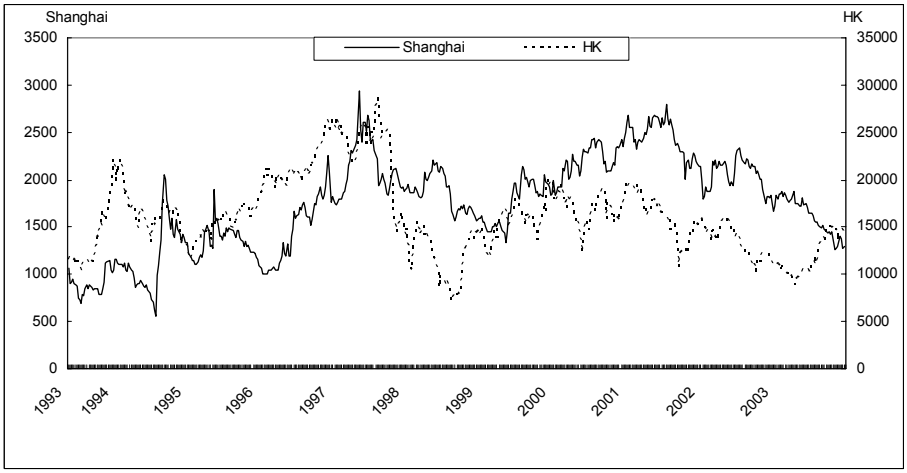
Source: Standard & Poor's Emerging Stock Markets Factbook 2003 and IMF
*Data from IMF country database, the others come from Stock Market Factbook
** Data come from DATASTREAM

In addition, the total value of all real estate in Hong Kong exceeds the total value of all shares and money. There are more than 100 listed property companies on the Hong Kong Stock Exchange. In this context, the top five companies are: Cheung Kong Limited, Sun Hung Kai Properties, Henderson Limited Development, Hang Lung Properties and Henderson Investment. The market value of Cheung Kong

Limited is more than US$12 billion in April 2003. Currently, the significance of property stocks in Hong Kong is declining due to the listing of China Mainland SOEs in the Hong Kong Stock Exchange.

Exhibit 2 provides an indication of the comparative movements for the two markets. In this paper, we employ the Shanghai SE Real Estate Index and Hang Seng Property Index as our research benchmarks. There are occasions when the two markets moved in tandem with each other. The co-movement relationship between the two markets is tight. However, the two indexes do not always move together. For example, in 1997, when the Asian Financial Crisis broke, the Hong Kong index touched the bottom. In the mean time, the China index still fluctuated with a decreasing trend. Overall, the two indexes have a close relationship in the long run. The indexes applied to all of the tests were the natural log of the original indexes.

Exhibit 2: Comparative market movements - Shanghai and Hong Kong property stock indices



RESEARCH METHODOLOGY

The empirical methodology in this study comprises three parts. They are briefly discussed below.

Unit Root Test

The first step in cointegration analysis is to test the order of integration for the time series. The order of integration of each time series needs to be the same. Usually, most of the time series are integrated of order one, i.e., they are stationary only in their first difference, but not in levels. In that sense, a test of unit roots is necessary

in the first step. The widely used unit root tests are the Augmented Dickey-Fuller (ADF) procedure and Phillips-Perron (PP) test. For the sub-period data, we will use these two techniques. For the full period data, considering the structural break around the Asian Financial Crisis, we will employ Perron's (1989) unit root test with structural break.

