DYNAMICS OF CO-MOVEMENT AMONG ASIAN STOCK MARKETS

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ABSTRACT

Stock market integration has been widely research throughout the world for its implication in portfolio diversification, still integration on the basis of segmented markets has not been given much importance. The present study is an attempt to fill in the gap by using advance econometric tools on regional blocks in Asia i.e. South-East Asia, East Asia, South Asia to test whether countries within the region are co-integrated with each other in respect to their stock markets so that investors can benefit maximum from diversification by investing in countries which doesn't move together with their home market. The study has concluded that on multivariate basis, markets are not co-integrated in regions but for Asia as a whole markets tend to exhibit common forces behind fluctuation. On bivariate basis markets are showing long-run equilibrium with each other, also with existence of short run dynamics. It can be inferred from the results that investors residing in developed countries within (Malaysia, Singapore, Hong-Kong) need to diversify beyond regional limits. Emerging countries (India, China, Taiwan, Korea, Philippines, Indonesia) are also moving towards greater level of co-integration in their respective regions. Thus investors residing in underdeveloped market such as Pakistan, Srilanka can only take the benefit of regional diversification. Hong-Kong has emerged as the most influential market in Asia.

Keyword: Diversification, Market Integration, Co-integration,

1. Introduction

The burgeoning importance of diversification has once again caught attention of international investors in the wake of Global Financial Crisis. The underlying idea behind international diversification is to generate abnormal return from low level of co-integration among the countries *[Markowitz, 1952],* but according to [Segot *et al.* 2005], even if market exhibit weak correlation it does not ensure market to be sound destination for diversification if it is thinly traded. However studies reveal that with the advent of financial deregulation markets are becoming efficient so that asset with same level of risk and liquidity yields equal reward across the countries. Despite growing co-movement correlation across the countries tend to be less than perfectly correlated due to varying degree of financial risk, hence diversification benefit can't be eliminated completely in practice. A number of empirical studies have been conducted to test long-run and short-run linkages among the countries. Liu *et al.* [1998], Fan [2003], Yang *et al.* [2003], Guidi F [2010], shows markets tend to exhibit greater level of co-movement between them at the time of crisis. According to Kearney and Lucey [2004] at times of exogenous shocks co-movement can artificially increase even without growing integration. While (Narayan and Symth

[2005], Maneschiölda, Per-Ola) concentrated on the impact of liberalization and financial deregulation on market co-integration. Many of the studies concentrated on the impact of US and Japan on Asian markets in the case of crisis or international shocks (Liu *et al.* [1998], Ghosh *et al.* [1999], Massey *et al.* [2006], Ismail and Rehman [2009]). The issue of regional impact on integration is largely unresolved inspite of its crucial implication for taking financial decision and fewer number of studies deals with it (Agmon T. [1972], Chan *et al.* [1997], Jorion *et al.* [1986], Raju et al.[2009]). Most of the studies account for different findings because of different sample period and frequency of data, with no concise and concrete results to rely upon. Asian markets may [or may not] be integrated with each other in long run as well as short run. Thus, the study has addressed this issue of regional co-integration for of Asian markets.

2. Research Methodology

To measure the short term and long run relationship among Asian markets a sample of 12 Asian markets has taken. It includes developed, underdeveloped and emerging markets in Asia because some markets such as Indonesia, Philippines, Pakistan, Sri-Lanka have not be given due consideration in the existing literature. The study tries to explore comprehensively long run as well as short run dynamics by employing advanced econometric tools on popular indices of Asian markets. Data consists of daily prices of stock indices from 12 asian nations, Malaysia(MLY) KLCI, Indonesia(IND) Jakarta Composite Index, Philippines(PHP) PSEi Index, Singapore(SG) Strait Times Index from South East Asia, India(IN) S&P CNX Nifty, Pakistan(PKS) KSE 100, Srilanka(SH) CSE All Shares from South Asia, China(CH) SSE Composite, Hongkong(HK) Hang Seng Index, Japan(JP) Nikkie 225, Korea(KR) KOSPI, Taiwan(TW) TWII from East Asia covering time period from July 3, 1997 to December 2, 2011 on the basis of availability of data. As frequency of data such as daily, weekly, monthly can lead different results and daily data contain too much noise and is subject to the problem of non-synchronous infrequent trading [Ibrahim, 1995] but Hakkio and Rush [1991] have shown that, given a fixed sample period, frequency of data did not affect co-integration results, thus daily data has been employed in the study. All of the indices values are in local currency terms and sourced from econstats.com.

