THE CHANGING RETURN DYNAMICS OF THE HANG SENG AND THE SHANGHAI COMPOSITE INDICES

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ABSTRACT

Diversification benefits to international investors depend fundamentally on the dynamic correlations of returns between market indices. The relationship between the Hang Seng and Shanghai Composite indices are analyzed in this research for the period before, during and after the 1997 British handover of Hong Kong. Diversification benefits between the two markets are shown to have reduced after the 1997 handover. A further series econometric analysis of the joint dynamics of these two markets shows an increasingly important role of the Shanghai Composite Index, particularly after 1999. The results of this research clearly demonstrate that diversification benefits have diminished between these two markets following the 1997 handover.

I. INTRODUCTION AND MOTIVATION

The research on international diversification has long been a subject of research in financial economics. It is generally accepted, that there are diversification gains from investing in countries with low correlation with one's home market. Studies published in the 1960's and 1970's showed that investors are rewarded for holding a globally diversified set of assets rather than skewing their portfolios toward domestic investments (Solnik, 1974). Since the time of this early research, barriers to international investment, such as government controls on cross-border capital flows, difficulties in obtaining information about foreign markets, and differences in financial institutions have gradually declined.

One of the primary theoretical reasons to invest in markets like China and Hong Kong are international diversification benefits. One can see this theoretical motivation by considering the problem facing the portfolio investor. The problem is often thought of as deciding upon appropriate country level allocation weights, to maximize portfolio returns subject to a risk constraint, or in absence of a prespecified risk level, to reach the portfolio that has the highest Sharpe ratio. The Sharpe ratio (S) is the ratio of expected excess returns (excess over the risk free rate) to the standard deviation of the return (Obsterfeld and Rogoff 1996). The portfolio investor problem can be thought of as:

$$MAX_{X_i} S = \frac{E(r_p) - r_f}{\sigma_p} \qquad (1)$$

where x_i refers to the portfolio weights for different countries and $E(r_p)$ and σ_p refers to the expected return and standard deviation of the return for the entire portfolio respectively. The variability of the portfolio returns depends not only on the variance of returns of an individual country but also on the correlation matrix of country level returns with the world market. Emerging markets with their low covariance with world markets are attractive to foreign portfolio investors.

With China becoming a more prominent player in the international financial market, this research tackles the timely subject of the diversification benefits of investing in both China and Hong Kong following the 1997 British handover of Hong Kong to mainland China. The existence of linkages across different national stock markets has important implications for investors who are seeking diversification opportunities internationally. When dynamic correlations indicate positive co-movement between different markets, this effectively reduces the scope for portfolio diversification possibilities. This implication is of particular interest to global investors considering investing in both Shanghai and Hong Kong.

This research looks at the dynamic linkages between the Shanghai Composite and Hang Seng indices for the periods before, during and after the British handover of Hong Kong. The linkages across markets that are examined include contemporaneous co-movements, granger causal relationships, responses to cross-market shocks, and long-run interdependence.

The handover of Hong Kong to China was a historic event that has real economic implications for the countries of the Asia-Pacific Rim. That is why this event in history is not just symbolic, nor is it a question solely of political ownership. The stated objective of the Chinese government is to develop Shanghai into a leading financial center by the year 2010 (Asian Pacific report, 1997). In the three years following the handover of Hong Kong to China, Hong Kong experienced continuing deflation and economic slowdown. Hong Kong's sluggish economy rebounded in 2002 relative to a year earlier. The U.S-Iraq War and the SARS epidemic in early 2002, however, affected Hong Kong's economy and for this reason the period after 2002 was not considered in this paper. In his 1997 policy address, Chief Executive Tung Chee-Hwa emphasized that Hong Kong will increase economic cooperation with the Mainland and facilitate economic integration. Toward this end, Hong Kong has actively worked on a Closer Economic Partnership Arrangement (CEPA) with the Mainland.