In Perron's framework, three different models are considered to test the null hypotheses of a unit root with a possible nonzero drift against trend stationary (TS) alternatives according to the nature of the impact on the structure of the economic time series examined. More specifically, the three models assume three different impacts on a time series of a specific structural break: an exogenous change in the level of the series (crash model), an exogenous change in the rate of growth (changing growth model), and both (crash with changing growth model). We termed the three hypothesized model as A, B and C respectively. The statistical procedure involves the following regression equations:

$$y_t = a_0 + a_1 y_{t-1} + a_2 t + u_2 DL_t + \sum_{i=1}^{k} \beta_i \Delta y_{t-i} + \varepsilon_t \quad (1)$$

$$y_t = a_0 + a_1 y_{t-1} + a_2 t + u_3 DT_t^* + \sum_{i=1}^{k} \beta_i \Delta y_{t-i} + \varepsilon_t \quad (2)$$

$$y_t = a_0 + a_1 y_{t-1} + a_2 t + u_2 DL_t + u_4 DT_t + \sum_{i=1}^{k} \beta_i \Delta y_{t-i} + \varepsilon_t \quad (3)$$

where t is the deterministic time trend, DL_t is a level dummy variable such that $DL_t = 1$ if $t > \tau$ and zero otherwise, τ is the time when the structural break point occurs. DT_t^* and DL_t are the trend dummy variables such that $DT_t^* = t - \tau$, and $DT_t = t$ if $t > \tau$ and 0 otherwise. The test statistic for the null hypothesis $a_1 = 1$ used by Perron is the standard t-statistic which is based on the proportion of observations occurring prior to the break $\lambda = \tau / T$, T is the total number of observations. The critical values are obtained from Monte Carlo simulations and are asymptotic in nature.

Cointegration and error correction model

Assuming that the time series for the price index of Shanghai property stocks (X) and Hong Kong property stocks (Y) are cointegrated, then there exists the equation between the two variables:

$$Y_t = \alpha + \beta X_t + u_t \quad (4)$$

If the two series are cointegrated, a movement away from the implied long-run equilibrium in one period will result in a proportion of the disequilibrium being corrected in the next period (Engle and Granger, 1987). In the other words, the deviation from long-term equilibrium is corrected gradually from a series of partial short-term adjustments. Therefore this process is called error correction. Engle and Granger (1987) argue that cointegration is equivalent to error correction. When examining the full period, we will incorporate the dummy variable as exogenous that indicates the structural break effect in the Asian Financial crisis. We can examine how the two markets price to maintain equilibrium by estimating an error correction model. The length of lag is determined by a test of Akaike Information Criteria (AIC). The following is simple bivariate Error Correction Model (ECM):

$$\Delta Y_t = c + \gamma_1 (Y_{t-1} - \beta X_{t-1} - \alpha) + \sum_{i=1}^{k1} u_1 \Delta X_{t-i} + \sum_{i=1}^{k2} u_2 \Delta Y_{t-i} + \varepsilon_i \qquad (5)$$

Equation (5) related current changes in stock price for Y(Hong Kong property equity) to be lagged changes in both Shanghai and Hong Kong property stocks. In the ECM, $Y_{t-1} - \beta X_{t-1} - \alpha$ is an error correction term, reflecting the dynamics of the long-term relationship between *Y* and *X*. The coefficient of the error correction component, γ_1, measures the rate at which disequilibrium is corrected.

GARCH (1, 1) model

An extended GARCH (1,1) model is used to examine the short-term mean and volatility spillovers. The GARCH (1,1) model is developed to study the transmission mechanism of returns and variances (mean and volatility spillovers) from one property stock market to the other market. The main idea is that the most recent squared residual from the conditional mean equation of the foreign property stock market is introduced as exogenous variables in the conditional variance equation of the domestic market. The full GARCH (1,1) model has the following specification:

<u>*Conditional mean equation*</u>*:*

$$R_{i,t} = c + \beta_{HK,i} R_{HK,t-1} + \beta_{China,i} R_{China,t-1} + \lambda ERR_{i,t-1} + \theta Dummy97 + \varepsilon_i \qquad (6)$$

<u>*Conditional variance equation*</u>:

$$\sigma^2_{i,t} = v + \alpha_{HK,i} \varepsilon^2_{HK,t-1} + \alpha_{China,i} \varepsilon^2_{China,t-1} + \beta \sigma^2_{t-1} \qquad (7)$$