2.1 Method of Analysis

To apply Co-integration model, ascertainment of degree of integration *I(d)* in variables with the help of unit root test is necessary. Existence of non-stationarity has strongly been documented for stock prices in Asian Market [Masih *et al.* 2001]. Two conventional methods ADF (Augmented Dickey Fuller test) and PP (Phillips and Perron) have been employed wherein null hypothesis assumes presence of unit root. Number of lags must be chosen with utmost attention in augmented version of unit root test for which number of criteria has been proposed such as AIC, SIC, HQ, LB etc., however study has relied upon AIC (Akaike Info Criteria) method to choose optimum number of lags [Masih and Masih 1997]. After deciding upon the level of integration, testing of co-integration comes. One of the major contributions in the field of Cointegration can be attributed to Clive Granger [1981] who first established a model (popularly known as two step method) to study the relationship between the non-stationary variables. The solution is based on a simple regression equation and turned out to be an extremely important model to study the co-integration relationship among non-stationary variables. Regression equation for Engle and Granger Test:

$$Y_t = \alpha + \beta(X_t) + \varepsilon_t$$

Where X_t is an exogenous variable and Y_t is endogenous variable generated by a stochastic process and ε_t is white-noise error term which is purely random walk with zero mean and constant variance. Usually time series in financial economics tend to be *I(1)* that is integrated of order one implies that taking their first difference series can be made stationary (if $Z_t \sim I(1)$ then $\Delta Z_t \sim I[0]$). Any combination of two *I(1)* series $Y_t + X_t$ tend to be *I(1)* which states that *I(1)* variables dominates $I(0)$ variables. Assuming series in question are integrated of order one $\Delta Y_t \sim I(0), \Delta X_t \sim I(0)$, then generally $Y_t - \beta(X_t)$ would be *I(1)*. But one important exception at this point is if tends to be *I(0)*. In this case series can be explained as co-integrating series with one co-integrated factor .

Engle and Granger suggested the appropriate technique of testing level of Cointegration in (1987) with null hypothesis of No Co-integration among a set of I*(1)* variables. Two steps involved in testing the co-integration among the variables is first running an estimation equation on endogenous variable using an intercept and exogenous variable and generating residual series. Then running unit root test (Augmented Dickey-Fuller test as described above) on residual series

Regression on residuals

$$\varepsilon_t = \alpha_1 \varepsilon_{t-1} + \sum_{i=2}^{p} \beta \Delta \varepsilon_{t-i} + \mu_t$$

Regression analysis deals with dependence of one variable over another variable but it is not necessary that their exist causation between the two variables, the idea behind Granger-Causality Test. This phenomenon is philosophical because it involves lots of controversies. According to one group of financial thinkers "everything causes everything" whereas on the other extreme are the people who deny the existence of causation whatsoever. The test helps in exploring type of exogenous behavior i.e. weak, strong, super strong if there is unidirectional causality. If *X* variable is weakly exogenous then estimation and testing of the regression model can be done, strong exogeneity is necessary for forecasting and

super exogeneity for policy analysis [Gujrati, 2009]. If two variables are co-integrated in the long run, causality can be established with Granger Causality Test. Granger represents the method of estimating unidirectional or bidirectional causality among the variable. The equation for Granger Causality Test takes the form of (for a bivariate autoregressive system of order):

$$Y_t = \alpha + \sum_{i=1}^{p} \delta_{1i} X_{t-i} + \sum_{j=1}^{p} \phi_{1j} Y_{t-j} + \varepsilon_{1t}$$

$$X_t = \alpha + \sum_{i=1}^{p} \delta_{2i} X_{t-i} + \sum_{j=1}^{p} \phi_{2j} Y_{t-j} + \varepsilon_{2t}$$

If Y_t and X_t are both *I(1)* and co-integrated then according to Granger representation theorem the system can be written in the error correction form in order to determine the speed of adjustment to return to equilibrium level. Granger representation theorem in error correction form:

$$\Delta Y_t = a_1(Y_{t-1} - \beta X_{t-1}) + \sum_{i=1}^{p-1} \hat{\delta}_{1i} \Delta X_{t-i} + \sum_{j=1}^{p-1} \hat{\phi}_{1j} \Delta Y_{t-j} + \varepsilon_{1t}$$

$$\Delta X_t = a_2(Y_{t-1} - \beta X_{t-1}) + \sum_{i=1}^{p-1} \hat{\delta}_{2i} \Delta X_{t-i} + \sum_{j=1}^{p-1} \hat{\phi}_{2j} \Delta Y_{t-j} + \varepsilon_{2t}$$

Where $\alpha_i(Y_{t-1} - \beta X_{t-1})$ is the error correction term and defines the strength of disequilibrium in the short run and atleast one of the parameter and deviates from zero. Since both right-hand side and left-hand side is balanced in the long run and are co-integrated of the same order $Y_{t-1} - \beta X_{t-1} \approx I(0)$ should be true and if not, there exist dynamic relationship among the variables.

