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A Comparison of the Long Term Interdependence of Southeast Asian Equity Markets*

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The purpose of this paper is to examine the equity market crisis contagion in major Asian economic markets. A comparative assessment of Asian markets during the Asian Financial Crisis and Global Financial crisis may clearly identify the changing nature of long term integration of major Asian markets. The selection criteria of specific Asian markets of different peripheries depend particularly on the roles and structure of these markets. The impact of the global financial contagion and the lingering financial linkage in the aftermath of crisis will explain the reaction of the majority of Asian markets to global linkage. While majority of the studies focused on dynamic short term association in European and MENA contagions in the post global financial crisis period; after the global financial crisis, attention paid to long term Asian contagion adds new perspective to hitherto disorganized theories.

Keywords: Financial Contagion, Financial Crisis, International Financial Markets, Financial Econometrics, Impulse Response
JEL Classification: G010, G150, G170, C580

I. Introduction

The precipitous fall of stock market indexes of the major South and East Asian economies which happened in late 1997 inspired researchers to investigate the ‘interdependence’ and ‘contagion’ debacle across the region. Controversial arguments that emphasize strong market linkage between markets do so simply for the fact that there are co-movement of markets and risks are generally country-specific (Daly, 2003). The reinforcement of the notion of international diversification that defines the primary motivation for risk-averse investors, drawn by ‘portfolio rebalancing’, is a critical tenet of the much studied ‘Efficient market hypothesis”. In contrast to the investor’s desire for a relatively low

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correlation, contagion effect causes the crisis spill over to markets with relatively little or no 'economic linkage'. The presence of the 'contagion' undermines much of the rationale of 'portfolio rebalancing' (Islam et al., 2013). To understand the state of interdependence between markets, it is crucial to understand individual behavior contributing to shock transmission. While much of the state of contagion can best be assessed with dynamic conditional mean and variance, the essential long term association may call for unique marginal reconstructions.

The major Southeast Asian economies prior to the Asian crisis have attracted half of the total capital inflows in Asia. High interest rates for seekers of higher returns primarily found Asian markets to be much more attractive than European markets. The increased capital investment eventually resulted in higher-leveraged economies, creating an asset bubble. As some critics suggested, accelerated growth such as that of the Southeast Asian region would only bring prosperity if improvement of total factor productivity surpassed immediate capital expansion (Krugman, 1994). The situation was made worse in the face of capital outflows, as many Asian economies shifted from fixed to floating exchange rate regimes, and faced immense depreciative pressure.

The first degree markets are the crisis markets (Indonesia, South Korea and Thailand) from which shock is believed to have spilled over to the Philippines, Malaysia and Singapore (Secondary crisis markets) and into many other Asian economies. Thailand, as the ground zero market, had to rely on Structural Adjustment Package (Khan, 2004). This compelled the Hong Kong government, which previously allowed short selling by speculators, to impose strict capital controls and direct capital market intrusion (Corbett and Vines, 1999). In contrast, Malaysia shifted from a floating to a fixed exchange regime, and profound restrictions were imposed. South Korean currency devaluation then quickly doubled. However, South Korea, with proper policy in place, tripled its per capita GDP in the eventually. China and Singapore allowed capital outflow, but successfully recovered due to their improved total factor productivity.

It did not take very long before the Asian economies in crisis regained their previous form. Nonetheless, they were initially throttled by hasty liberalization, lack of corporate governance and proper financial controls (Daly, 2003). Among others, there were things such as the abrupt lifting of the credit ceiling, and restrictions on the rate of return as emphasized by Montes and Popov (1998). During the periods following this turmoil, developing economies quickly responded with foreign currency reserves, and 'Pan Asian currency swaps' were

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introduced as insurance against individual and country specific risks. Interestingly, nations such as Japan, China and India restricted their economies from building up extensive 'foreign exchange reserves', shifting funds to US treasury bonds, mortgage markets and securities, leading to the development of an asset bubble in the US.

The most significant economic crisis in recent history, the Global Financial Crisis (GFC) of 2007-2008, warrants much investigation. GFC has been so extensively studied from many different perspectives, such as asset market linkage, financial instruments and liabilities, risks of short selling and credit default swaps. This led to the Asian Crisis falling to the wayside academically, due to severity of GFC that crippled even the least associated markets. In spite of the availability of many different discussions on crisis spillover, the explanation of Caballero and Simsek (2013) is perhaps the most thought provoking. Unstoppable capital inflows into the US mortgage market resulted in asset scarcity and helped the formation of stochastic economic bubbles. It is considered that the bursting of the bubble resulted in intensification of scarcity in commodities and other alternative vehicles through contingent and non-contingent channel crisis. Reversal of the tightened commodity prices and the reduction of destabilization were the results of investors seeking petrodollars after the oil price hike. This brought an end to this vicious cycle that crippled many completely or partially associated markets. The GFC had an overwhelming impact on foreign exchange reserves, capital markets, real estate and equities. This crisis instantaneously affected emerging market economies, and further deterioration occurred in the form of increased risk premium on bank lending (Thao and Daly, 2012).

This paper seeks to make significant contribution to investigate further the changing nature of long term association between multiple Asian markets. This paper attempts to investigate the co-movement of South Korea as the first-level economy, and one of the most quickly growing economies; to that of second-level economies such as Taiwan, Malaysia; and to China, Japan and Singapore which was the least-affected. This paper also investigates the changes regarding the association between multiple economies in the post GFC period to compare policy implications. In addition, it provides insights into the newly globalized economies and the degree of integration between them. Hence, this paper delves into comparison of the impact of two different crises. The study examines the change in the nature of integration between similar markets, to identify pure contagion or idiosyncratic shocks spilling crisis over to the markets.

