

E C O N O M I C S B U L L E T I N

Are the Asian Equity Markets more Interdependent after the Financial Crisis?

Siew-Yen Foo

National University of Singapore

Wing Keung Wong

Hong Kong Baptist University

Terence Tai-Leung Chong

The Chinese University of Hong Kong

Abstract

This paper examines the impact of the 1997 Asian Financial Crisis on the linkages between the Singapore and five Asian-Pacific stock markets. We show that the interdependence between these markets has intensified after the crisis. Before the crisis, only the Malaysian stock market is found to be cointegrated with Singapore. However, after the onset of the crisis, the stock markets of Hong Kong, Japan, Malaysia and the US are found to be cointegrated with the Singapore stock market.

We would like to thank the Department of Economics, National University of Singapore for the provision of research grant. We also thank Xiaobing Zhang for assistance. Corresponding author: Terence Tai-Leung Chong, Department of Economics, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong. Tel: (852) 26098193, Fax: (852) 26035805, e-mail: chong2064@cuhk.edu.hk. Homepage: <http://www.cuhk.edu.hk/econo/staff/tlchong/tlchong3.htm>.

Citation: Foo, Siew-Yen, Wing Keung Wong, and Terence Tai-Leung Chong, (2008) "Are the Asian Equity Markets more Interdependent after the Financial Crisis?." *Economics Bulletin*, Vol. 6, No. 16 pp. 1-7

Submitted: March 13, 2008. **Accepted:** April 21, 2008.

URL: <http://economicsbulletin.vanderbilt.edu/2008/volume6/EB-08F30013A.pdf>

1. Introduction

The interdependence of stock markets in the Asian Pacific region has been widely studied in the past decade. Chan *et al.* (1992) study the inter-relationship among the stock markets of Hong Kong, Singapore, South Korea, Taiwan, Japan and the US. It is found that these markets are all weak-form efficient but not cointegrated with each other. Cheung and Ho (1993) report the unstable correlations between the developed markets and the Asian emerging markets. By taking the exchange rate fluctuations into account, Hung and Cheung (1995) find evidence of cointegration among Asian stock indices. Corhay *et al.* (1995) investigate the long-run relationship between major Pacific-Basin stock markets and conclude that they are cointegrated. Chong *et al.* (2008) show that the Japanese stock market has important linkages with other major stock markets in the world.

In this paper, we examine the international linkages of the Singapore stock market before and after the 1997 Asian Financial Crisis. Singapore is chosen as the host country because of its uniqueness as a small, highly open economy, making it susceptible to foreign shocks. Five other Asian-Pacific stock markets are included in our study, namely, Hong Kong, Malaysia, Japan, Thailand and the US. Hong Kong is chosen for her leading role in the regional financial markets. Malaysia and Thailand are included because of their close proximity to Singapore, and the fact that Thailand is the epicenter of the crisis. Japan and the US are chosen because of their influence on other markets.

2. Data and Methodology

The data obtained from DataStream include the monthly closing price of the Bangkok SET Index (SET, Thailand), Hang Seng Index (HSI, Hong Kong), KLSE Composite Index (KLSE, Malaysia), Nikkei 225 Index (Nikkei, Japan), Singapore Straits Industrial Index (STI, Singapore) and the Dow Jones (DJ, US) for the period from 1990-2001. We use July 1, 1997 as the cut-off date for the pre- and post-Crisis periods. The stock indices are adjusted by the corresponding exchange rate so that they are denominated in Singapore dollar.

To begin with, we first examine the time series properties of the six stock indices via the standard Dickey-Fuller (DF) and the Augmented Dickey-Fuller (ADF) unit root tests. Our calculations show that the null hypothesis of unit root cannot be rejected for all the six indices. In this paper, we are interested in pairwise the cointegration relationship between the stock market index of Singapore and those of other Asian-Pacific economies. The results of the cointegration tests are shown in Table 1.