Much of the research using the methodology this paper applies has used data surrounding the Asian Financial Crisis (Maroney, Naka and Wansi, 2004). Moon (2001) investigated the impact of the 1997 Asian financial crisis on stock market integration in East Asia and found that in the long and short run, East Asian stock markets have become increasingly integrated with the US market after the Asian Financial Crisis. This Moon said confirmed the view that the Asian crisis brought about US dominance over Asian stock markets and should increase the linkages between the two major national stock market indices.

Sheng and Tu (2002) examined the changing patterns of linkages among the stock markets of 12 Asian counties for the periods before and during the Asian financial crisis. The daily closing prices for the period from July 1996 to June 1998 were used to provide evidence of cointegration among the stock indices during the crisis but not before.

Another study by Yang and Lim (2002) also used daily market returns from January 1990 to October 2000 and tested the extent of contagion effects among nine East Asian equity markets during the pre-crisis and post-crisis periods. They found no evidence of long-term co-movements among the East Asian markets, but only short-term correlations, in both sub periods. They found a substantial increase in the degree of interdependence, which they said reflected the presence of contagion effects in the region.

Jang and Sul (2001) conducted a study to examine the changes in the co-movement among the stock markets of the countries that were directly affected by the Asian financial crisis in 1997 and showed that there is a significant increase in cointegration during the crisis period and thereafter. They also found no Granger-Causal relationship before the crisis, but a marked increase during and after the crisis.

Cheung, Cheung and Ng (2002) applied cointegration techniques to daily equity returns in order to examine the interactions between the US market and the four east Asian markets of Hong Kong, Taiwan, Korea and Singapore before, during and after the Asian financial crisis and confirmed the dominate role of the US market in all three sub-periods. They also interestingly found that while the US market leads these East Asian markets before, during and after the crisis, it only Granger-caused they during the crisis.

Using cointegration techniques to the daily data from 1977 to 1999, Fernades-Serrano and Sosvilla-Rivero (2000) found no evidence of long-run relationships among Asia's top five stock markets of Japan, South Korea, Taiwan, Singapore and Hong Kong.

The remainder of this paper will be structured as follows: Section two presents the empirical methods and data used in this paper, section three will present the empirical results and the final section will conclude.

II. METHODOLOGY AND DATA

The data used in this paper are the daily closing prices of the Hong Kong (Hang Seng) and Shanghai (Shanghai Composite) stock exchange indexes. The period considered is from 1997 to 2001 and the total number of observations included is 1751. The data for this study was obtained from Bloomberg. Three periods were identified in this paper, pre-handover, handover and post-handover.

Let p_{it} be the logarithm of the price index for stock market i, where i=1,2 and t=1, 2...n, where n is the number of observations in the sample period, in this case 1751. The daily returns are calculated as the log difference. As mentioned before the paper is divided into three periods. To test if the average market returns underwent significant changes, the below autoregressive process is fitted:

$$R_{it} = \beta_o + \beta_1 D_{1t} + \beta_2 D_{2t} + \sum_{k=1}^{p} \phi_k R_{i,t-k} + \varepsilon_{it} \quad (2)$$

Where D_{1t}=1 for observations beginning January 1st to January 1st 1999 and zero otherwise. D_{2t}=1 for observations beginning in January 2nd 1999 to the end of the sample period. Significant β_1 and β_2 would suggest structural changes in the behavior of the market.