Another fundamental contribution in the area of co-integration was of Johansen [1988] and Johansen and Juselius [1990] Maximum Eigenvalue test and Trace test. The technique takes its starting point in Vector Auto regression [VAR] of order *p*. Johansen Co-integration test equation:

$$Z_t = C + A_1 Z_{t-1} + \cdots\cdots\cdots + A_p Z_{t-p} + \mu$$

Where Z_t is a vector of $n \times 1$ variables integrated of the same order –commonly *I(1)*. is vector of constant or endogenous variable. A_i is matrix of coefficients to be estimated at different lag intervals. μ_t is vector of $n \times 1$ white noise error terms with mean zero and constant variance.

This VAR can be re-written as in error-correction form. Standard VAR in Error Correction Form:

$$Z_t = C + \pi Z_{t-1} + \sum_{i=1}^{p-1} \tau_i \Delta Z_{t-i} + \mu_t$$

Where = and $\pi \sum_{i=1}^{p} A_i - 1 \; and \; \tau_i = -\sum_{j=i+1}^{p} A_j$. If the coefficient matrix has reduced rank $r<n$, then there exist $n \times r$ matrices $\alpha \; and \; \beta$ each with rank r such that $\pi = \alpha\beta' \; and \; \beta' Z_t$ is stationary. According to Johansen technique r is the number of Cointegration factors among the set of variables. The elements of α is the error correction or adjustment parameter and each column of β is cointegrating factor. Johansen proposed two different likelihood ratio test for reduced rank of π: Maximum Eigenvalue and Trace test given as:

$$\lambda_{trace} = -T \sum_{j=r+1}^{k} In[1 - \lambda_j]$$

$$\lambda_{trace} = -T \, In[1 - \lambda_{r+1}]$$

Where T is the sample size and $\hat{\lambda}_j$ are the estimated values of characteristics roots obtained from the π matrix. The trace test tests the null hypothesis of r co-integrated variables against the alternative of n co-integrating vectors, while the maximum Eigenvalue test the null of r cointegrating vectors against the alternative of $r+1$ co-integrating vectors.

Johansen method has been used in the study as it allows for inclusion of more than one co-integrating vector and is more efficient with respect to error in making serially uncorrelated [Ng 2002].

3. Results and Discussion

Exhibit I shows statistics on logarithmic return on indices. Except Japan and Taiwan all other markets are offering positive rate of return in the long run. Japan and Taiwan's current valuation is below the mark in 1997 as per the data of series. J-B test rejects the null hypothesis of normality in data as expected on daily basis. Japan, China, Taiwan, India, Pakistan, Korea with negative skewness and longer tails on left side of distribution of data are giving more frequent small gains with little extreme losses as opposed to Hongkong, Singapore, Malaysia, Philippines, Indonesia, Srilanka which have frequent small losses with little extreme gains.

Very high kurtosis indicates the concentration of large number of observation around the mean. Exhibit II shows the level of correlation among the countries. To test the impact of Global financial crisis which starts laying its wings in 2007, whole sample has been divided into two sub-sample, pre-crisis[07/08/1997: 07/31/2007] and post-crisis[08/01/2007: 12/02/2011]. As laid down by (Yang *et. al.* [2003], Fan [2003], Guidi [2010]), correlation pattern is strongly affected by crisis with increased correlation at the time of crisis. However, Sri Lanka and Pakistan has been found to be weakly correlated with the other markets with little impact of crisis on correlation. One of the reason for low correlation can be the low volume of trade in respective countries.

