International Journal of Economics and Finance
www.ccsenet.org/ijef
Vol. 2, No. 1
February 2010

Malaysian and Tiger Market Linkages: An Analysis on the Long Run Relationship and Risk Diversification

Maran Marimuthu (Corresponding Author)
Tunku Abdul Rahman University
Department of Economics, Faculty of Accountancy and Management
Bandar Sungai Long Campus, 43000 Kajang, Selangor DE, Malaysia
Tel: 60-3- 9019-4722 E-mail: maran@utar.edu.my

Ng Kean Kok
Tunku Abdul Rahman University
Department of Economics, Faculty of Accountancy and Management
Bandar Sungai Long Campus, 43000 Kajang, Selangor DE, Malaysia
Tel: 60-3- 9019-4722 E-mail: ngkk@utar.edu.my

Abstract

The fundamental argument in the Capital Asset Pricing Model (CAPM) is that the market risk is impossible to be eliminated. Investors tend to look into the possibility of diversifying their investment activities in various countries in the same region, hence, regional of equity markets. This study makes an attempt to re-examine the dynamic relationship among the Malaysian, and the Tiger markets (Hong Kong, South Korea, Singapore and Taiwan). This study adopts the Johansen multivariate cointegration test and VECM using a five-variable model and followed by the Granger causality test. The results indicate that there is a long run relationship among the five markets, and that the Hong Kong and Taiwan markets appear to be the most influential markets in this region.

Keywords: Malaysia, Tiger markets, Causality, Long run relationship, Risk diversification

1. Introduction

Studies on regional market linkages have become increasingly important for most investors. Undoubtedly, the Asian region is vulnerable to 'shocks' (i.e. financial crisis) and where the crisis is contagious, it can affect the entire region. Accordingly then, the countries in the region should become more concerned about their interdependency in the event of any occurrences of any financial turmoil. The Asian financial crisis began with the collapse of Thai baht in July 1997 and its stock market, and the subsequent erosion in Hong Kong and other Asian markets in October 1997 and as a result, the co-movement among the Asian financial markets increased.

Besides that, Ghosh, Saidi, and Johnson (1999) found that the volatility and co-movement of financial markets increased several months after the financial crisis happened. Choudhry (2001) indicated that stock returns of Asian stock markets could be predicted in the long run. Poon (2001) in his extensive work on twelve stock markets, noted that stock markets' downturn could reduce the benefits of international diversification. Chaterjee (2003) argued significant correlation among the Asian markets may not be felt especially in the presence of economic shocks due to their own returns behaviour. However, others argue that the Asian markets tend to converge towards the long term linkages. Nonetheless, it should be understood that despite its vulnerability to economic environment, the Asian region could be a major source of returns for investors if its markets linkages are clearly understood. Hence, knowledge of the Asian market linkages has to be incorporated into the international investment strategies.

Capital Asset Pricing Model (CAPM) suggested that the systematic risk, (or 'market risk'), is impossible to be eliminated. As investors become more risk averse, further risk diversification continues to be their main concern. The best step taken by investors is to invest in different countries under the concept of international diversification, where the general argument is that foreign investments offer additional profit potential while concurrently reducing the total risk of the investment portfolio. However, recent co-movements among financial markets around the world have reduced the diversification benefit. Further, world financial markets are rapidly integrating into a single global marketplace as investors are driven to developing countries in the search for higher returns and opportunities for risk diversification. To some extent, portfolio investments have been redesigned e.g. mutual funds, to cater for the risk adverse investors (Ng, 2002) and this helps to diversify the risk of investment.

2. Rationale of the study

Researchers have only been interested to investigate the effect of the crisis on the market linkages and individual country's dependency on other stock markets. However, a more contemporary model is required to understand the Asian market linkages in the short run and also long run. Besides this, a few reasons may be put forward as to why this study should be carried out. First, the sample period of 1997 – 2007, in particular the aftermath of the 1997 financial crisis, may be able to offer more insightful information on both short and long run relationships between the Malaysian, Hong Kong, South Korea, Singapore and Taiwan markets (Note 1). In addition, the withdrawal of the fixed exchange rates (capital control) regime by Malaysia in 2006 (and China in 2006, effectively affecting the Tiger markets, particularly the Hong Kong market) is expected to dictate the short run relationship among the regional markets. Second, this study also paves a way for us to relate to the significance of the monetary policy, fiscal policy, political turmoil and other economic practices of each of the Asian Tigers, including effects on the Malaysian market as they can create a strong impact on the Asian markets as a whole. Third, the findings of this study could be very useful for regional and global investors for risk diversification purposes.

Investigations on direction of causality between markets may also provide fund managers and individual investors insights as to which markets to follow or avoid once certain markets start to move. If certain financial markets are seen to be on the uptrend and investment opportunities are missed in certain markets, knowledge of other markets that are correlated and especially, the direction of causality may provide similar investment opportunities elsewhere. Perhaps then, it might allow for better investment decisions to be made, with the ultimate goal being to maximize returns for a given level of risk or to minimize risk for a given level of returns.

3. Objective

This study continues the work and effort of other researchers in understanding regional market linkages in particular. Hence, our objective is to re-examine the dynamic relationship and dependency among the Malaysian, Hong Kong, South Korea, Singapore and Taiwan markets.

4. Literature Review

Janakiramanan et al. (1998) studied on the linkages among the stock markets of Australia, Hong Kong, Indonesia, Japan, Malaysia, New Zealand, Singapore, Thailand and the United States markets and subsequently, Cheung and Mak (1992) added Taiwan and the Philippines. Gorenen and Franses (2000) used a graphing technique to investigate stock market correlations and their evolution over time. They did not observe a world market portfolio but rather three clusters of markets that break down along geographical lines, namely Europe, Asia and the USA. The ASEAN stock markets might be inter-related because of co-movements in the expected cash flows. This is because ASEAN economies experience aggregate economic shocks that affect all of them similarly. Masson (1998) terms this as 'monsoonal effects', where economic shocks in the developed economies can result in effect on the emerging markets. An example of a common shock that could affect all the ASEAN stock markets would be a slowdown in the US economy that causes slower economic growth in the region. Chung and Liu (1994) found that the stock markets of the USA and five Asian countries shared four common stochastic trends.