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In the first section, some discussion on market interdependence is followed by a review of important literature from the past. Subsequently, the empirical framework is drawn and detailed data analyses presented. Finally, remarks on the significance of the study are included in conclusion as well as suggestions for review of relevant policy.

II. Previous Research

In the post-Asian Crisis and post-Global Crisis periods, extensive research and investigation was carried out on the degree and nature of the association between markets. In fact, a plethora of studies was conducted on homogeneity of stock markets in several places. Bley (2007) conducted a study about the determination of homogeneity of stock markets in the Middle East and North Africa (MENA). The study determined the degree of market integration, modification of the return sensitivity of the market, and the influence of other stock markets such as the impact of US stock markets on those of the Middle East and North African countries. The study proposed an outcome that reflects changing dynamics and simultaneous stock market interaction within the regions of the Middle East and North Africa.

Among others, Kasa studied integration of five different stock markets-Canada, Germany, Japan, UK, and USA (1992). Arshanapalli and Doukas (1993) analyzed the stock indices from France, Germany, Japan, UK, relative to the USA and made remarks on the dependence among these markets. Miloudi (2003) conducted a similar analysis for 16 European stock indices. Ibrahim (2006) examined the relationship between the US, Japan and four Asian (Indonesia, Philippines, Singapore, Thailand) equity markets. They suggested the discontinuation of long-term association between markets after capital control is imposed.

Emerging stock markets of Asian countries have increased interest in international diversification. *Investor's portfolio rebalancing* is suggestive of benefits from inversely correlated international markets. Maneschiold (2005) investigated the advantage of international diversification. It was suggested that there is a higher degree of interdependence that exist between specific emerging markets rather than only among various emerging markets. The willingness to invest in emerging stock markets is increasing due to the high price volatilities and returns. Sebra (2001) examined the possibilities of emerging markets and commented that these markets are often inefficient despite offering high returns. This study advocates the notion that equity markets are sometimes self-integrated and international diversification allows investors to enhance their reward to

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volatility ratio by reaping the benefits they offer. In addition, studies have found that capital and exchange control removal increases stock market integration. Removal of capital control in 1980 in Japan increased integration in Japanese and US stock markets (Gultekin, 1989).

However, contradicting the idea of long term association, Islam et al. (2013) studied the transmission of volatility and financial contagion among 15 countries from both Asia-Pacific and Europe. It was suggested that the Asia-Pacific region is integrated, more through real linkage than financial linkage, and thus less vulnerable to persistent global shock. In contrast, the European market exhibits major cross-volatility spillovers and it is suggested that "financial contagion" is more significant in Europe. It must be noted that the financial contagion phenomenon can only be explained properly with volatility transmission. In an earlier paper, Islam et al. (2013) recommended that the level of contagion increased regardless of idiosyncratic shocks or real linkage. Most recently, the varying interdependence stabilized the magnitude of the volatility among them, despite the persistence of the shock in the US economy. Therefore, this points to the possibility that Asian countries may experience some temporary shocks due to their prolonged integration with the US market. This is caused by information asymmetry or by the irrational characteristics of market makers who are acting upon private information. The economies of India, Japan and Singapore display strong integration among themselves in the absence of dependence on the US, mostly due to substantial real linkage. In the end, impact of massive shocks in these markets commonly leads to reactive stabilization.

A number of previous studies successfully identified the major reasons behind shock spillover, or higher degree of interdependence between markets. Unparalleled economic shifts and policy adjustments cause variation in commodity prices, and results in surging capital flights from susceptible economies. A relatively stable economy may encounter subdued security prices, and fall prey to speculative attack, due to excessively competitive devaluation rampant among trading partners. Subsequently, a plunge in the volume of short term loans and a rapid devaluation appear (Corsetti et al., 1999). An increasing level of integration with developed economies can also be blamed for unprecedented shock spillover. A devaluation of the yen against the dollar in 1995-96 had a significant impact throughout the East Asian export slump in the period therafter, and was cited as an important factor in precipitating the Asian crisis (Corsetti, Pesenti and Roubini, 1998; Radelet et al. 1998). On the contrary, Scharfstein and Stein (1990) argues accentuation of investor ***herd behavior***, stemming from

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investors' proclivity to evade information collection costs, by simply following potentially informed investors, resulting in unflinching capital flight.

In accordance with the idea of association, first degree (most affected markets) and ground zero (crisis generation point) markets have extensively been studied in the post-Asian crisis period. Significant studies such as that of Thao and Daly (2012) discuss in detail the changing nature of interdependence between Thailand, Indonesia and Philippines etc. In the post crisis period, little increase in integration can be found. Thao and Daly (2012) examined the first degree economies for evidence of post-crisis surge in interdependence. Bilateral long-term relationship was found between first degree crisis economies in the presence of structural breaks.

Much of the novelty and originality of this paper is grounded in its methods for assessing the response of Asian Crisis affected markets and comparison to that of the global recession. This will help identify if the policy adjustments adopted during 1997-98 crisis led to long term protection against crisis or ended up as short-term remedies. The Bank for International Settlement (1998) emphasized that Japanese interdependence with the US transformed Japan into an important conduit for the financial crisis among emerging markets of East Asia. As a newly integrated market, India had minimal role during the Asian crisis, but played a pivotal role in Asia during the global recession. South Korea responded to the spike in capital outflows during the Asian Crisis by doubling devaluation, and became robust against shocks in the years that followed, and also tripled its GDP. In contrast, Singapore and China liberalized capital flows, while Malaysia imposed stringent restrictions on its capital movements. It is essential to scrutinize the possible recurrence of the Asian crisis during the Global recession, and to assess if the Asian markets are resilient to such happenstance.