Exhibit I: Descriptive Analysis

	JP	CH	HK	SG	MLY	TW	PHP	IN	IND	PKS	KR	SH
Mean	-0.000337	0.000316	9.99E-05	0.000132	0.000137	-0.000106	0.000180	0.000571	0.000664	0.000781	0.000368	0.000814
Median	4.15E-05	0.000439	0.000286	0.000349	0.000216	-0.000136	-0.000127	0.001207	0.001094	0.001332	0.001195	0.000508
Maximum	0.115365	0.345961	0.172470	0.214742	0.202595	0.160768	0.200096	0.163343	0.190842	0.127622	0.138635	0.305353
Minimum	-0.136638	-0.370606	-0.159720	-0.119782	-0.241534	-0.112850	-0.136399	-0.219990	-0.179514	-0.132133	-0.189111	-0.296767
Std. Dev.	0.019020	0.023057	0.021850	0.018531	0.019850	0.019776	0.019943	0.021426	0.023128	0.021028	0.025419	0.018423
Skewness	-0.421830	-0.346081	0.004815	0.738556	0.582318	-0.041198	0.749625	-0.389549	0.192487	-0.522544	-0.259067	0.798513
Kurtosis	8.602859	52.46464	12.43983	16.94975	38.23836	8.570944	14.39416	13.36245	14.79300	8.693786	8.569987	77.81412
Jarque-Bera	3293.314	251045.0	9141.249	20186.08	127521.2	3184.413	13548.66	11077.71	14281.95	3437.712	3210.162	574436.2
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

(Source: Compiled by author and notations are JP(Japan), CH(China), HK(Hong-Kong), SG(Singapore), MLY(Malaysia), TW(Taiwan), PHP(Philippines), IN(India), IND(Indonesia), PKS(Pakistan), KR(Korea), SH(Srilanka))

Before testing co-integration, testing of level of integration is necessary. Literature support the view that stock indices are normally integrated of order one *I(1)* that is taking their first difference make the series stationary. The study has employed both Augmented Dickey-Fuller and Phillips Perron Test with constant and trend [Karim *et al.* 2010, Ng 2002] to test stationarity in time series. Bandwidth for Phillips Perron test has been chosen on the basis of *Bartlett Kernel,* and maximum Lag for Augmented Dickey-Fuller test has been selected on the basis of *Akaike Information Criteria* and then conducting autocorrelation LM test on residual in an attempt to make it sure that residuals shouldn't be auto correlated. The results in Exhibit III corresponds to the well established literature that series are stationary in first difference.

Exhibit IV with the help of Engle and Granger test helps in explaining long term phenomenon among the countries. A graphical look on the residuals couldn't detect any trend in it thus ADF test without intercept and trend has been relied upon Guidi (2010). Results indicate that Philippines and Singapore are co-integrated with all the market Ng (2002) whereas Indonesia and Philippines doesn't have long run equilibrium with Malaysia in case of Southeast Asia. In South Asia India is showing co-integration with the other two markets whereas Pakistan is not co-integrated with India, this could be due to the controversial relations among the two countries. Srilanka has strong relationship with India and Pakistan. In East Asia China is not co-integrated with Japan and Hongkong in the long run and Korea is not in equilibrium with Japan and Taiwan. Hongkong and Taiwan also doesn't depict long run equilibrium with each other.

Exhibit V shows that Malaysia and Philippines are explained by all the other markets whereas Singapore and Indonesia are explaining other markets which goes against the finding of Janakiramanan and Lamba [1998] that Indonesia is the most isolated country but in favor of Yang *et al.* [2003] that shows Singapore to be a influential market in Asia.

In Southeast Asia greater level of causality can be established compared with other regions. In South Asia except India [ranked 6th in the world in terms of number of trade *source: federation of World Exchange*] the other two markets are less developed and thinly traded, with India having unidirectional causality with Srilanka which is causing Pakistan only. In East Asia Korea is explaining each market except China [Yang *et al*, 2003 shows positive role of Korea in Asia]. Hong-Kong has been found to be leading all the markets except Japan. Taiwan is explained by each country except china but is unable to lead any market except Korea. [Yang *et al.* 2003]. Japan is caused by or lagged from Korea and China by Hong-Kong only.

Exhibit VI deals with multivariate Johansen Co-integration test which resides on linear VAR. The test has been heavily relied upon and been proved better than simultaneous equation method or MS-VAR [Ismail *et al.* 2009].