Sheng and Tu (2000) used cointegration and variance decomposition analysis to examine the linkages among the stock markets of 12 Asia-Pacific countries, before and during the period of the Asian financial crisis. The tests showed that there was no cointegration before the period of the financial crisis, and one cointegration relationship among the national stock indices during the period of the financial crisis. In addition, Granger causality test suggested that US still Granger-causes some Asian countries during the period of crisis, reflecting the US market's persisting dominant role. Masih and Masih (1999, 2002) found cointegration in the pre-financial crisis period of October 1987 among the stock markets of Thailand, Malaysia, the US, UK, Japan, Hong Kong and Singapore. But there were no long-run relationships between these markets for the period after the global stock market crash of 1987. Arshanapalli et al. (1993) noted an increase in stock market interdependence after the 1987 crisis for the emerging markets of Malaysia, the Philippines, Thailand, and the developed markets of Hong Kong and Singapore. Najand (1996), using linear state space models, detected stronger interactions among the stock markets of Japan, Hong Kong, and Singapore after the 1987 stock market crash.

Weber (2007) revealed various causality-in-variance effects between the volatilities in the national financial markets in the Asian-Pacific region (Australia, Hong Kong, Indonesia, India, Japan, South Korea, New Zealand, Philippines, Singapore, Taiwan and Thailand) for the post-crisis period 1999–2006. Cheung (1995) observed a long-run relationship among five emerging stock markets: Hong Kong, Korea, Malaysia, Singapore, and Thailand. Sharma and Wongbangpo (2002) investigated the long-term trends and cycles of stock markets in Indonesia, Malaysia, Singapore, and Thailand. They observed that the stock markets of Indonesia and Thailand are cycle dominated, and those of Malaysia and Singapore are trend dominated. Masih and Masih (1997) conclude that the markets of Japan, US, UK, and Germany drive the fluctuations in the markets of Taiwan, South Korea, Singapore, and Hong Kong. Kwan, Sim, and Cotsomitis

(1995) noted that the markets of Hong Kong, Singapore, Korea, and Taiwan are not cointegrated among themselves but they are cointegrated with G-7 countries. Tan (1998) and Baig and Goldfajn (1999) investigated Southeast Asian stock markets during the period 1995 to 1998 and verifies the contagion effect during the Asian financial crisis. Moon (2001) examined and compared the behaviour of Asian stock markets after the 1997 Asian currency crisis with the behaviour of European stock markets after the 1992–93 Exchange Rate Mechanism (ERM) crises. Ratanapakorn and Sharma (2002) investigated the short-run and long-run relationships among stock indices of the US, Europe, Asia, Latin America, and Eastern Europe and Middle East for the pre-Asian crisis and for the crisis period. No long-run relationship was observed among these indices during the pre-Asian crisis period. They also inferred that only the European markets directly affected the US market, while the other regional markets indirectly influenced the US market through the European market.

Yang, Kolari, and Min (2003) examined long-run relationships and short-run dynamic causal linkages among the US, the Japanese, and ten Asian emerging stock markets, with particular attention to the 1997–1998 Asian financial crisis. In general, the results showed that both long-run cointegration relationships and short-run causal linkages among these markets were strengthened during the crisis, and that these markets have generally been more integrated after the crisis than before it. Lai et al. (1993), Richards (1995) Solnik et al. (1996), Darbar and Deb (1997), Yuhn (1997) and Francis and Leachman (1998) only incorporated Japan in their studies of international stock market linkages, Ramchand and Susmel (1998) added Singapore and Hong Kong, while Kwan et al. (1995) also included Taiwan and Korea. Cha and Oh (2000) investigated the relationship between the 2 largest equity markets in the world – the USA and Japan – and the Hong Kong, Korea, Singapore and Taiwan of the Asian emerging equity markets. They found that the links between developed markets and the Asian emerging markets began to increase after the stock markets crash in October 1987, and have significantly intensified since the outbreak of Asian financial crisis in July 1997. Sheng and Tu (2000) also examined the linkages among the stock markets of twelve Asia-Pacific countries, before and during the period of the Asian financial crisis, and found evidence in support of the existence of cointegration relationship among the national stock indices.

Divecha et al. (1992) investigated ten emerging Asian stock markets and found that they were homogenous with a dominating strong market force and less correlated with each other and with developed markets. Masih and Masih (1997) applied co-integration tests to South Korea, Taiwan, Hong Kong, and Singapore and test whether these are co-integrated with four developed stock markets (the US, UK, German, and Japanese markets). An interesting study by Ghosh et al. (1999) indicated that some of the Asian stock markets are closer to the Japanese market, while others are more linked to the US market. Chan et al. (1992) studied the inter-relationship among the stock markets of Hong Kong, South Korea, Singapore, Taiwan, Japan and the US and found that these markets are all weak form efficient but not co integrated with each other. Cheung and Ho (1993) reported the unstable correlations between the developed markets and the Asian emerging markets. By taking the exchange rate fluctuation into account, Hung and Cheung (1995) found evidence of co integration among Asian stock indices. Corhay et al. (1995) investigated the long-run relationship between major Pacific-Basin stock markets and conclude that they are co-integrated. Bailey and Stulz (1990) examined portfolio diversification across Pacific-Basin stock markets during 1977-1985 and found a high degree of correlation between US and Asian equity markets. Garret and Spyrou (1997) showed that Asia Pacific stock markets (Indonesia, Malaysia, Thailand and Philippines) had a small inter-market dependency with two exceptions, South Korea and Taiwan. Roca et al. (1998) reported that with an exception of India, ASEAN-5 markets were closely linked in the short-run but not in the long-run, and two markets (Singapore and Thailand) had strong linkages with other markets.