Table 1: Cointegration results

Country	Model	R ²	DF	ADF
BEFORE THE 1997 CRISIS				
Hong Kong	STI=341.71+0.6820(HSI)	0.8859	-1.19	-1.19
Japan	STI=697.47-1.6815(Nikkei)	0.0185	-1.30	-1.30
Malaysia	STI=65.77+4.8392(KLSE)	0.9261	-2.85**	-2.85**
Thailand	STI=249.54+18.7675 (SET)	0.4648	0.70	0.70
US	STI=150.67+0.2146(Dow Jones)	0.6997	-0.79	-0.79
AFTER THE 1997 CRISIS				
Hong Kong	STI=46.563+0.5876(HSI)	0.8182	-2.70**	-2.70**
Japan	STI=181.39+6.2061(Nikkei)	0.6226	-2.34*	-1.58
Malaysia	STI=550.28+4.2292(KLSE)	0.4109	-2.27*	-2.27*
Thailand	STI=641.97+39.4863(SET)	0.2663	-1.34	-1.20
US	STI=-34.74+0.1075(Dow Jones)	0.3104	-2.69**	-2.69**

* p < 5%, ** p < 1%

The only evidence of co-movement of stock indices before the 1997 Crisis is found for Malaysian and Singapore. This is due to the long-standing economic and political ties between the two countries. It also suggests that the removal of the companies cross listed in the Singapore and Malaysian stock markets in 1990 does not weaken their financial integration². Evidence of co-movement in stock indices is found for Singapore and Hong Kong, Japan, Malaysia and the US after the outbreak of the 1997 Financial Crisis. This suggests that the integration between Singapore and these economies has intensified after the crisis. However, no cointegrating relationship is found for Singapore and Thailand, although the two countries are trading partners and physically in close proximity to each other.

² On January 1, 1990, Singapore-incorporated companies were delisted from the Malaysian bourse and vice-versa when the two exchanges went their separate ways. Singapore kept the trading of Malaysian stocks alive in the city-state through the over-the-counter market known as Central Limit Order Book (CLOB) International. But Malaysia put an end to this in 1998.

To examine the causality, if a cointegration relationship is found, a Vector Error Correction Model (VECM) is estimated:

$$\Delta X_t = C_1 + \theta_1 \varepsilon_{t-1} + \sum_{i=1}^k \alpha_{1i} \Delta X_{t-i} + \sum_{i=1}^k \beta_{1i} \Delta Y_{t-i} + v_t, \quad (1)$$

$$\Delta Y_t = C_2 + \theta_2 \varepsilon_{t-1} + \sum_{i=1}^k \alpha_{2i} \Delta X_{t-i} + \sum_{i=1}^k \beta_{2i} \Delta Y_{t-i} + \delta_t, \quad (2)$$

where ε_{t-1} represents the deviation from long-run equilibrium in period t-1 obtained from the cointegration regression. In particular, Y_t does not cause X_t if all the β_{1i} are zero. Similarly, X_t does not cause Y_t if all the α_{2i} are zero.

For non-cointegrating series, we study the Granger causality by the Vector Autoregressive (VAR) model. The form of the VAR model is obtained by deleting the ε_{t-1} terms in (1) and (2). The results of the VECM and VAR are sensitive to the lag structure chosen for the underlying model. In this paper, we determine the lag length by the minimum final prediction error criterion (FPE) of Hsiao (1979, 1981). The FPE statistic of ΔX_t for n lags of ΔX_t and m lags of ΔY_t is

$$FPE_{\Delta X_t}(n, m) = \frac{(N + n + m + 1) \sum (\Delta X_t - \hat{\Delta X}_t)^2}{(N - n - m - 1)N}, \quad (3)$$

where N is the number of observations. The FPE statistic for ΔY_t is found analogously. The results of the Granger causality test are reported in Table 2. Note from Table 2 that the STI is Granger-caused by the KLSE, and that there is a long-run equilibrium between the two after the crisis. Although the Thai and Singapore stock markets are not cointegrated, they achieve a short-run equilibrium without reverse causation before the crisis. For other stock markets, they are not cointegrated with the Singapore market.

After the crisis, there is evidence that the Singapore stock market is Granger-caused by the Hong Kong stock market. We also find that the Singapore stock market continues to be Granger-caused by the Malaysian stock market after the crisis, but the relationship is weakened. This can be attributed to the implementation of capital and currency control³ in Malaysia in September 1998 to curb currency speculation, and the cessation of trading of the Central Limit Order Book (CLOB) shares in the Singapore

³ This measure was introduced to peg the Ringgit to the US dollar at 3.80 in order to restrict the flow of capital in and out of the country.

Stock Exchange. For other stock markets, no significant evidence of Granger causality is found between them and the Singapore stock market.