In the above conditional mean equation, a statistically significant value for $\beta_{i,i}$ indicates that the conditional mean of property returns in market *i* is influenced by its own mean spillovers. On the other hand, there is evidence of cross-mean

spillovers from market j to market *i* if $\beta_{j,i}$ (j ≠ i) is statistically significant. In the full period (equation 6), if there is a cointegration relationship between the two markets, we should include the error correction term in the mean equation. In addition, we will include a dummy variable, which takes the value of one for one year period after July of 1997, to test whether the Asian Financial Crisis impacts on the returns of the two markets. On the volatility dimension, statistically significant values for $\alpha_{j,i}$ imply that past volatility shocks in market *i* influence current volatility in market *i* (own-volatility spillovers). A significant $\alpha_{j,i}$ implies that past volatility shocks in market j influences current volatility in market i.

INVESTMENT PERFORMANCE OF TWO MARKETS

Portfolio returns: 1993-2003

A summary of the returns and basic statistics appears in Exhibit 3. Over the full period, the two markets almost have the same performance from a return perspective. The China index returns average 0.03% per week, with 1.57% per year, while the Hong Kong index gains an average of 0.04% per week, annually 2.1%. But for the volatility, which is measured by the standard deviation in weekly returns, the Shanghai index is higher than the Hong Kong, with 5.71% comparing to 5.06%.

Exhibit 3: Descriptive statistics of weekly returns: 1993 - 2003

	Mean	Standard Deviation	Maximum	Minimum	Skewness	Kurtosis
Full Period						
Shanghai	0.0003	0.0571	0.5782	-0.1965	2.64	26.47
Hong Kong	0.0004	0.0506	0.1981	-0.2812	-0.29	6.53
Before Asian Financial Crisis						
Shanghai	0.0033	0.0783	0.5782	-0.1965	2.47	18.23
Hong Kong	0.0035	0.0413	0.1402	-0.1202	0.27	3.60
After Asian Financial Crisis						
Shanghai	-0.0017	0.0372	0.1376	-0.1431	0.24	5.30
Hong Kong	-0.0016	0.0559	0.1981	-0.2812	-0.38	6.52

Furthermore, Exhibit 3 compares the weekly return performance of the two markets for two sub-periods. We divide the sub-periods from July 1997, when Hong Kong

became the Special Administrative Region (SAR) and the Asian Financial Crisis broke. It shows that the average returns before the Asian Financial Crisis in Hong Kong are almost the same as the Shanghai market, with 0.35% per week (19.92% per year) comparing to 0.33% (18.69% annually). But the real estate stock market in Shanghai is more volatile than Hong Kong, with 7.83% against 4.13%.

The results for the measure of skewness indicate that the distributions of returns have positive skewness except for Hong Kong (full period) and Hong Kong after the Asian Financial Crisis. On the other hand, Hong Kong property stocks display a negative skewness, which means there is an unusually higher chance to score lower than average returns in the market indices. Both property stock indices in the sample display fat-tails and have a positive kurtosis.

Risk-adjusted performance: 1993-2003

Four risk-adjusted performance indicators are computed and compared:

(1) coefficient of variation (CV)
(2) Sharpe's reward to variability ratio (SI)
(3) Jensen's time-varying JI
(4) Tenynor Index(TI).

CV measures risk per unit of return of an investment portfolio:

$$CV_i = \sigma_i / R_i \qquad (8)$$

where:

R_i = the nominal return for portfolio *i;*

σ_i = the standard deviation of returns for portfolio *i.*

The SI measures investment performance using total risk:

$$SI_i = (R_i - R_f) / \sigma_i \qquad (9)$$

where R_f = the risk-free rate of return.