Ghosh et al. (1999) found that there were three types of stock markets with distinctive features during the Asian financial crisis (1997-1998): the first group (Hong Kong, South Korea and Malaysia) was mostly influenced by the US stock market; the second group (Indonesia, Philippines and Singapore) influenced by Japanese stock market, and the third group (Thailand and Taiwan) influenced by neither stock markets. Cheung and Mak (1992), Liu and Pan (1997) and Wu and Su (1998) have shown that both US and Japanese stock markets affect the stock markets of the Asian countries. Cha and Oh (200) showed that the US and Japanese markets affect Hong Kong, Korea, Singapore, and Taiwan. Another study is that of Rogers (1994), which investigated the price interactions between the equity markets of the US, Japan, Germany, UK, Taiwan, South Korea, Thailand, Mexico and Chile based on daily price data in US dollars also for the period 1986 to 1988. For East Asia, Park (2002) uses a co-integration test for six East Asian national stock markets, but did not find any meaningful evidence of integration. Roca (1999) investigated the price linkages between the equity markets of Australia and that of the U.S., U.K., Japan, Hong Kong, Singapore, Taiwan and Korea using weekly stock market data. He uses Johansen cointegration technique to determine the long run relationship between the price levels of the above countries and employed Granger causality tests to determine the short run relationships. His results indicated no cointegration between Australia and other markets. However, the Granger causality tests revealed that Australia is significantly linked with the U.S. and the U.K. Roca et al. (1998) reported that with an exception of India, ASEAN-5 markets are closely linked in the short run but not in the long run, and two (Singapore and Thailand) markets had strong linkages with other markets.

Linkages among national stock markets before and during the period of the Asian financial crisis in 1997/98 were also explored by Sheng and Tu (2000). In particular, adopting multivariate cointegration and error-correction tests, these authors focused on 11 major stock markets in the Asian-Pacific region (Australia, China, Hong Kong, Indonesia, Japan, Malaysia, Philippines, Singapore, South Korea, Taiwan and Thailand) and the US. Using daily closing prices, they found empirical evidence that cointegration relationships among the national stock indices has increased during, but not before, the period of the financial crisis.

5. Research Methodology

Engle and Granger (1987) introduced cointegration approaches to investigate the nature of long run equilibrium relationships. In the case of time series analysis, cointegration test is useful when two or more non-stationary series are combined for a linear relationship. Hence, they are integrated of order one (1). The main argument under the cointegration proposition is that data series may drift apart in a short run but they eventually tend to form a long run equilibrium. The details of the stock exchanges and indices considered for the study are shown in Table 1 below.

Model:

$$\mathbf{KLCI_t = + \beta_0 + \beta_1 HSI_t + \beta_2 KOSPI_t + \beta_3 STI_t + \beta_4 TAIEX_t + u_t}$$

In view of performing the cointegration tests, first, each of the five data series were tested for stationarity using the unit root test. Three techniques were used for the unit root test; Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmialt-Shin (KPSS). All the data series must be non-stationary and integrated at I(1) for cointegration test. The details are as follows:

Model of ADF (1981) test was used.

$$\Delta Y_t = \alpha + \phi Y_{t-1} + \delta T + \sum_{i=2}^{p} \beta_i \Delta y_{t-i-1} + \varepsilon_i$$

$$\Delta Y_t = \alpha + \phi Y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i-1} + \varepsilon_i$$

Where Y_t = variable in period t, t = time trend, ε_t = i.i.d. disturbance with mean 0 and variance σ^2; that is, [ε_t - NI(0,σ^2)].

Another form of unit root hypothesis was PP test. PP test allowed us to estimate serial correlation and error variance.

$$\frac{1}{N}\sum_{t=1}^{N} \hat{\varepsilon}_t^2 + \frac{2}{N}\sum_{t=1}^{N} \varpi(s,l) \sum_{t=s+1}^{N} \hat{\varepsilon}_t \hat{\varepsilon}_{t-s}$$

Where ∫ is truncation lag parameter; and w(s,l) is a window that is equal to 1-s/(∫ + 1).

As for KPSS test could be illustrated as follows;

To obatained the residual test for unit root, the model below was applied.

$$X_t = \beta_0 + \beta_1 Y_t + \varepsilon_{x,t}$$

$$Y_t = \beta_0 + \beta_1 Y_t + \varepsilon_{y,t}$$

ADF test without drift and time trend was applied as follows:

$$\Delta \hat{\varepsilon}_t = a_1 \hat{\varepsilon}_{t-1} + \sum_{i-1}^{k} a_{i+1} \Delta \hat{\varepsilon}_{t-i-1} + \varepsilon_t$$

Where $\Delta \hat{\varepsilon}$ was include the $\varepsilon_{x,t}$ or $\varepsilon_{y,,t}$ and the H0 : $a_1 = 0$

After determining the non-stationarity of data, the cointegration test was then initiated. The cointegration test in this study followed the means and method as developed by Johansen and Juselius (1990). Finally, we applied Granger's [1969] causality test to identify the interdependency among the financial market under investigation. There were also some past studies that adopted this test for the same purpose such as Arshanpalli and Doukas (1993),Malliaris and Urrutia (1992) and Mathur and Subrahmanyam (1990).

Error correction model (ECM) from Engle and Granger (1987)

$$\Delta \chi_t = \beta_1 + \sum_{i=1}^{n1} \beta_{11}(i) \Delta \chi_{t-i} + \sum_{j=1}^{n2} \beta_{12}(j) \Delta y_{t-j} + \beta_s(\varepsilon_{t-1}) + \eta_t$$

$$\Delta y_t = \beta_2 + \sum_{i=1}^{n3} \beta_{21}(i) \Delta \chi_{t-i} + \sum_{j=1}^{n4} \beta_{22}(j) \Delta \chi_{t-j} + \beta_f(\varepsilon_{t-1}) + \eta_t$$

ε_{t-1} = n x t vectors of error correction terms represents the previous period's disequilibrium ($y_{t-1} - \alpha_1 X_{t-1}$), η t = n x t vectors of residuals.

Granger Causality Test and Vector Error Correction Model (VECM)

Causality test should incorporate co-integration test involving two or more data series and error correction term (ECT) in order to avoid the misspecification (Granger, 1981) and hence, co-integration testing by Engle and Granger (1987), Johansen and Juselius (1990) is significantly important in performing granger causality test.