Since the impact of cross-market shocks can be felt within the same period or after a lag. The lagged impact induces causal relationships between the returns of the two stock markets. The Granger likelihood ratio test is performed to examine the presence of such relationships. This is done using the regression below and an autoregressive equation for the unrestricted model.

$$R_{it} = \mu + \sum_{k=1}^{p} \phi_{ik} R_{i,t-k} + \sum_{k=1}^{p} \phi_{jk} R_{j,t-k} + \varepsilon_{it} \quad (3)$$

In order to understand the dynamic relationship between these two markets returns, several vector autoregressive models are estimated. A VAR model is composed of a system of regressions in which the dependent variables are expressed as functions of their own and each other's lagged values (Enders, 2004). For example, consider the following bivariate VAR with a one period lag:

$$\begin{aligned} R_{ct} &= b_{10} - b_{12}R_{ht} + \beta_{11}R_{ct-1} + \beta_{12}R_{ht-1} + \varepsilon_{rt} \\ R_{ht} &= b_{20} - b_{21}R_{ct} + \beta_{21}R_{ht-1} + \beta_{22}R_{ct-1} + \varepsilon_{ht} \end{aligned} \quad (4)$$

where R_{ct} and R_{ht} are returns of the Shanghai Composite and Hang Seng respectively. VAR is basically, simultaneous equation modeling (Sims, 1980). VAR is useful especially for forecasting systems of interrelated time-series variables. Due to the feedback inherent in the VAR process equation, the primitive equation (4) cannot be estimated directly. The reason is that R_{ct} is correlated with the error term ε_{ht} and is R_{ht} correlated with the error term ε_{ct}. Standard estimation techniques require that all repressors be uncorrelated with the error term. In order to deal with this problem of estimating equation (4) one must use matrix algebra to transform the system of equations into the following form:

$$\begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix} \begin{bmatrix} R_{ct} \\ R_{hit} \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{21} \end{bmatrix} + \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix} \begin{bmatrix} R_{ct-1} \\ R_{ht-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{rt} \\ \varepsilon_{ft} \end{bmatrix} \quad (5)$$

This can be written in a more compacted form: $Bz_t = \Gamma_0 + \Gamma_1 z_{t-1} + \varepsilon_t$

where:

$$B = \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}, z_t = \begin{bmatrix} R_{ct} \\ R_{ht} \end{bmatrix}, \Gamma_0 = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix}, \Gamma_1 = \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix}, \varepsilon_t = \begin{bmatrix} \varepsilon_{ct} \\ \varepsilon_{ht} \end{bmatrix}$$

Then one can simply premultiply by the inverse of the B matrix giving the standard form of a VAR model as:

$$z_t = A_0 + A_1 z_{t-1} + e_t \quad (6)$$

where:

$$A_0 = B^{-1}\Gamma_0,\ A_1 = B^{-1}\Gamma_1,\ e_t = B^{-1}\varepsilon_t$$

Now e_t is a vector of uncorrelated structural shocks. $[\varepsilon_t \sim N(0,\Omega]$ It is important to note that the error terms in equation (4) are composites of two shocks ε_{ct} and ε_{ht}. Arranging our primitive VAR into the reduced form allows us to estimate the two elements of A_0 and the four elements (in the case of a first order auto regressive problem) A_1. Moreover, after obtaining the residuals from the two regressions, it is possible to calculate estimates of the variance and covariance of the elements in e_t.

The issue with VAR is whether it is possible to obtain the information present in the primitive system (4). using equation (6).

This is not possible unless one is willing to impose restrictions on the primitive system. In a bivariate system, one must restrict one parameter and more generally, $(n^2 - n)/2$ parameters must be restricted to achieve identification of the primitive system.

It has become standard in VAR to restrict parameters assuming that one variable has no contemporous effect on the other; this is known as Choleski decomposition. This research uses variance decomposition to decompose the forecast error variance in the returns of a stock market into the components shocks attributed to the other stock market as well as its own shocks. Impulse response functions are looked at to facilitate the analysis of the relative influence of random innovations in each stock market on the variation of its own returns and also the returns of the other market.

The stock market linkages could be long-term in nature if the market indices are cointegrated. This paper uses Engle and Granger's (1987) method to investigate if cointegration between market indices exists.