III. Empirical Framework

To examine the level of integration between seven major Asian stock indices (South Korea, Singapore, Taiwan, China, India, Malaysia and Japan) for both post-Asian and post Global crises, we assemble the weekly stock prices of these particular countries. South Korea represents the only first degree crisis economy in the current study. The long term interdependence of Thailand and Indonesia were examined previously in several articles. In spite of massive devaluation of South Korean currency as a first degree crisis economy, South Korea re-emerged to be one of the world's fastest growing economies. Nevertheless, South

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Korea has been absent in the academic literature investigating long term association in the aftermath of the Asian crisis and the Global Financial crisis. This paper, therefore, highlights the bi-directional and multi-directional integration from the South Korean perspective primarily. Malaysia was a second degree economy that experienced direct crisis spillover from first degree markets, which led to massive action against speculators during Asian Financial crisis, and is an important inclusion from a policy perspective. Following the study of Islam et al. (2013), India, Japan and Singapore; all economies on the 'periphery' of the crisis, had significant functions during the Asian crisis. It is notable that these markets are a blend of developed and emerging markets. Japan had been an important conduit during the Asian crisis (Bank of International Settlement, 1998) and Singapore emerged as an important conduit during the global financial crisis (Islam et al. and Islam et al., 2013). India is a crucial and fast growing economy, having major volatility spillover effects from and to other Asian markets (Islam et al. and Islam et al., 2013). This might purely be due to real linkage, but it allows India to act as a pure conduit. In the next crisis, we may even see India become a ground zero market. It is necessary to check the equity market integration of these major Asian markets in both conditional and non-conditional frameworks.

Weekly data has been retrieved from Korean KOSDAQ, Malaysian BURSA, Singapore SGX, Taiwan TSEC, China SSE, TSE and Bombay BSE respectively. To diminish the effect of time zone differences and to avoid the overlapping of one country's trading day with that of the others, weekly data is crucial in applications. The weekly data is collected for 13 years (January 1999 to February 2013), which include total observation of 721 (collected from Yahoo! Finance). The sample period was split into the post-Asian crisis period, beginning from 1999 to 2007 and the post-Global Financial Crisis from 2007 to 2013. The weekly stock index has been converted into logarithmic terms where the series of observed returns were converted into squared weekly returns each point in time (t).

Two unit root tests are performed in order to examine if the stock returns follow a random walk. We apply the Augmented Dickey-Fuller Test (ADF) and the Phillip-Perron Test (PP) to examine the preciseness regarding the unit root conclusion. Our study will test each time series individually to ensure non-stationarity at the different levels of the data, and also run the unit root tests on the first differences to ensure I (1). The equation for the ADF is given below:

$$\triangle y_t = \alpha + \beta_t + \gamma y_{t-1} + \delta \triangle y_{t-1} + \ldots\ldots + \delta_{p-1} \triangle y_{t-p+1} + \varepsilon_t \quad (1)$$

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Where, α is a constant, β is the coefficient on a time trend and p is the lag order of the autoregressive process. Imposing the constraints $\alpha=0$ and $\beta=0$ corresponds to modeling a random walk and using the constraint $\beta=0$ corresponds to modeling a random walk with a drift.

The PP test is parallel to that of ADF test. The main reason that we also conduct a PP test is because the ADF test loses the power of sufficiently large values of p; the number of lags are assessed (Ghosh et al., 1999). It includes an automatic correction to the Dickey-Fuller process for auto-correlated residuals (Brooks, 2008). The PP test is a more comprehensive theory of unit root non-stationarity. The regression is as follows where u_t is serially correlated:

$$Y_t = b_0 + b_1 y_{t-1} + u_t \tag{2}$$

The autocorrelation test (Box and Jenkins, 1976) was performed to detect non-randomness of the time series modeling.

$$y_t = \alpha + \beta x_t + u_t$$
$$\text{Where}: u_t = \rho u_{t-1} + \varepsilon_t \tag{3}$$

We conduct a multivariate Johansen test for all of the return series so that we can investigate co-integration involving all variables, instead of analysis only at the bi-variant level. The Johansen process is a maximum likelihood method that determines the number of co-integrating vectors in a non-stationary time series Vector Auto-regression (VAR) with restrictions imposed, known as a Vector Error Correction model (VEC). Johansen's model specification is as follows:

$$\triangle X_t = \mu + \sum_{i=0}^{p} \Gamma i \triangle X_{t-I} + \alpha\beta' X_{t-i} + \varepsilon_t \tag{4}$$

X = (n x 1) vector of all the non-stationary returns

Γ = (n x n) matrix of coefficients

α = (n x r) matrix of error correction coefficients where r is the number of co-integrating relationships in the variables, so that $0 < r < n$. This measures the speed at which the variables adjust to their equilibrium. (Also known as the adjustment parameter)

β = (n x r) matrix of r co-integrating vectors, so that $0 < r < n$. This represents the long-run co-integrating relationship between the variables.