Impulse Responses Functions (IRF) and Variance Decomposition (VDC)

While VECM provides causality outcome within the sample period, variance decomposition (VDC) is used to describe the causality outside of the sample estimation. It offers information about the relative importance of each random shock to the variable in the VAR. Meaning, it tends to show the percentage of forecast error variance for each of the index selected that may attribute to its own shocks and to fluctuations in other indices. IRF measures the predictable response to a one –standard deviation shock to one of the indices in the model. Indirectly, it shows the future path of these indices' changes in response to the shock. Choleski approach was used to orthogonalize all innovations or shocks. The Generalized Impulse Response Functions (GIRFs) were used as the literature , to some extent, did not offer a clear ordering of indices used in the model.

Data Collection

This study adopted daily data of composite indices for the five countries selected for this study. Some researchers had applied daily data to better keep track of the dynamic of international transmission (Hamao et al., 1990; Koutmos and Tucker, 1996; Dwyer and Hafer, 1988). Daily data is better than weekly or monthly data because the intervals of daily data allow the underpinning of interrelations that conclude within one or only a few days (Stivaktakis et al., 2006). This study covered the period of 1997 to 2007 and thus, data were collected accordingly.

6. Empirical Findings

Figure 1 below shows the pattern of the movements of the five indices over the period 1997 to 2007 and Table 2 presents the descriptive statistics of the five data series. Three types of stationarity test were used; Augmented Dicky-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmialt-Shin (KPSS). The results of the tests are shown in Table 3 below. In the case of ADF and PP, we failed to reject the null hypothesis of non-stationarity at level involving intercept and intercept and trend. KPSS test showed consistent results as we rejected the null hypothesis of stationarity at level under intercept and intercept and trend. Very importantly, the stationarity test on residual will be another significant step in moving forward for cointegration testing. The results were very consistent between ADF and PP, thus, the residual was stationary or I(0) as given in Table 3. This allowed us to proceed for cointegration test.

Cointegration Test

As for multivariate analysis, two tests have been suggested in determining cointegration rank; λ_{max} and λ_{trace} (Johansen, 1988; Johansen and Juselius, 1990) with the details of the results given in Table 5 below. The results, indicate that there is evidence that two cointegrations exist among the stock exchanges (under both techniques) as the null hypothesis of no cointegration vector hypothesis (r=0) is rejected at 5 per cent significance level involving all the lags.

The results in Table 5 are consistent with our general expectation where the Malaysian and Tiger markets will have a long run relationship. The cointegrating indices should have an error correction representation. By furthering the analysis using the VECM approach, we would be able to detect the direction of the Granger causality relationship as shown in Table 6. The adoption of the right VECM is dependent on the AIC or BIC criteria in line with the number of lags being considered here. As this study involved daily data, obviously there was a need to incorporate more lags in the analysis. Misspecification resulting from this model must also be taken into consideration for other test (Masih and Masih, 1997a and 1997b).

Granger causality test

Table 6 confirms that there is a short run relationship among the equity markets before they converge into the long run equilibrium relationship. Based on Table 6, over the period 1997-2007, Hong Kong, South Korea and Taiwan did granger cause Malaysia at the lag model (lag 5, with the lowest AIC). These findings seemed to be almost similar at lag 6 and 7. In the case of Singapore, it was the Malaysian market that affected the Singapore market. Additionally, there was a two-way granger causality between Malaysia and Taiwan.

As to further our analysis on GIRF and VDC, a stability test was considered to check on the best VECM sample (lag 5) using the CUSUM test which statistically supports the linear stability on transformed data as given in Figure 2 below. This can be accomplished by taking Malaysia as a dependant variable and the Tiger markets as independent variables, coupled with the use of the OLS approach. As it enhances the robustness of the findings in VECM, we can conclude that our forecast via GIRF and VDC would offer more insights.

GIRF and VDC

An analysis of GIRF is presented in Figure 3 below with a consideration of 150 days to check on the shocks. It seems shocks in Hong Kong will give impact on the Malaysian market for at least 100 days before it becomes stable. Surprisingly, impact of shocks in Singapore on Malaysia is perceived to be quite serious as it leads to negatives returns though Singapore does not granger cause Malaysia. Both South Korea and Taiwan share the same magnitude in terms the impact of their instability on the Malaysian market. However, shocks in the Malaysian market will have a serious impact on the Singapore market, but the Tiger markets do not see Malaysia as a major threat.

The results of VDC are presented in Table 7. An extended 'ten to one hundred-fifty days' period was employed to convey a sense of dynamics of the system. Malaysia seems to be somewhat endogenous as only 64 per cent explained by itself at period 50 and reduced to 43 per cent at period 150. Hong Kong remains very strong on its exogeneity as 90 per cent of the variation is explained by itself and probably about 4 per cent is explained by Taiwan. South Korea is also said to be exogenous as even at period 150, 83 per cent is explained by itself and about 8 per cent explained by Taiwan. Singapore is an endogenous market as only 9 per cent explained by itself, thus regional performance is essentially important for the Singapore market. Taiwan seems to exogenous as the earlier discussions show that there were two way granger causality between Taiwan and other Tiger markets.

7. Conclusion and Implications

This study encompasses co-integration test in the VAR framework, granger causality to determine the direction of the relationship of the stock indices on a bivariate basis, followed by GIRF and VDC. Evidence from co-integration reiterates the fact that there is a long run relationship among the regional stock markets though such relationships appear to be weak in the short-run. Specifically, we may conclude that there appears to be some linkages between the Malaysian market and the Tiger markets. In particular, we found that the Hong Kong, South Korea and Taiwan markets influenced the Malaysian stock market. Conversely, the Malaysian market affected the Singaporean market. Also, our findings demonstrate that for all of the five stock markets sampled, the Hong Kong and Taiwanese stock markets demonstrated strong exogenous characteristics. Hence, fund managers and individual investors are advised to take Hong Kong and Taiwanese stock markets as the main reference point, and if there shall exist any abnormal or 'shock' effects in these markets, the other markets are likely to follow thereafter. Fund managers and individual investors henceforth may use this result to assist in their investment decision making process.