III. EMPRICAL RESULTS

Before starting with the analysis of the linkages between the Hand Seng and Shanghai Composite indices, it is interesting to understand the behavior of the market returns for the selected periods. Table 1 shows the mean daily returns for the three periods:

TABLE 1: Mean Returns

Period	Hang Seng	Shanghai Composite
Pre-handover	0.0010**	0.0013*
Handover Period	-0.0009*	-0.0001*
Post-handover	-0.0002*	0.0002**

**significant from zero at 5% level, **significant from zero at 1% level*

Table one demonstrates that returns of Shanghai Composite and Hang Seng are basically in the same direction before the handover, but after it appears as if the markets are moving in opposite directions (i.e. Shanghai increasing and Hong Kong declining).

Next, standard diagnostic tests are preformed on the price and return data for the Shanghai Composite and the Hang Seng. Estimation of the standard Augmented Dickey-Fuller (1979) tests indicated that daily returns of both the Shanghai Composite and the Hang Seng are stationary. The second set of diagnostic tests is performed to determine optimal lag length for autoregressive models to be estimated. Both the Akaike (AIC) and Schwarz information criterion (SBIC) suggest a lag length of 3 be used.

Table 2 contains the results of this regression outlined in equation two. Only the dummy variable for post handover for Hong Kong was significant and negative. This suggests that there was a drop in average market returns for Hang Seng after the handover.

In order to study the lead-lag relationship between stock market returns, Granger causality tests are performed based on equation three and use an autoregressive equation of order three for the unrestricted model. The log likelihood ratio for the null hypothesis that Shanghai Composite

TABLE 2: Structural Regression Results

	Dummy for Handover	Dummy for post Handover	R_{it-1}	R_{it-2}	R_{it-3}
Shanghai Composite	-0.0012 (0.28)	-0.0010 (0.36)	0.0170 (0.47)	-0.0900 (0.68)	0.0700** (0.003)
Hang Seng	-0.0017 (0.19)	-0.0010* (0.04)	0.2900 (0.22)	-0.0560* (0.02)	0.1120** (0.00)

p-values in parenthesis, * and ** represent significance at 5% level and 1% level respectively

returns do not Granger cause the returns of the Hang Seng was 5.42090 and the likelihood ratio for the null hypothesis that Hang Seng returns do not Granger cause the returns of Shanghai Composite was 4.96876. Both these results are significant and hence the null hypothesis is rejected. When the periods were broken down in to sub-periods the results change. Interestingly there is significant Granger causation in all sub-periods for Shanghai stock market Granger causing Hong Kong Stock returns, but there is only significant Granger causation the other way (i.e. Hong Kong stock market Granger causing Chinese stock returns) for the period before handover and no Granger causation for the Hang Seng Granger causing Chinese stock returns for the period of the handover and post handover. This implies a decreased significance of the Hang Seng during and after the handover, which would be consistent with the stated policy of the Chinese government to increase the significance of Shanghai.

To understand the dynamic relationships between these two markets Vector Autoregression (VAR) of order three are fitted to the full sample and the three sub periods, variance decompositions are obtained and these results are summarized in table 3.

Variance decomposition measures the historical contribution of each variable to

TABLE 3: Variance Decompositions

	Standard error	Hong Kong	Shanghai
Full Sample			
Hang Seng	0.02	99.69	0.31
Shanghai Composite	0.02	7.83	92.17
Pre handover			
Hang Seng	0.00	98.86	1.14
Shanghai Composite	0.02	0.56	99.44
Handover period			
Hang Seng	0.03	98.71	1.29
Shanghai Composite	0.02	2.81	97.19
Post Handover			
Hang Seng	0.02	29.19	70.81
Shanghai Composite	0.01	99.63	0.37

the variance of the other variable in the system. Variance decomposition provides evidence on the relative importance of each of the shocks. The entries in table 3 are the percentage of return forecast error variance of a market that can be explained by random innovations of its own market as well as those of the other market. The component explained by own market innovations are often used as a measure for the degree of exogeneity of that market, because it nets out the other markets influences. The results in the table 3 are for ten-day ahead forecasts. As table 3 illustrates the relative influence of the Hang Seng is the highest before the handover; this implies that the Shanghai Composite index is more exogenous after the handover that before. During the period of the handover the Shanghai Composite was almost completely exogenous of the Hang Seng index, and this continues to the end of the sample period. The Hong Kong stock market appears to be for the most part exogenous before and during the handover, but displays a much larger degree of endogeneity after the handover. This supports the results from the Granger causality tests. In all cases the F-test for block exogeneity fails to reject the null hypothesis.