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In the later part of this paper, we use the Impulse response to trace out the sensitivity of dependent variables in the VAR to determine shocks to each of the other variables. Therefore, for each variable from each equation separately, a unit shock is applied to the error and the effects upon the VAR system over the stated time period. Thus, if there are g variables in a system, a total of g_2 impulse responses could be generated. Granger-causality is tested in the context of linear regression models. In this paper, we conduct pair wise granger causality test. The model specification for pairwise test is presented below:

$$\begin{aligned} X_{1(t)} &= \sum_{j=1}^{p} A11,\ j\ X_{1(t-j)} + \sum_{j=1}^{p} A1,,\ j\ X_{((t-j)}+E_{1(t)} \\ X_{2(t)} &= \sum_{j=1}^{p} A21,\ j\ X_{1(t-j)} + \sum_{j=1}^{p} A22,\ j\ X_{2(t-j)}+E_{2(t)} \end{aligned} \quad (5)$$

Here, p is the maximum number of lagged observations included in the model (the model order), the matrix A contains the coefficients of the model i.e. the contributions of each lagged observation to the predicted values of $X_{1(t)}$ and $X_{2(t)}$, and E_1 and E_2 are residuals (prediction errors) for each time series. If the variance of E_1 (or E_2) is reduced by the inclusion of the X_2 (or X_1) terms in the first (or second) equation, then it can be said that X_2 (or X_1) Granger-(G)-causes X_1 (or X_2). In other words, X_2 Granger causes X_1 if the coefficients in A_{12} are both different from zero.

IV. Empirical results

Tables 1a and 1b represent the summary statistics of the stock market returns (South Korea, Singapore, Taiwan, China, India, Malaysia and Japan) respectively. The investigation of weekly percentage returns is vital, for it is a means of explicating relative volatility. The mean returns of the bourses in both post-Asian and post-Global crises are positive and close to each other. Malaysia has a comparatively low mean of 2.896591 during the post-Asian crisis and also during the post-Global crisis when the mean was a low 3.122613. During the post-Asian crisis, Malaysia had the lowest standard deviation and also for the post-Global crisis South Korea has the lowest standard deviation. Most of the distributions are skewed to left and kurtosis represents classic leptokurtic distributions, where the series show greater fluctuation around the mean. The outcomes of the Jarque-Bera test statistics are significant at the 1 % level of significance for all the stock market returns except for Taiwan and China during the Post-Asian Crisis where these two bourses were significant at 10% and 5% consecutively.

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From both tables, it is shown that the degree of change in the price indices has not been remarkable. The weekly percentage returns have increased for majority samples which is expected, due to the rise in relative volatility during post global financial crisis period, relative to that of the Asian crisis period.

Table 1a. Summary Statistics for Post-Asian Crisis/ Pre GFC

	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
South Korea	2.918728	2.91356	0.123687	0.292635	2.295704	14.08103***
Singapore	3.280044	3.289335	0.084942	-0.23165	2.413994	9.37063***
Taiwan	3.781766	3.77989	0.088296	0.076128	2.943382	0.443091*
China	3.186548	3.186108	0.079802	-0.03907	2.4182	5.786376**
India	3.704974	3.673402	0.185674	0.74127	2.587142	39.76898***
Malaysia	2.896591	2.898851	0.066888	-0.16385	2.147655	14.00224***
Japan	4.105554	4.074809	0.105842	0.043712	1.92815	19.41965***

*** 1% ,**5%,*10% level of significance

Table 1b. Summary Statistics, Post-Global Crisis

	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
South Korea	3.232984	3.249541	0.073918	-1.17338	4.051278	87.3402
Singapore	3.453646	3.475354	0.081314	-1.60091	5.305507	205.614
Taiwan	3.875068	3.887781	0.074356	-1.67569	5.861762	256.5252
China	3.450037	3.437551	0.112902	0.907097	3.516733	46.9993
India	4.203862	4.229165	0.087376	-1.50098	4.840869	163.7899
Malaysia	3.122613	3.133587	0.076223	-0.93642	3.213633	46.93143
Japan	4.033828	3.99889	0.104862	0.875057	2.548636	43.14668

Note: all the values in Jarque Bera indicate 1% level of significance

Table 2 represents the pairwise correlation coefficients. The correlation coefficients of most of the stock returns are positive, ranging from -0.567 (South Korea-China) to 0.927 (Malaysia-South Korea). This result indicates that almost all of the stock returns are positively correlated to each other, also suggesting that positive movement of any market will lead to a positive impact on other markets and vice-versa. Interestingly, the Asian market correlation has shown a significant upward trend since the post Asian crisis. In the post-global financial crisis period, South Korea and Singapore show a dramatic rise in correlation. Though there has not been much of a change in the integration of Taiwan and

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Chinese markets to that of the rest of Asian markets, India shows a significant increase in interdependence with the rest of the sample Asian markets in the post-global financial crisis. Interestingly, India has a negative correlation with China during the Post-Asian Crisis period. This has not been the case in the post Asian financial crisis. It appears that there could still be surprises in the future.

Table 2. Pairwise Correlation Coefficients

	South Korea	Singapore	Taiwan	China	India	Malaysia	Japan	Mean
South Korea	1.000	0.796	0.375	-0.567	0.901	0.809	0.431	0.457
Singapore	**0.822**	1.000	0.687	-0.264	0.858	0.824	0.771	0.616
Taiwan	**0.809**	**0.924**	1.000	0.038	0.408	0.563	0.819	0.593
China	**0.292**	**0.557**	**0.603**	1.000	-0.417	-0.407	0.071	0.116
India	**0.902**	**0.811**	**0.807**	**0.340**	1.000	0.848	0.464	0.695
Malaysia	**0.927**	**0.780**	**0.714**	**0.122**	**0.878**	1.000	0.469	0.648
Japan	**0.102**	**0.585**	**0.518**	**0.703**	**0.088**	**0.013**	1.000	0.334
Mean	**0.642**	**0.742**	**0.617**	**0.091**	**0.452**	**0.441**	**0.504**	

NOTE: The top diagonal displays correlation coefficients for the stock market indices over the post Asian crisis period. The bottom diagonal represents the corresponding post global financial crisis period.