References

Arshanapalli, B., & Doukas, J. (1993). International stock market linkages: Evidence from the pre- and post-October 1987 period. *Journal of Banking and Finance*, 17(1), 193– 208.

Bailey, W. and Stulz, R. M. (1990). Benefits of international diversification: the case of Pacific Basin stock markets, *Journal of Portfolio Management,* 16(1), pp. 57–61.

Cha B. and Oh S. (2000). "The Relationship Between Developed Equity Markets and the Pacific Basin's Emerging Equity Markets", *International Review of Economics and Finance 9*, pp. 299-322.

Chaterjee A. and Maniam B. (2003). Asian financial crisis: The pre- and post-crisis analysis of Asian equity markets, managerial Finance, 29, 4, 62-86.

Cheung, A. C. S. (1995). The UK stock market and economic factors: a new approach. *Journal of Business Finance and Accounting*, 22 (1), 129–142.

Cheung, Y. L. and S. C. Mak. (1992). The international transmission of stock market fluctuation between the developed markets and the Asian-Pacific markets. *Applied Financial Economics*, 2, pp. 43-7.

Choudhry T. (2001). The long memory of time varying beta: examination of three emerging Asian stock markets, Managerial Finance, 27,1/2, 5-23.

Garret, I. and Spyrou, I. (1997). Common trends in emerging equity markets, *Middlesex University Discussion Paper Series number* 38.

Granger, C.W.J. (1969). Granger, Investigating causal relations by econometrics models and cross spectral methods, *Econometrica,* 37, 424–438.

Ghosh, A., Saidi, R., & Johnson, K.H. (1999). Who moves the Asia-Pacific stock markets-US or Japan? Empirical evidence based on the theory of cointegration. *Finanancial Review.* 34, 159–179.

Ghosh, A., Saidi, R., & Johnson, K.H. (1999). Who moves the Asia-Pacific stock markets-U.S. or Japan? Empirical evidence based on the theory of cointegration. *The Financial Review,* 34(1), 159-170.

Liu Y. A. and M. Pan. (1997). Mean Volatility Spillover Effects in the US and Pacific- Basin Stock Markets. *Multinational Finance Journal,* 1, pp. 47-62.

Masih A. M. M. & Masih R. (1997a): "A Comparative Analysis of the Propagation of Stock Market Fluctuations in Alternative Models of Dynamic Causal Linkages." *Applied Financial Economics,* 7(1), 59-74.

Masih, A. M. M. & Masih, R. (1997b). Dynamic linkages and the propagation mechanism driving major international stock markets: An analysis of the pre- and post-crash eras. *Quarterly Review of Economics and Finance*, 37, 859−885.

Masson, P. (1998). Contagion: Monsoonal effects, spillovers and jumps between multiple equilibria. *International Monetary Fund Working Paper*, WP/98/142.

Poon S.H. and Lin H. (2001). Taking stock at the new millennium: a study of twelve stock markets, Managerial Finance, 27, ½, 62-81.

Ratanapakorn, O., & Sharma, S.C. (2002). Interrelationships among regional stock indices. *Reviewof Financial Economic*s 11, pp. 91–108.

Roca, E. D., Selvanathan, E. A., and Shepherd, W. F. (1998). Are the ASEAN equity market interdependent? *ASEAN Economic Bulletin* 15(1), pp. 109-120.

Roca, E.D. (1999). “Short-Term and Long-Term Price Linkages Between the Equity Markets of Australia and Its Major Trading Partners”, *Applied Financial Economics*, 9, 5, pp. 501-511.

Rogers, J. H. (1994). Entry barriers and price movements between major and emerging stock markets, *Journal of Macroeconomics*, 16, pp. 221-41.

Sheng H.C. & Tu, A.H. (2000). “A Study of Cointegration and Variance Decomposition Among National Equity Indices Before and During the Period of the Asian Financial Crisis”. *Journal of Multinational Financial Management, 10*, 345-365.

Weber, A. (2007). Volatility and causality in Asia Pacific financial markets, SFB 649 Discussion paper 2007–004.

Wu C. and Y. Su. (1998). Dynamic Relations among International Stock Markets. *International Review of Economics and Finance*, 7, pp. 63-84.

Notes

Note 1. Jomo, K.S. (1998). *Tigers in trouble: financial governance and the crisis in East Asia*. London, UK

Table 1. Stock Indices under investigation

Country	Stock Exchange	Index
Malaysia	Bursa Malaysia (Kuala Lumpur Stock Exchange)	KLCI
Hong Kong	Hang Seng Index	HSI
South Korea	Korea Composite Stock Price Index	KOSPI
Singapore	Straight Time Index	STI
Taiwan	Taiwan Capitalization Weighted Stock Index	TAIEX

Table 2. Descriptive Statistics

Details	Malaysia	Hong Kong	South Korea	Singapore	Taiwan
Mean	6.662242	9.492830	6.691905	7.543534	8.781363
Median	6.668559	9.498870	6.669726	7.549459	8.768409
Maximum	7.272669	10.36212	7.632813	8.259911	9.230359
Minimum	5.571013	8.803938	5.634790	6.690892	8.145045
Std. Dev.	0.268477	0.269904	0.419914	0.279799	0.224725
Skewness	-0.237911	0.370564	0.051353	0.076588	-0.167481
Kurtosis	3.880228	3.125489	2.790912	3.263737	2.419216
Jarque-Bera	107.4629	60.64532	5.824587	9.984119	48.24738
Probability	0.000000	0.000000	0.054351	0.006792	0.000000

Table 3. Stationary test on Indices at level

Markets/Tests	Intercept			**Intercept and trend**		
	ADF	**PP**	**KPSS**	**ADF**	**PP**	**KPSS**
Malaysia	**-1.309964**	**-1.267148**	**2.322857***	**-2.800323**	**-2.720693**	**0.50727***
Kong Kong	**-0.7463**	**-0.5085**	**2.2040***	**-1.7166**	**-1.4848**	**0.7443***
South Korea	**-0.5507**	**-0.5446**	**4.1066***	**-2.7815**	**-2.6328**	**0.4948***
Singapore	**-0.7368**	**-0.6786**	**2.7158***	**-2.0817**	**-2.0337**	**0.7537***
Taiwan	**-1.9115**	**-1.9470**	**1.2060***	**-1.7641**	**-1.8326**	**1.0904***

Notes: For ADF and PP, (*) Rejection of the null hypothesis at 5% and therefore all indices are stationary at I(1). KPSS indicates rejection of the null hypothesis of stationarity. Thus, the results are very consistent.