Impulse response functions are reported in Graphs 1-4. The impulse response function gives the estimated response of each variable in the VAR to a pure shock to one of the variables in the system. A pure shock is defined as a shock to one of the variables that is uncorrelated with any of the shocks to the other variables in the system. The impulse response function is the path whereby variables return to equilibrium. The impulse response functions in the graphs 1-4 illustrate the effects on Hong Kong as a response to a one time innovation in the return of Shanghai. There was a significant change in the impulse response functions for the period of pre-handover verses the period of the post handover, graph 1 reports the impulse response function for the pre-handover period and graph two reports the impulse response function for the post handover. The impulse response function for the period during the handover is very similar to the post handover function and is not reported.

An innovation in the Shanghai Composite return affects the Hang Seng contemporaneously and with a lag, but it can be seen from the above impulse response functions that pre-handover effects caused more volatility in Hong Kong than in the post handover period. As with the impulse response functions of Hong Kong there was a significant change in the impulse response functions for the period pre-hand over verses the period of post handover for Shanghai as well. Graph 3 reports the impulse response functions for the pre-handover period and Graph 4 reports the impulse response function for the post handover period. The impulse response function for the period during the handover is very similar to the post handover function and is not reported.

There are no contemporaneous effects of an innovation in Hang Seng return on the Shanghai Composite, but Shanghai is affected with a lag. The impulse response functions are interesting because they changed dramatically. In the pre-handover period a one-time innovation in Hong Kong positively affected Shanghai markets with a lag, but post handover the opposite effect is occurring. Now an innovation in Hong Kong negatively affects Shanghai markets with a lag.

In terms of linkages of long-run nature, Table 4 displays Engle-Granger cointegration results. The null hypothesis of no cointegration in rejected for the full sample and in all sub periods. The results suggest the stock market indices are 'tied' together by long-run equilibrium relationship in all periods. Such long-run relationships are expected given the close regional and economic integration of the two markets. The results indicate that the degree of cointegration has strengthened.

TABLE 4: Engle Granger Cointergration Results

Cointegrating vector (Full Sample)			
	1	2	
Hang Seng	1.00000	1.00000	
Shanghai	-0.30061	-4.00957	
Engle-Granger (tau) cointegration tests (Full Sample)			
Dep. Var.	**TestStat**	**P-value**	**Num. Lags**
Hang Seng	-20.34254	8.32847D-37	3.00000
Shanghai	-19.18412	3.66648D-36	3.00000
Cointegrating vector (Pre-Handover)			
	1	2	
Hang Seng	1.00000	1.00000	
Shanghai	-0.015321	-13.55769	
Engle-Granger (tau) cointegration tests (Pre-Handover)			
Dep. Var.	**TestStat**	**P-value**	**Num. Lags**
Hang Seng	-10.05242	1.78804D-16	3.00000
Shanghai	-8.56156	3.32874D-12	3.00000
Cointegrating vector (Handover Period)			
	1	2	
Hang Seng	1.00000	1.00000	
Shanghai	-0.23427	-8.84724	
Engle-Granger (tau) cointegration tests (Handover Period)			
Dep. Var.	**TestStat**	**P-value**	**Num. Lags**
Hang Seng	-11.07138	1.96830D-19	3.00000
Shanghai	-13.63525	1.78330D-26	2.00000
Cointegrating vector (Post-Handover)			
	1	2	
Hang Seng	1.00000	1.00000	
Shanghai	-0.62736	-2.21488	
Engle-Granger (tau) cointegration tests (Post-Handover)			
Dep. Var.	**TestStat**	**P-value**	**Num. Lags**
Hang Seng	-17.21908	6.83615D-34	2.00000
Shanghai	-16.81148	3.02472D-33	2.00000