Under the rational expectations hypothesis, the JI is estimated from the following equation:

$$(R_{i,t} - R_f) = \alpha_i + \beta_i (R_{m,t} - R_f) + \varepsilon_t \qquad (10)$$

α_i is the Jensen's measure of abnormal returns. A time-varying JI will provide a more appropriate profile of abnormal performance. In this paper, we will employ maximum likelihood estimation and a Kalman filter to estimation of time-varying JI and β.TI is estimated from equation 11.

$$TI_i = (R_i - R_f) / \beta_i \qquad (11)$$

Exhibit 4 reports the average CV, SI, TI and time-varying JI for the full period and the two sub-periods. As can be seen, before the Asian Financial Crisis, the Hong Kong property stock market provided lower risk per unit of return with a lower CV. Over the full period, the SI and TI are both negative because of low returns of the two markets. On a systematic risk-adjusted basis, the time-varying JI results indicate that whether the property stock markets outperform their respective market portfolio. In the full sample period, the Shanghai property stock outperformed the Shanghai stock market, but the Hong Kong property market underperformed its stock market. Both property stock markets performed well before the Asian Financial Crisis. But, with the impact of the Asian financial crisis, their JIs underperformed the market portfolio after 1997.

Exhibit 4: Risk-adjusted performance measures

	CV	SI	Time-varying JI	β	TI
Full period					
Shanghai	190.33	-0.007	0.0004	1.01	-0.0004
Hong Kong	126.50	-0.0113	-0.0008	1.18	-0.0005
Before Asian Financial Crisis					
Shanghai	23.72	0.028	0.0046	0.94	0.0023
Hong Kong	11.80	0.061	0.0006	1.20	0.0021
After Asian Financial Crisis					
Shanghai	-21.88	-0.056	-0.0022	1.06	-0.0017
Hong Kong	-34.94	-0.045	-0.0011	1.17	-0.0021

EMPIRICAL RESULTS AND DISCUSSION

Long- term relationship

The first step in the cointegration analysis is to determine the order of differencing for the series to achieve stationarity. The two indexes are examined for their stationarity on the level and first difference using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root test. The test is necessary, as the finding of a unit root in any of the index series indicates non-stationary, which has implications for modelling the relationships between the two indexes. Exhibit 5 reports the results of the Perron unit root test for exogenous-event break points before and after the first difference. The results show that both the data series are nonstationary and integrated of order 1 or ***I***(1). For the sub-period data, the unit root tests (Exhibit 6) also report that the two indexes are not stationary in level, but stationary after first difference. Therefore, the indexes are both ***I***(1).

Exhibit 5: Perron unit root test for structural break (full period)

	Model	*t*-value	
		Level	Difference
Shanghai	A	-2.05	-22.42**
	B	-3.04	-22.42**
	C	-2.38	-22.44**
Hong Kong	A	-3.23	-21.63**
	B	-2.44	-21.61**
	C	-3.90	-21.58**

Note: Model A means "Crash", model B means "Changing Growth ", model C means " Crash with Changing Growth ". The critical values vary with the proportion of observations occurring prior to the break. We report the asymptotic critical value based on Perron(1989): Model A= -4.01(1%), -4.34(5%); Model B=-4.55(1%), -3.94(5%); Model C=-4.81(1%), -4.22(5%). ** indicates significance at 1% level.

Exhibit 6: Unit root test for sub-periods

	Shanghai	Hong Kong
Before Asian Financial Crisis		
ADF Level	-1.39	-1.47
ADF Difference	-14.16**	-14.38**
PP Level	-1.51	-1.47
PP Difference	-14.16**	-14.39**
After Asian Financial Crisis		
ADF Level	-1.35	-2.84
ADF Difference	-17.54**	-16.58**
PP Level	-1.32	-3.10
PP Difference	-17.54**	-16.58**

Note: ADF means Augmented Dickey-Fuller test; PP means Phillips-Perron test. ** indicate significance in 1% level. The critical value for "Before Asian Financial Crisis" is -3.45, for " After Asian Financial Crisis" is -3.46.