In testing for co-integration, primarily, it is vital to assess if national stock index data are integrated at order one (I). Variables or index in time series is essential in estimating for non-stationary conditions, and the significant existence of a unit root in level and first difference is indicated in Table 3.

Table 3 presents the results of unit root tests for all the stock market returns. The results of both Augmented Dickey Fuller and Phillips Perron tests are presented, and on both occasions the stock return series are tested with the null hypothesis of “series has a unit root” against the alternative “series is stationary.” For all the stock market returns, the null hypothesis is accepted at the 1% level of significance in level data and rejected on first difference. The ADF and PP tests do not show any evidence to support the presence of a unit root in first differences of stock market returns. This suggests the variables are stationary or (I1) in their first differences, but non-stationary in level, and so level data is used for the analysis.

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Table 3. Unit Root test for stock market indices on first difference and level data

	ADF		PP	
	level	1st difference	Level	1st difference
South Korea	-1.1109	-29.2235	-1.1109	-29.2215
Singapore	-1.2247	-26.0596	-1.3956	-26.1433
Taiwan	-2.0889	-26.9655	-2.2914	-27.0146
China	-1.6235	-25.3160	-1.8579	-25.8165
India	-0.8183	-17.0177	-0.8795	-26.0487
Malaysia	-1.1683	-24.6428	-1.3690	-24.9314
Japan	-1.8512	-27.6180	-1.8805	-27.6054

Note: all the values in 1st difference indicate 1% level of significance

In addition, deciding on the lag order of Vector Auto Regression (VAR) model is needed. Akaike information criterion (1974) and alternatively, the Schwarz Bayesian criterion (1978) methods are used for inspection; the lowest coefficients are deemed to determine the lag orders (Johansen and Jesulius, 1990). For specification, unrestricted intercepts and non-deterministic trends are assumed.

Table 4a. Lag length selection table for the Post-Asian crisis period

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Akaike Information Criteria by Rank (rows) and Model (columns)					
0	-41.00195	-41.00195	-40.98247	-40.98247	-40.96052
1	-41.04101*	-41.03642	-41.02108	-41.03902	-41.02209
2	-41.04000	-41.03071	-41.01523	-41.03403	-41.02032
3	-41.01364	-41.00286	-40.99102	-41.01148	-41.00230
4	-40.96985	-40.96868	-40.96100	-40.97866	-40.97396
5	-40.91761	-40.91978	-40.91664	-40.93741	-40.93724
6	-40.85438	-40.85941	-40.85981	-40.88772	-40.88909
7	-40.78897	-40.79096	-40.79096	-40.82545	-40.82545

Note: The lag length of the co-integrating model is based on the minimum value of the Akaike Information Criteria (AIC). * denotes information of lag length selection and appropriate model.

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Table 4b. Lag length selection table for Post-Global crisis period

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Akaike Information Criteria by Rank (rows) and Model (columns)					
0	-42.65968	-42.65968	-42.63140	-42.63140	-42.61862
1	-42.73825	-42.74043	-42.71714	-42.73879	-42.73240
2	-42.71413	-42.81249*	-42.79494	-42.81132	-42.80947
3	-42.68438	-42.77633	-42.76372	-42.79144	-42.79452
4	-42.64436	-42.73412	-42.72692	-42.75347	-42.75879
5	-42.58390	-42.68651	-42.68572	-42.70739	-42.71105
6	-42.51264	-42.61742	-42.61463	-42.64001	-42.63471
7	-42.42414	-42.53176	-42.53176	-42.55195	-42.55195

Note: The lag length of the co-integrating model is based on the minimum value of the Akaike Information Criteria (AIC). * denotes information of lag length selection and appropriate model.

In order to earn an insight into the association among the examined stock markets, bivariate co-integration tests were performed within the Asian stock markets. These bivariate co-integration tests determine if pairs of stock market returns are integrated. The outcomes of the bivariate co-integration tests are presented in table 5.

The table presents the maximum Eigenvalue tests and trace tests for bivariate co-integration for both the post-Asian and the post-Global crisis periods. The tables are used to verify (r) the quantity of co-integrating vectors for each pair of stock market returns. In contrast, the existence of a long run stable association between a pair of market indices can also be investigated. In every scenario of the bivariate co-integration test, the null hypothesis rejects co-integration. During the Post-Asian Crisis period, Taiwan, China and Malaysia exhibited substantial long term association with South Korea; whereas during the Post-Global Crisis period, no significant co-integration between the stock market returns with South Korea was found except for Japan.