Table 4. Stationary test on residual at level

	None (No intercept, No intercept and trend)	
	ADF	PP
Residual	-5.412557*	-5.412557*

Notes :(*) Rejection of the null hypothesis at 5% and therefore the residual is stationary.

Table 5. Johansen and Juselius Cointegration test

Null Hypothesis	λ_{max}	5%	λ_{trace}	5%
Lag Length = 1				
r = 0	133.7862*	33.87687	200.026*	69.81889
r < 1	42.19605*	27.58434	66.23978*	47.85613
r < 2	18.35974	21.13162	24.04373	29.79707
r < 3	5.090959	14.2646	5.683991	15.49471
r < 4	0.593032	3.841466	0.593032	3.841466
Lag Length = 2				
r = 0	131.5209*	33.87687	191.2152*	69.81889
r < 1	38.06762*	27.58434	59.70427*	47.85613
r < 2	15.65694	21.13162	21.63665	29.79707
r < 3	5.33512	14.2646	5.979707	15.49471
r < 4	0.644588	3.841466	0.644588	3.841466
Lag Length = 3				
r = 0	100.5004*	33.87687	160.1363*	69.81889
r < 1	36.74961*	27.58434	59.63589*	47.85613
r < 2	16.3838	21.13162	22.88627	29.79707
r < 3	5.716924	14.2646	6.50247	15.49471
r < 4	0.785546	3.841466	0.785546	3.841466
Lag Length = 4				
r = 0	85.86317*	33.87687	138.1229*	69.81889
r < 1	31.72035*	27.58434	52.25938*	47.85613
r < 2	14.37939	21.13162	20.53938	29.79707
r < 3	5.396575	14.2646	6.159989	15.49471
r < 4	0.763414	3.841466	0.763414	3.841466
Lag Length = 5				
r = 0	82.65687*	33.87687	136.1704*	69.81889
r < 1	33.11441*	27.58434	53.51357*	47.85613
r < 2	14.20983	21.13162	20.39915	29.79707
r < 3	5.480772	14.2646	6.189321	15.49471
r < 4	0.708549	3.841466	0.708549	3.841466
Lag Length = 6				
r = 0	77.76276*	33.87687	128.9746*	69.81889
r < 1	30.77154*	27.58434	51.21185*	47.85613
r < 2	13.98134	21.13162	20.44031	29.79707
r < 3	5.930268	14.2646	6.458972	15.49471
r < 4	0.528704	3.841466	0.528704	3.841466
Lag Length = 7				
r = 0	76.52705*	33.87687	126.6405*	69.81889
r < 1	30.00385*	27.58434	50.11349*	47.85613
r < 2	13.42551	21.13162	20.10963	29.79707
r < 3	6.111787	14.2646	6.684127	15.49471
r < 4	0.57234	3.841466	0.57234	3.841466
Lag Length = 8				
r = 0	74.70305*	33.87687	124.6094*	69.81889
r < 1	31.14699*	27.58434	49.90632*	47.85613
r < 2	11.96669	21.13162	18.75933	29.79707
r < 3	6.290106	14.2646	6.792635	15.49471
r < 4	0.502529	3.841466	0.502529	3.841466

* significance level at 5%.

Table 6. Granger Causality test in VECM

Dependent Variables	Malaysia	Hong Kong	South Korea	Singapore	Taiwan
Lag Length = 1	AIC = -26.63937				
Malaysia		1.822922	3.816135	16.97532*	0.627335
Hong Kong	1.936825	1.043655	0.000169	3.202102	5.058663*
South Korea	0.506968	0.288751	0.270442	0.416726	9.997825*
Singapore	0.293876	1.889241	10.83382*	1.63937	3.033397
Taiwan	0.473585				
Lag Length = 2	AIC = -26.67638				
Malaysia		2.304355	13.65316*	89.88269*	0.954146
Hong Kong	3.747051	2.472186	6.26886*	20.24973*	5.088646
South Korea	3.393829	0.86981	0.707421	1.127462	9.327409*
Singapore	2.049785	7.615695*	13.15565*	1.06008	7.299749*
Taiwan	5.164818				
Lag Length = 3	AIC = -26.70062				
Malaysia		5.352858	12.64281*	85.42876*	4.70194
Hong Kong	23.6563*	7.550722	11.02374*	32.69738*	8.256392*
South Korea	11.85257*	0.374906	4.240115	2.289461	12.62815*
Singapore	2.438316	10.33146*	17.03563*	3.644616	10.13064*
Taiwan	8.134086*				
Lag Length = 4	AIC = -26.73424				
Malaysia		6.675597	10.63469*	83.30373*	4.77408
Hong Kong	41.55576*	8.108227	15.21423*	43.8357*	12.18906*
South Korea	14.16427*	0.485488	5.902871	3.665783	13.41971*
Singapore	1.452398	17.75633*	33.36109*	3.089001	10.42745*
Taiwan	9.345346				
Lag Length = 5	**AIC = -26.73497**				
Malaysia		**7.469272**	**10.11101**	**88.83888***	**11.76015***
Hong Kong	**39.92697***	**8.436799**	**19.26291***	**42.50663***	**14.898***
South Korea	**13.0743***	**1.267872**	**11.92913***	**4.460457**	**14.25682***
Singapore	**1.525132**	**17.55972***	**43.40528***	**3.095599**	**6.970059**
Taiwan	**10.42115***				
Lag Length = 6	AIC = -26.72888				
Malaysia		7.873938	10.99687	85.31846*	13.99181*
Hong Kong	40.59751*	11.25546	22.08787*	46.74536*	16.67932*
South Korea	14.70119*	3.504841	13.31619*	5.718437	14.81939*
Singapore	1.70851	20.37151*	45.13153*	4.21186	10.98481
Taiwan	13.64847*				
Lag Length = 7	AIC = -26.72241				
Malaysia		9.511444	10.63786	86.17011*	14.05916
Hong Kong	39.17962*	12.24855	22.92453*	46.99063*	16.75503*
South Korea	14.57845*	12.30377	13.84804	6.737552	16.42205*
Singapore	1.645406	22.95167*	49.61575*	4.992936	13.2276
Taiwan	19.4593*				
Lag Length = 8	AIC = -26.71822				
Malaysia		10.59417	11.81015	86.77005*	13.47206
Hong Kong	38.31336*	15.52487*	22.42934*	48.67633*	16.64605*
South Korea	15.47629	14.29116	13.68947	12.1501	16.57307*
Singapore	2.280444	36.24997*	49.18756*	6.017084	13.14278
Taiwan	23.03117*				