The next step is to employ the Johansen Full Information Likelihood technique (FLML) to test whether two indexes are connected through long-run relationships. The results in Exhibit 7 indicate that there is one cointegration between the China and Hong Kong property stock indexes over the period from 1993 to 2003. As for the sub-period results, before the Asian financial crisis, there is no cointegration between two markets. But after the Asian financial crisis, the two markets present a long term relationship along with the tight business corporations between the two regions. The test evidence suggests that there is a long-term contemporaneous

relationship between the two indexes. Given the cointegration relationship existing among these variables, empirical tests are performed based on the Error Correction Model.

Exhibit 7: Cointegration test results

Sample Period	Trace	Max
Full Period	23.82*(19.96) 7.14(9.24)	16.67*(15.67) 7.14(9.24)
Before Asian Financial Crisis	9.36(15.41) 2.80(3.76)	6.54(14.07) 2.80(3.76)
After Asian Financial Crisis	18.39*(15.43) 2.93(3.76)	15.46*(14.07) 2.93(3.76)

Note: The results (trace tests and maximal eigenvalues) are from the Johansen Full Information Likelihood(FLML) cointegration regressions. The null hypothesis for the trace test is that the number of cointegrating vectors is less than or equal to r, with the alternative of larger than r. The null hypothesis for the maximum eigenvalue test is the number of cointegrating vectors is r, with the alternative of r + 1. Critical values are in parentheses. Significance is indicated by * at the 5% level.

The final step for the long term relationship test is employing ECM. Exhibit 8 presents the estimation results of the ECM model. For the full period results, the coefficient of the error correction term is significant at the one percent level. These results suggest that the error-correcting price adjustment occurs in the two markets to maintain the long-run equilibrium. On the other hand, the small coefficients (-0.02 and -0.0317) indicate the correction speed is low. After the Asian Financial Crisis, there also exists an error correction mechanism between the Hong Kong and Shanghai property stock markets. Similar with the full period result, their error correction speed is slow. In addition, the coefficients of the lagged Shanghai and Hong Kong property stock indexes are not significant, meaning the short term lead/lag relationship between two markets is not remarkable.

The empirical evidence is consistent with the institutional environment in China. After 1997, there were some major changes in China's capital market. The increasingly opening up of the stock market in the China mainland could explain why there was cointegration between the two markets after 1997, which did not exist before. Specifically, in 2002, the Chinese government announced the QFII (Qualified Foreign Institutional Investors) policy, which allowed the foreign investors to enter China's capital market if authorized. At the same time, the domestic investors were also permitted to invest in Hong Kong's stock market. These series of policies would combine the two capital markets more closely, as

well as the property stock markets. From a real estate investors' perspective, the integration between the two markets means little diversification gain across the markets. Those real estate investors who would move to China should highlight this result and develop the relevant investing strategy.

Exhibit 8: Estimation results for ECM

	Sample Period	Shanghai	Hong Kong	Sample Period	Shanghai	Hong Kong
Error Correction term		-0.02**	-0.0317**		-0.0032*	-0.0473**
		(-2.81)	(-3.01)		(-1.96)	(-3.45)
D(HK-1)		0.0524	0.0899*		-0.0087	0.0966
		(1.08)	(2.09)		(-0.23)	(1.77)
D(HK-2)		-0.0577	0.0168**		-0.0451	0.1393**
		(-1.19)	(2.72)		(-1.23)	(2.56)
D(HK-3)		0.0379	0.0023	**After**	0.0168	-0.0026
	Full	(0.78)	(0.05)	**Financial**	(0.45)	(-0.05)
D(Shanghai-1)	**Period**	0.0512	-0.0211	**Crisis**	0.0411	0.0510
		(1.20)	(-0.56)		(0.74)	(0.62)
D(Shanghai-2)		0.0132	0.0074		-0.0884	0.0688
		(0.31)	(0.20)		(-1.63)	(0.85)
D(Shanghai-3)		0.0222	0.0253		0.0111	0.1287
		(0.53)	(0.67)		(0.20)	(1.58)
C		-0.0055	0.0115**		-0.0014	-0.0009
		(-1.09)	(2.56)		(-0.69)	(-0.32)
Dummy		0.0099	-0.018**		N.A.	N.A.
		(1.36)	(-2.84)			
R Square		0.027	0.037		0.026	0.067

NOTE: D(HK-1) means one time lag for one difference of Hong Kong property stock index; D(Shanghai-1) means one time lag for one difference of Shanghai property stock index. Dummy is the dummy variable indicates the break of Asian Financial Crisis. The figures in parentheses are *t* statistics. **,* indicate significance at 1% and 5% level.