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Table 5. Bi-variate co-integration tests

			Post Asian crisis		Post Global crisis	
Countries	Null	Alternative	Eigenvalue	Trace	Eigenvalue	Trace
South Korea	r = 0	r = 1	6.91	7.92	8.88	11.58
Singapore	r ≤ 1	r = 2	1.01	1.01	2.69	2.69
South Korea	r = 0	r = 1	15.06*	18.71*	9.07	12.75
Taiwan	r ≤ 1	r = 2	3.64	3.64	3.67	3.67
South Korea	r = 0	r = 1	7.11	12.76	4.03	5.73
China	r ≤ 1	r = 2	5.64*	5.64*	1.70	1.70
South Korea	r = 0	r = 1	7.62	7.91	11.14	14.52
India	r ≤ 1	r = 2	0.28	0.28	3.37	3.37
South Korea	r = 0	r = 1	15.58*	16.49*	13.37	13.99
Malaysia	r ≤ 1	r = 2	0.91	0.91	0.62	0.62
South Korea	r = 0	r = 1	10.18	12.94	7.86	11.79
Japan	r ≤ 1	r = 2	2.76	2.76	3.93*	3.93*

* indicating 5% level of significance

Table 6, presents the outcome of the multivariate co-integration tests between South Korea and other stock market returns. The test was carried out with the null hypothesis that rejects co-integration. The outcome of the test suggests that the null hypothesis was rejected at the 5 % level of significance and also indicates the existence of three and two co-integrating equations consecutively.

The multivariate co-integration test result also supports the findings of the bivariate co-integration test outcomes. It reaffirms integration within the markets as being more stable during the post-Asian crisis period. This also indicates the long, steady and balanced association between the examined markets in both post-Asian and post-global crisis.

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Table 6. Multivariate co-integration test

			Post Asian Crisis		Post Global Crisis	
Countries	Null	Alternative	Eigenvalue	Trace	Eigenvalue	Trace
South Korea	r = 0	r = 1	44.27	158.95*	79.25*	183.88*
Singapore	r ≤ 1	r = 2	40.41*	114.68*	48.63*	104.62*
Taiwan	r ≤ 2	r = 3	31.75	74.27*	20.95	56.00
China	r ≤ 3	r = 4	20.45	42.52	17.07	35.05
India	r ≤ 4	r = 5	12.43	22.07	10.61	17.98
Malaysia	r ≤ 5	r = 6	9.01	9.65	5.07	7.37
Japan	r ≤ 6	r = 7	0.64	0.64	2.30	2.30

* indicating 5% level of significance

VECM Procedure

From the long run error correction model presented below, the speed of adjustment for the Post-Asian crisis and the Post-Global crisis periods was 0.41% and 12% consecutively. This implies that the South Korean market reacted after a shock very slowly and took longer to absorb the shock. It also indicates that additional shock was dissipated at the end of the Post-Global crisis period. The impact of other stock market returns prevails over the South Korean market during the Post-Asian Crisis period. During this period, Malaysia and Japan have the most significant positive impact and Taiwan and India have the most negative impact on the South Korean Market.

Long Run Error Correction Model

Post-Asian Crisis Period:

$$Y_{LSKt} = -3.905 + 1.379\ln SNG_t - 9.376\ln TAI_t - 1.229\ln CHN_t - 3.042\ln IND_t + 10.715\ln MAL_t + 5.335\ln JPN_t + 0.0041 ECM_t$$

Post Global Crisis Period:

$$Y_{LSKt} = -0.390 - 0.826\ln SNG_t + 1.293\ln TAI_t + 0.074\ln CHN_t - 0.372\ln IND_t + 1.008\ln MAL_t - 0.093\ln JPN_t + 0.120 ECM_t$$

Table 7 presents the pair wise granger causality test for all the market returns with South Korea. The test was performed with a null hypothesis of "specific markets does not granger cause another market returns and vice versa" against the alternative "that the particular market granger causes the other." In every occasion, the null hypothesis is rejected except for Singapore, China and Malaysia to South Korea; South Korea being the market of interest. In addition, South Korea does not granger cause India. In a nutshell, market returns do

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have an impact on each other which was expected, as these markets are fairly integrated with one another.

Table 7. Granger Causality test results

Null Hypothesis	F-Statistic
Singapore does not Granger Cause South Korea	0.736
South Korea does not Granger Cause Singapore	8.046***
Taiwan does not Granger Cause South Korea	5.204***
South Korea does not Granger Cause Taiwan	8.485***
China does not Granger Cause South Korea	1.316
South Korea does not Granger Cause China	3.446**
India does not Granger Cause South Korea	18.563***
South Korea does not Granger Cause India	1.054
Malaysia does not Granger Cause South Korea	1.284
South Korea does not Granger Cause Malaysia	10.142***
Japan does not Granger Cause South Korea	4.533**
South Korea does not Granger Cause Japan	26.589***

*** 1%, ** 5%,* 10% level of significance

Figures 1 and 2 demonstrate the generalized impulse response for each of the stock market returns to price shocks from the rest of the market returns. This is interesting in that while all of the markets tend to revert back to steady state, the markets seemed to react negatively to a shock in Japan during the Post-Global Crisis period. South Korea and Singapore display concurrent movements, regardless of the covariance with the other markets. China and India seem to have minimal impact on the rest of the markets, though they are prompt in their reversal to steady state. Interestingly, a shock in Malaysia seems to push the Japanese index down instantaneously. It can be said that throughout the two crisis periods, the low degree of shocks has not caused a dramatic change in the Japanese stock index. Most of Asian markets maintain a trade deficit with Japan, as the Japanese exports account for 40% of total exports in Asia. The ‘Asian Flu’ prompted Japan to initiate policy changes in order to protect Japan from the Asian contagion in the post-Global Financial Crisis period.