IV. CONCLUSIONS

This research dissects the linkages between the Hang Seng and Shanghai Composite for the period before, during and after the handover of Hong Kong to China, to address the issues of diversification benefits. Portfolio theory states that diversification is most effective is markets are dynamically uncorrelated or negatively correlated. The British handover of Hong Kong to Mainland China in 1997 has significantly altered the dynamic correlations between these two markets. The returns of Hang Seng and Shanghai Composite were for the most part heading the same direction before the handover, but after the handover there is some evidence that the markets are moving in the opposite directions. This was supported by the test for structural changes, which indicated that post handover Hong Kong has experienced relatively negative returns.

In terms of long-run casual relationships, the Shanghai Composite stock is playing an increasingly dominant role when compared to the Hang Seng. The Hang Seng was for the most part exogenous before and during the handover, but seems to display a much larger degree of endogeneity for the period after the handover to the end of the sample period.

As expected the two markets are cointegrated in all three sub-periods. The results show that the degree of cointegration has strengthened slightly, which implies that diversification between the two markets would be less beneficial.

Overall the results of this analysis indicate that the policy of increasing the importance of Shanghai is working, Shanghai seems to be gaining in importance relative to Hong Kong.

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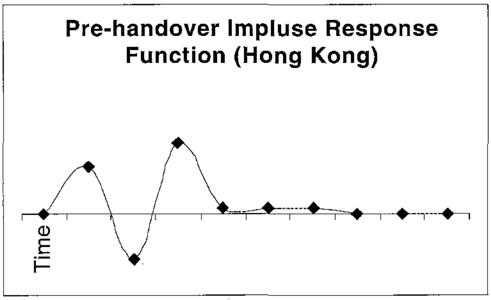
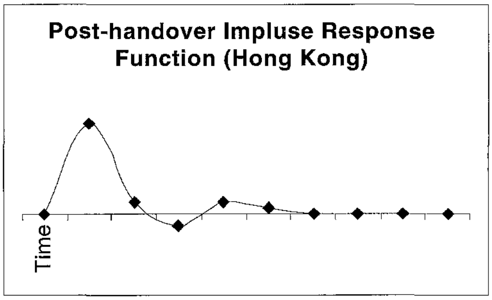
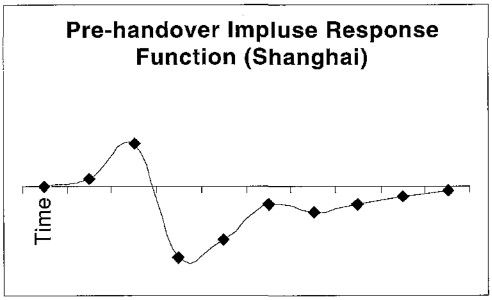
Graph 1:



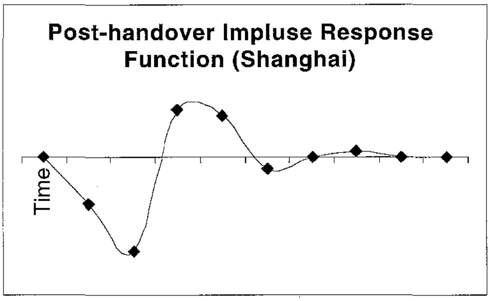
Graph 2:



Graph 3:



Graph 4:



Graphs one though four present the impulse response function for the VAR outline in equation 6.

Short Bio of Joseph J. French

Joseph J. French is an assistant professor of finance at the Monfort College of Business at the University of Northern Colorado. French received his PhD in financial economics from the University of New Orleans.