Short-term relationship

Mean spillovers

Exhibit 9 illustrates the estimation for the conditional means. Before the Asian Financial Crisis, the cross-mean spillover coefficient indicates that the past Hong Kong property stock return has a significant positive effect (0.3028) on current property stock returns in Shanghai. The results show no other statistically significant mean spillovers across the two markets in our sample period. What is more, there exists own-mean spillover in the Hong Kong property stock market. Within the full period and after the Asian financial crisis, the own-mean spillover coefficients in the Hong Kong market are 0.0962 and 0.1165 respectively. This result means, in the Hong Kong property stock market, the past property stock return has a significant effect on the current return. In the Shanghai property stock

market, we have not found significant evidence for own-mean spillover. On the other hand, the estimates for θ (dummy for Asian Financial Crisis) confirm that the Asian Financial Crisis have an adverse impact on the property stock return in Hong Kong, with a negative coefficient (-0.0172). For the Shanghai property stock market, it has not been significantly impacted under the protection of government.

Exhibit 9: Mean spillover results

Mean equation:

$$R_{i,t} = c + \beta_{HK,i} R_{HK,t-1} + \beta_{China,i} R_{China,t-1} + \lambda ERR_{i,t-1} + \theta Dummy97 + \varepsilon_i$$

	β_{China}	β_{HK}	c	λ	θ	R^2
Full Period						
Shanghai	0.0493	0.0495	-0.0071	-0.0206**	0.0106	0.023
	(1.16)	(1.03)	(-1.36)	(-2.93)	(1.47)	
Hong	-0.0089	0.0962*	0.0116*	-0.0169**	-0.0172**	0.022
Kong	(-0.23)	(2.25)	(2.53)	(2.72)	(2.71)	
Before Asian Financial Crisis						
Shanghai	0.04	0.3028*	0.0023	N.A.	N.A.	0.028
	(0.59)	(2.37)	(0.44)			
Hong	-0.0105	0.0215	0.0035	N.A.	N.A.	0.008
Kong	(-0.29)	(0.31)	(1.22)			
After Asian Financial Crisis						
Shanghai	0.0364	-0.0188	-0.0017	-0.002	N.A.	0.007
	(0.66)	(-0.51)	(-0.83)	(-1.27)		
Hong	0.0334	0.1165*	-0.0015	-0.0411**	N.A.	0.039
Kong	(0.41)	(2.16)	(-0.51)	(-3.14)		

NOTE: **,* indicate significance at 1% and 5% level respectively. The figures in parentheses are *t* statistics.

Volatility spillovers

Exhibit 10 demonstrates the results for the conditional variance equation. The results indicate the presence of significant heteroskedasticity in the two markets' return series. In the full sample period, both of the markets present a high degree of volatility persistence with 0.9114 and 0.8967 respectively. Furthermore, the volatility in the Hong Kong market would spill over to the Shanghai market with small effect (0.0742). This indicates the past Hong Kong property stock volatility shocks have an obvious positive effect on China property stocks. Before the Asian Financial Crisis, the two markets both have cross spillover effects. More

specifically, Hong Kong property stock market volatility spills over to the China market with a significant coefficient 0.4306; for the Shanghai market, this coefficient is -0.0057. After the Asian Financial Crisis, with the depression of the Hong Kong economy and booming of China mainland's real estate market, the Shanghai property stock shocks spillover the Hong Kong market with positive effect (0.1230).