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Figure 1. Impulse Response with Generalized One Standard Deviation during the Post Asian Crisis period

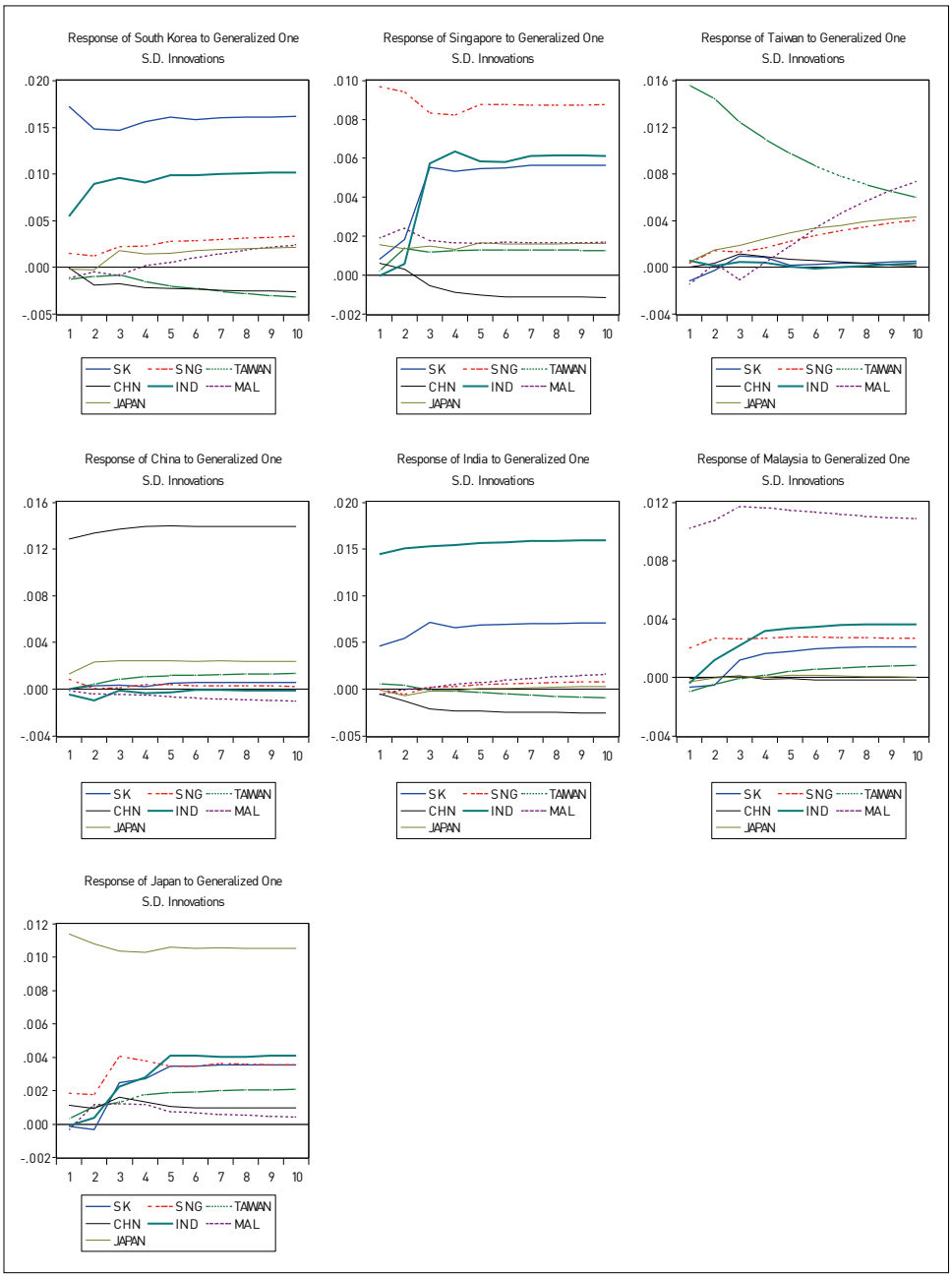

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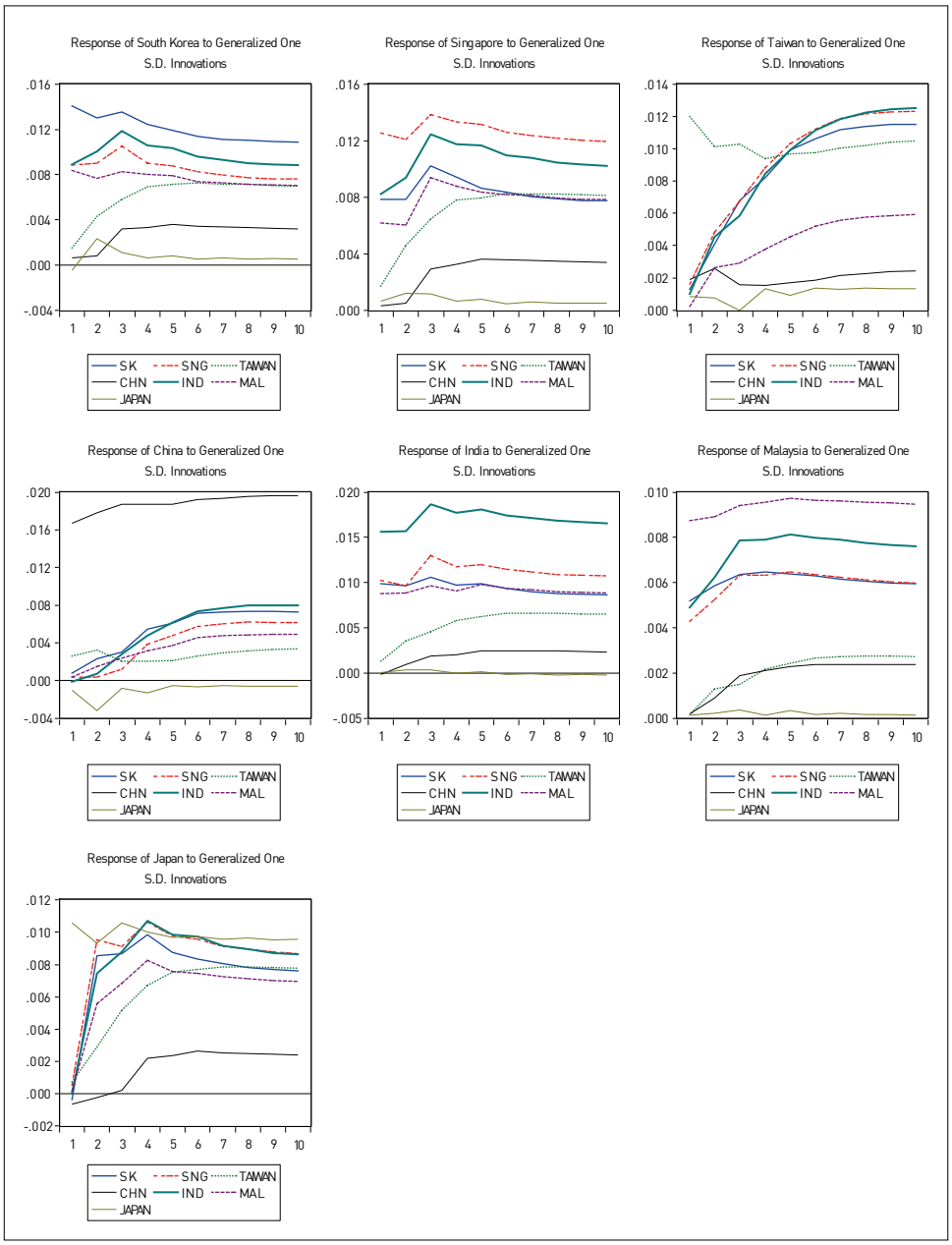
Figure 2. Impulse Response with Generalized One Standard Deviation during the Post Global Crisis period



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V. Conclusion and Remarks

In terms of comparative assessment, more specifically the first degree economies affected by the Asian crisis, it can be asserted that these markets have effectively undergone reduction in terms of the degree of interdependence in the years following the Asian crisis. In the period after the global financial crisis, the interdependence of South Korea with other economies was significantly low. Similar trends can be observed for Malaysia as well. The Singapore market, less affected by the Asian crisis, reduced its interdependence even more, in the post-crisis phase after the global financial crisis. This study found that though the Indian market experienced significant shock from the crisis among Asian economies in the post-global financial crisis period, India never had significant interdependence during the Asian crisis. While affected markets learned from experience, it seems to indicate new era of interdependence among inexperienced but rapidly growing markets, with potential for rapid propagation in case of crisis. In contrast, Granger causality suggests that the stock market returns examined in this paper stimulates the South Korean market except for China, Singapore and India, all economies with no impact over South Korea. VECM procedure actually shows strong influence between South Korea, Japan, Singapore and Malaysia.

Ways of curbing such market interdependence were presented in a number of studies. In the post Asian crisis period, it has been observed that Asian economies were struggling to comply with industry-country standard to improve surveillance in financial institutions and with implications for prudential control. The emphasis, presently, is in finding ways to ensure an unhindered flow of information to and from the bourses, which could consequently reduce **herding** (Hawkins and Turner, 2000). In this study, the existence of increased interdependence is undeniable, which casts doubts on the effectiveness of the policies imposed on stock exchanges. According to Dornbusch et al. (2000), some level