* significance level at 5%

Table 7. Variance Decomposition of various countries – Malaysia (MAL), Hong Kong (HK), South Korea (SK), Singapore (SING), Taiwan (TAIW)

MAL Period	S.E.	MAL	HK	SKOR	SING	TAIW
1	0.016387	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.023520	99.91229	0.055415	0.000925	0.003330	0.028045
3	0.029144	99.52135	0.289187	0.014178	0.027747	0.147535
4	0.033953	98.41099	1.085749	0.078382	0.061251	0.363623
5	0.037460	96.51432	2.515696	0.233309	0.168727	0.567945
6	0.041018	95.02949	3.406181	0.413687	0.289035	0.861610
7	0.044285	93.71248	4.151267	0.609427	0.407692	1.119130
8	0.047339	92.55160	4.774243	0.765468	0.539149	1.369539
9	0.050311	91.55217	5.237141	0.903226	0.681854	1.625605
10	0.053069	90.55661	5.724707	1.033787	0.844805	1.840089
50	0.125882	63.61568	16.92690	5.666291	9.124227	4.666899
80	0.165488	53.40373	20.50503	7.631689	13.19062	5.268928
100	0.188421	49.24541	21.90540	8.444842	14.91943	5.484919
150	0.237404	43.33254	23.85606	9.609963	17.42951	5.771922
HK Period	S.E.	MAL	HK	SKOR	SING	TAIW
1	0.016939	0.077123	99.92288	0.000000	0.000000	0.000000
2	0.024197	0.216491	99.73671	0.019336	0.000949	0.026511
3	0.029110	0.293334	99.33540	0.139301	0.003193	0.228775
4	0.034235	0.238393	98.91699	0.387195	0.013822	0.443596
5	0.038478	0.192259	98.24429	0.665013	0.024517	0.873921
6	0.041923	0.173112	97.52016	0.942704	0.055132	1.308890
7	0.045251	0.157439	97.01400	1.120638	0.083643	1.624281
8	0.048413	0.149141	96.63708	1.213358	0.106266	1.894158
9	0.051376	0.146852	96.33786	1.273341	0.131170	2.110776
10	0.054260	0.142794	96.11573	1.318259	0.157423	2.265794
50	0.129225	0.040569	92.75652	2.497653	1.197146	3.508115
80	0.167501	0.049092	91.65953	2.906836	1.718900	3.665640
100	0.189257	0.058432	91.18769	3.079465	1.953123	3.721289
150	0.235504	0.076591	90.48254	3.334606	2.309570	3.796694
SKOR						
Period	S.E.	MAL	HK	SKOR	SING	TAIW
1	0.021204	0.056291	0.002094	99.94162	0.000000	0.000000
2	0.030799	0.165355	0.001742	99.63476	0.000166	0.197975
3	0.037302	0.495635	0.067634	99.05655	0.019226	0.360958
4	0.042606	0.746377	0.290946	98.22212	0.016297	0.724255
5	0.047226	0.997898	0.697497	96.61756	0.016171	1.670870
6	0.051322	1.254979	1.295865	94.56773	0.081212	2.800211
7	0.055203	1.382680	1.788408	93.06591	0.133007	3.629995
8	0.058918	1.446010	2.162090	91.95415	0.162791	4.274958
9	0.062464	1.493270	2.446017	91.13079	0.188326	4.741601
10	0.065840	1.530252	2.651973	90.53311	0.208795	5.075873
50	0.150844	1.462242	4.965898	85.06343	0.812491	7.695940
80	0.193172	1.295974	5.475333	84.19501	1.088751	7.944928
100	0.217154	1.223086	5.681279	83.85667	1.213079	8.025890
150	0.268184	1.113396	5.982604	83.36852	1.404238	8.131238
SING						
Period	S.E.	MAL	HK	SKOR	SING	TAIW
1	0.013496	0.110052	0.057821	0.003902	99.82822	0.000000
2	0.019710	0.582899	0.092928	0.002268	99.31265	0.009255
3	0.024249	2.459086	0.276802	0.007331	97.22498	0.031802
4	0.027994	3.642114	0.213312	0.008059	96.11002	0.026493
5	0.031219	4.712718	0.520505	0.006945	94.72076	0.039068
6	0.033973	5.840297	0.893696	0.044732	93.16739	0.053887
7	0.036354	6.444011	1.415479	0.141580	91.91923	0.079700
8	0.038500	6.823357	2.054952	0.290401	90.70020	0.131087
9	0.040435	7.027776	2.677849	0.501944	89.59096	0.201465