Exhibit 10: Volatility spillover results

Variance equation:

$$\sigma^2_t = v + \alpha_{HK}\varepsilon^2_{HK,t-1} + \alpha_{China}\varepsilon^2_{China,t-1} + \beta\sigma^2_{t-1}$$

	v	α_{China}	α_{HK}	β	$\alpha+\beta$	$Q(6)$	$Q(12)$	$Q^2(6)$	$Q^2(12)$
Full Period									
Shanghai	0.0004** (3.55)	0.3512** (6.61)	0.0573** (3.47)	0.5029** (5.88)	0.9114	10.79	16.88	2.26	5.79
Hong Kong	0.0001** (2.09)	-0.0797 (-1.82)	0.0735 (3.18)	0.9029** (29.60)	0.8967	7.65	10.19	17.81	19.60**
Before Asian Financial Crisis									
Shanghai	0.0005 (1.57)	0.4797** (3.11)	0.4306** (4.39)	0.3916** (2.73)	1.3019	4.93	10.18	3.75	5.99
Hong Kong	0.0004 (3.32)	-0.0057** (-8.7)	0.0642 (1.21)	0.7193** (7.80)	0.7778	3.86	11.95	0.64	8.92
After Asian Financial Crisis									
Shanghai	0.0009 (3.00)	0.0352 (1.29)	-0.0028 (-1.71)	0.6826** (6.51)	0.7149	6.90	11.74	1.38	12.07
Hong Kong	0.001** (3.51)	0.1230** (2.39)	0.2852** (4.15)	0.5121** (6.83)	0.9230	8.52	12.68	10.64	43.47**

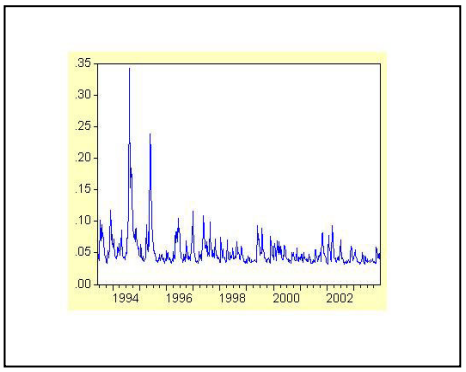
NOTE: $Q(k)$ and $Q^2(k)$ are the Ljung-Box test statistics for serial correlation of the original and squared standardized residuals. $\alpha + \beta$ represents the volatility persistence. The figures in parentheses are t statistics. ** indicate significance at 1% level ; * indicate significance at 5% level.

Exhibit 11 depicts the movement of conditional variance of each property stock market in both the sub and full periods. It's worth noting that, around the Asian financial crisis, the Hong Kong property stock presents high conditional variance.

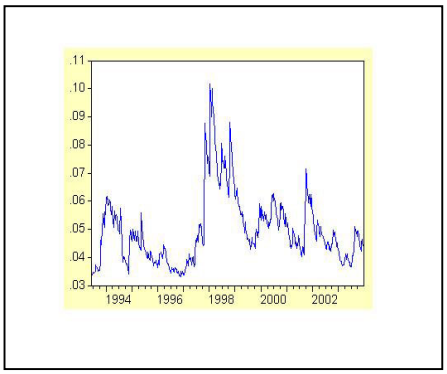
The short-term relationship across the two markets has totally changed since 1997. This is because the business environments of the two markets have experienced changes after 1997. As for the Hong Kong side, impacted on by the Asian Financial Crisis, business as well as investors' confidence went down rapidly. The economic growth and real estate sector was restrained as well. However, in the China mainland, the economic progress has been strong since 1997. It's economic growth