Table 2: Granger Causality Tests

Time Period	Causality	FPE	VAR p-value	ECM p-value	Error correction term p-value
Pre-Crisis	STI → HSI	1,1	0.8419	-	-
	HSI → STI	1,1	0.9341	-	-
	STI → NIKKEI	1,1	0.9173	-	-
	NIKKEI → STI	3,1	0.7210	-	-
	STI → KLSE	1,1	-	0.1789	0.9391
	KLSE → STI	3,1	-	0.7046	0.0381**
	STI → SET	1,3	0.0446**	-	-
	SET → STI	1,1	0.7227	-	-
	STI → DJI	1,1	0.7826	-	-
	DJI → STI	1,1	0.5523	-	-
Post-Crisis	STI → HSI	6,1	-	0.1153	0.9381
	HSI → STI	4,2	-	0.1510	0.0640*
	STI → NIKKEI	6,1	-	0.3414	0.1200
	NIKKEI → STI	4,2	-	0.1823	0.6813
	STI → KLSE	6,1	-	0.2683	0.7519
	KLSE → STI	5,2	-	0.6837	0.0939*
	STI → SET	6,1	0.3344	-	-
	SET → STI	5,1	0.3539	-	-
	STI → DJI	6,2	-	0.2631	0.1383
	DJI → STI	1,1	-	0.3960	0.9888

* p < 10%, ** p < 5%, *** p < 1%

4. Conclusions

In this paper, we explore the co-movements between the stock indices of Singapore and five Asian Pacific economies. Before the 1997 Asian Financial Crisis, we witness a high degree of cointegration between Singapore and Malaysia. After the crisis, the cointegrating relationship continues to exist. Besides Malaysia, the Singapore stock market also sees itself moving in tandem with the stock markets of Hong Kong, Japan,

and the US. This substantiates the hypothesis of increasing integration between the Singapore and other regional stock markets after structural breakdown. In particular, for the Thailand case, the VAR results show that the SET is Granger-caused by the STI before the crisis. The stock market of Singapore is Granger-caused by that of Malaysia, but the causal relationship has weakened considerably after the crisis. This shows how the pegging of Ringgit to the US dollar and the termination of CLOB trading in the Singapore Stock Exchange affect cointegration of the two stock markets. In addition, the Hong Kong stock market is also found to Granger-cause the stock market of Singapore after the crisis.

References

Chan, K. C., Benton E. Gup, and M. S. Pan (1992). An Empirical Analysis of Stock Prices in Major Asian Markets and the United States. *Financial Review*, 27, 289-307.

Chan, W. S. and Z. G. Chen (1998). A Statistical Approach for Disaggregating Mixed-Frequency Economic Time Series Data. *Advances in Econometrics*, 3, 21-45.

Cheung, Y. L. and Y. K. Ho (1993). A Note on the Stability of the International Relationships between the Asian-Pacific Equity Markets and the Developed Markets – a Non-Parametric Approach. *Journal of Business Finance and Accounting*, 20, 229-236.

Chong, T. T. L., Wong, Y. C. and I. K. M. Yan (2008). International Linkages of the Japanese Stock Market. *Japan and the World Economy*, forthcoming.

Corhay, A., Rad, A. T. and J. P. Urbain (1995). Long Run Behavior of Pacific Basin Stock Prices. *Applied Financial Economics*, 5, 11-18.

Dickey, D. A. and W. A. Fuller (1979). Distribution of Estimates for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association*, 74, 427-431.

Dickey, D. A. and W. A. Fuller (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. *Econometrica*, 49, 1057-1072.

Dwyer, G. P., Jr., and R. W. Hafer (1988). Are International Stock Markets Linked?, *Federal Reserve Bank of St. Louis Economic Review*, November, 3-14.

Engle, R. F. and C. W. J. Granger (1987). Cointegration and Error-correction Representation, Estimation and Testing. *Econometrica*, 55, 251-276.

Engle, R. F. and C. W. J. Granger (1991). *Long-Run Economic Relationships: Readings in Cointegration*. *Advanced Texts in Econometrics*, Oxford University Press.

Eun, C. and S. Shim (1989). International Transmission of Stock Market Movements. *Journal of Financial and Quantitative Analysis*, 24, 241-256.

Hsiao, C. (1979). Causality Tests in Econometrics. *Journal of Economic Dynamics and Control*, 1, 321-346.

Hsiao, C. (1981). Autoregressive Modelling of Money Income Causality Detection. *Journal of Monetary Economics*, 7, 85-106

Hung, B. W. S. and Y. L. Cheung (1995). Interdependence of Asian Emerging Equity Markets. *Journal of Business Finance and Accounting*, 22, 281-288.