10	0.042196	7.128418	3.307984	0.753402	88.52333	0.286861
50	0.086689	2.861031	35.82353	18.14055	38.53052	4.644364
80	0.118541	2.016125	46.21050	25.01316	20.78824	5.971976
100	0.138307	1.926677	49.23474	27.19495	15.29008	6.353550
150	0.181193	1.964204	52.51287	29.70943	9.050237	6.763252
TAIW						
Period	S.E.	MAL	HK	SKOR	SING	TAIW
1	0.015958	0.237740	0.029081	0.279529	0.012830	99.44082
2	0.022922	0.337871	0.036235	0.670315	0.006750	98.94883
3	0.028429	0.319482	0.035924	0.786815	0.035190	98.82259
4	0.033370	0.480896	0.040820	0.658629	0.135360	98.68429
5	0.037353	0.638107	0.108084	0.542127	0.223032	98.48865
6	0.040963	1.005515	0.277140	0.460053	0.264992	97.99230
7	0.044332	1.306362	0.456487	0.403654	0.282302	97.55119
8	0.047457	1.497485	0.620641	0.370548	0.283456	97.22787
9	0.050423	1.640186	0.759219	0.361837	0.278347	96.96041
10	0.053243	1.715199	0.872289	0.366130	0.269625	96.77676
50	0.123065	1.652231	2.556664	0.790057	0.107967	94.89308
80	0.157262	1.420217	3.121771	1.034498	0.183846	94.23967
100	0.176612	1.318488	3.366638	1.146717	0.234866	93.93329
150	0.217790	1.165295	3.737265	1.320955	0.326196	93.45029

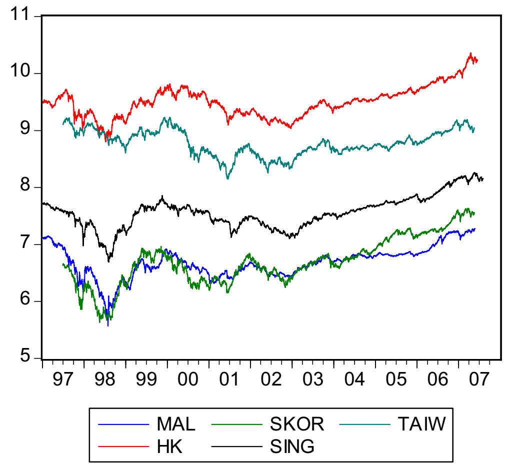

Figure 1. Line Graph of the Malaysian

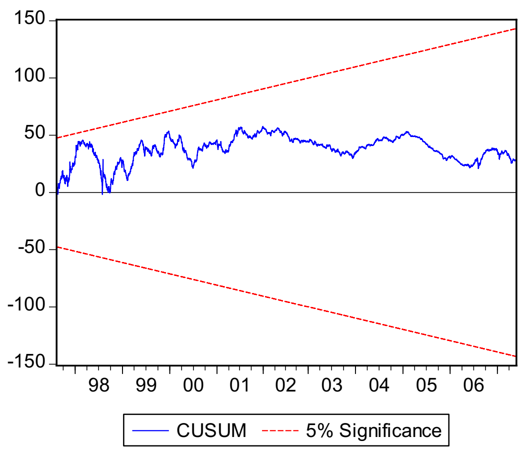

Figure 2. CUSUM Test

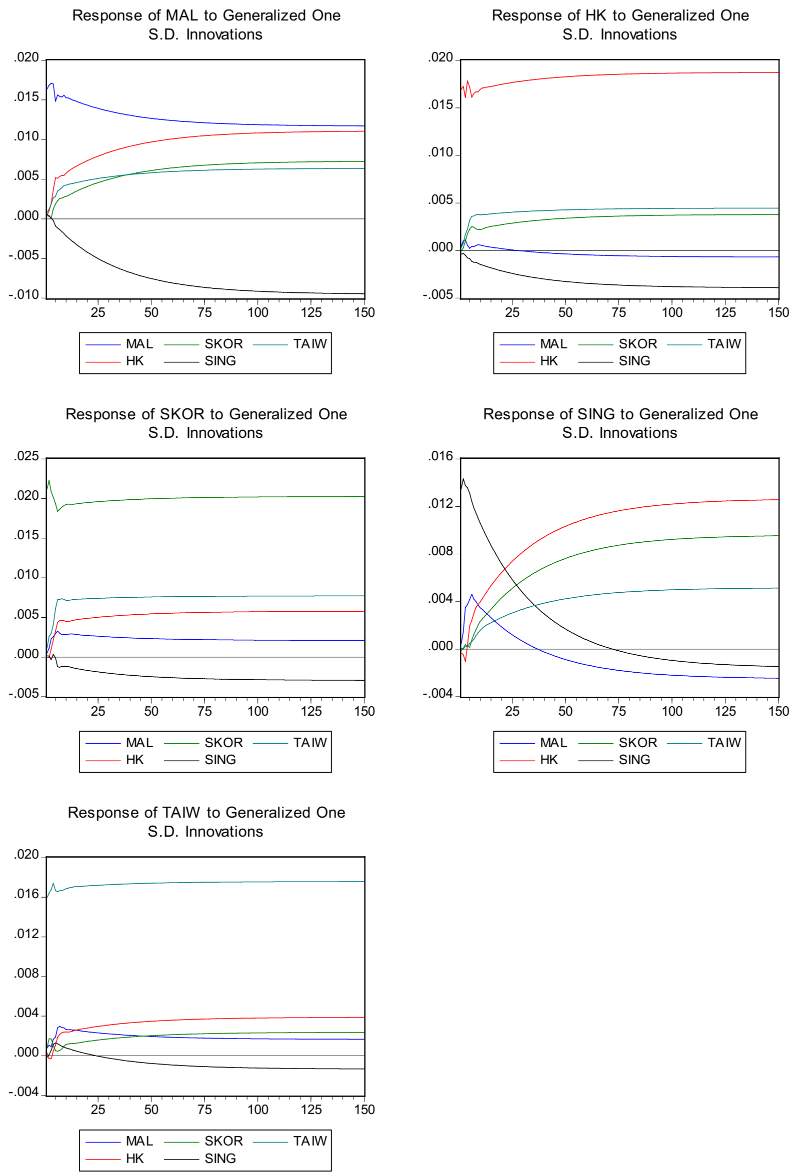

Figure 3. Generalized Impulse Response Functions of One Standard deviation Shocks/Innovations