Exhibit 11: Conditional variance graphs

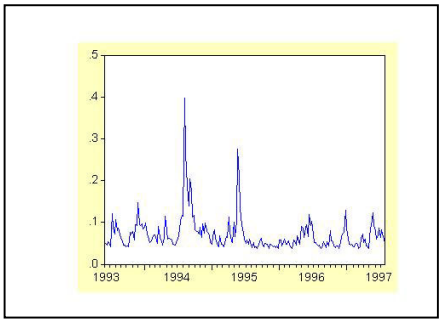
Shanghai full period



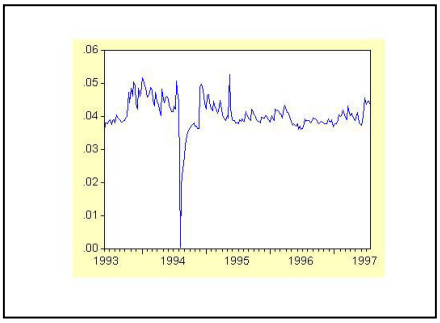
Hong Kong full period



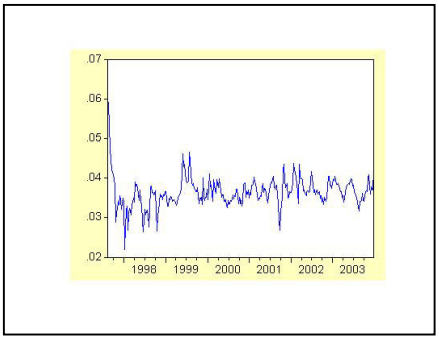
Shanghai before crisis



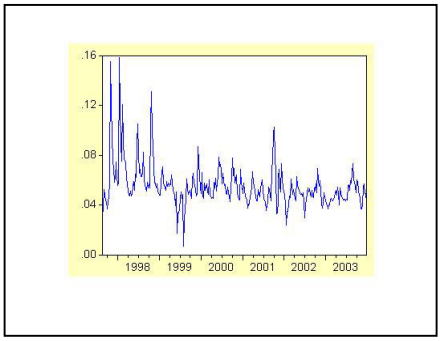
Hong Kong before crisis



Shanghai after crisis



Hong Kong after crisis



rate maintained 7-8% annually and China's trade surplus to America was twice as much as Japan's. Every week, more than $1 billion of foreign direct investment flowed into the country. A large part of the funds would go to Shanghai and its surroundings. All these testified the uprising of China. Thereby, the change of business environment made the Hong Kong economy rely on the China mainland heavily. This type of situation also could cause the Shanghai property stock market to affect the Hong Kong market in the short run after 1997. Real estate investors can make use of this linkage of the two markets and adjust their portfolio across the markets accordingly.

CONCLUSION

This study has examined the relationship of the Shanghai and Hong Kong property stock markets on both a long and short term basis. Our results indicate the following, (a) from the investment portfolio perspective, Shanghai property stock weekly return was always higher than the Hong Kong. Both the two markets' performances appeared quite different between the time prior to 1997 and after 1997. Before 1997, both the two property stock markets outperformed their respective stock markets and had the positive average weekly return. But things were reversed after 1997; (b) the Johansen cointegration and ECM results suggest that there is a long-term contemporaneous relationship between the Shanghai and Hong Kong property stock markets and error correcting price adjustments occur in the two markets to maintain the long-term equilibrium; (c) we employ the GARCH (1,1) model to examine the mean and volatility spillovers across the two markets. Before the Asian Financial Crisis, there is evidence of cross-mean spillovers from the Hong Kong property stock market to the Shanghai market; (d) the Asian Financial Crisis adversely impacted on the property stock returns in Hong Kong, but not in Shanghai; (e) as for the linkage in the second moment of the return series, we find significant evidence of own-volatility and cross-volatility spillovers. In the full period (1993-2003), the Hong Kong property stock volatility would spill over to the Shanghai property stock volatility. But, in the period after 1997, Shanghai's volatility would affect the Hong Kong market; and (f) the long-term relationship between the two markets implies that investors would not benefit from diversifying property stock portfolios between Hong Kong and Shanghai, especially after the Asian Financial Crisis.

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