of reduction in interdependence can be attained if the bourses under investigation ride down in tandem, to tackle the higher level of collinearity and interdependence. An accord can be drafted to control the operation of hedge funds and to limit mismatches, to ensure enhancement of poor systems with sanctions, to ensure controls on capital flight and to hold foreign assets proportionate to liabilities.

According to the Bank of International Settlement (1998), the Asian crisis may suggest a regime shift in emerging markets. While emerging markets are more prone to contagion, developed markets have turned into strong conduits.

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This study contradicts the popular belief to some extent. While the bi-directional relationship means spillover from South Korea to different stock market returns and vice-versa is irresistible, real linkage and idiosyncratic shocks may have a significant function in such a relationship. It is stipulated that Japan has a bi-directional linkage due to the 24-hour market connection, and Singapore is strongly associated through fundamental and financial linkage. South Korea has been discussed as strong conduits in both the Asian and Global financial crises (Islam et al; 2013, Dungey et al, 2010). While developed 'conduits' through fundamental association (Singapore) and financial association (Japan) were significant in transmitting the crisis from the US to Asia, India is turning into an 'ideal' future conduit with better association, albeit with a deteriorating magnitude of shock and increasing speed of adjustment. India is, therefore, recently proposing strong market integration, purely through unidentified but developing integration, and emerged as a concrete evidence of *pure contagion* due to its rapid growth after the Asian crisis and during the global financial crisis. Yet India did not become embroiled in the Asian crisis and we find this to be a hopeful sign as other emerging Asian economies show signs of following the example of India in the coming few years. As this study compared the Asian crisis to global crisis in regards to the impact on important Asian markets, some suggestions were elicited as a result. A high level of congruence among future researchers is required, to propose reconciliation among the pool of Asian markets, and to strengthen individual bourses that would be able to tackle future crisis resulting from long term interdependence.

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