Exhibit II: Correlation Matrix [Daily Returns]

Subsample 1 [Pre-crisis 07/08/1997: 07/31/2007]

	JP	CH	HK	SG	MLY	TW	PHP	IN	IND	PKS	KR	SH
JP	1.000000											
CH	0.093121	1.000000										
HK	0.495339	0.091798	1.000000									
SG	0.451398	0.085318	0.640325	1.000000								
MLY	0.235807	0.077826	0.379172	0.431932	1.000000							
TW	0.357643	0.087553	0.364190	0.393766	0.225760	1.000000						
PHP	0.303876	0.058766	0.444965	0.459214	0.300662	0.261862	1.000000					
IN	0.285625	0.017042	0.354003	0.303578	0.156795	0.223433	0.224370	1.000000				
IND	0.265379	0.064827	0.393320	0.403074	0.358534	0.230454	0.375674	0.281972	1.000000			
PKS	0.098748	0.055452	0.143058	0.139041	0.111720	0.142014	0.113929	0.166810	0.092556	1.000000		
KR	0.453104	0.045721	0.485748	0.447640	0.283009	0.400097	0.327568	0.297569	0.342133	0.053308	1.000000	
SH	0.063766	0.020318	0.080037	0.101401	0.061858	0.070381	0.071005	0.045714	0.043282	0.083851	0.011980	1.000000

Subsample 2 [Post-crisis 08/01/2007: 12/02/2011]

Countries	JP	CH	HK	SG	MLY	TW	PHP	IN	IND	PKS	KR	SH
JP	1.000000											
CH	0.315834	1.000000										
HK	0.709167	0.512121	1.000000									
SG	0.691729	0.376757	0.855321	1.000000								
MLY	0.449030	0.309922	0.503544	0.498766	1.000000							
TW	0.667121	0.375134	0.757343	0.749207	0.492295	1.000000						
PHP	0.502204	0.309551	0.529059	0.474245	0.462522	0.560092	1.000000					
IN	0.530919	0.351095	0.716904	0.708343	0.389529	0.568167	0.382443	1.000000				
IND	0.608974	0.328478	0.720860	0.726813	0.515597	0.674656	0.590347	0.594372	1.000000			
PKS	0.109452	0.090377	0.086073	0.041304	0.094414	0.111653	0.142011	0.087690	0.098725	1.000000		
KR	0.720165	0.342830	0.748815	0.728499	0.473559	0.767638	0.494395	0.596863	0.668115	0.133913	1.000000	
SH	0.106953	0.051940	0.103068	0.115711	0.093506	0.118644	0.119332	0.077011	0.131142	0.008578	0.099009	1.000000

[Note: the stock returns are in nominal terms in domestic currency]

Exhibit III: Results of Unit Root

[H_0: unit root vs. H_a: no unit root]

Variables in Log Level	ADF [With constant and Trend]		PP [With constant and Trend]		1% Critical Value	5% Critical Value
	Level	First Difference[“]	Level	First Difference[“]		
JP	-1.026690	-40.24419*	-1.204878	-57.48051*	-3.96	-3.41
CH	-1.489668	-47.95394*	-1.72507	-69.82384*	-3.96	-3.41
HK	-0.366017	-13.38904*	-2.368255	-58.85914*	-3.96	-3.41
SG	-2.251740	-31.63024*	-2.334011	-53.55238*	-3.96	-3.41
MLY	-3.475865	-5.831491*	-5.065564**	-59.17444*	-3.96	-3.41
TW	-1.252150	-16.94358*	-2.695544	-55.57171*	-3.96	-3.41
PHP	-2.203700	-47.92630*	-2.695291	-47.64538*	-3.96	-3.41
IN	-1.113374	-8.331648*	-2.201874	-54.39179*	-3.96	-3.41
IND	-3.023713	-47.94527*	-3.542676	-47.67447*	-3.96	-3.41
PKS	-0.768855	-10.76906*	-1.378681	-51.85733*	-3.96	-3.41
KR	-2.910849	-54.34841*	-2.855667	-54.33073*	-3.96	-3.41
SH	-1.241379	-17.77844*	-2.180716	-55.87028*	-3.96	-3.41

*[Optimal lag length for ADF regression and PP is based on Akaike Info Criterion and Bandwidth respectively. The p-values are the Mackinnon [1996] one sided p-values and *, ** indicates significance at 1%, 5% respectively]*

Exhibit IV: ADF Test results on Engle–Granger Cointegration test Residuals

	Regressor			
	Southeast Asia			
Regressand	**MLY**	**IND**	**PHP**	**SG**
MLY	-3.113683*	0.541955	0.207633	-4.11152*
	[0.0018]	[0.8330]	[0.7464]	[0.0000]
IND	0.083300	-3.200958*	-3.877147*	-3.365991*
	[0.7089]	[0.0013]	[0.0001]	[0.0008]
PHP	-2.565030*	-3.587815*	-2.399264**	-2.349989**
	[0.0100]	[0.0003]	[0.0519]	[0.0182]
SG	-3.825014*	-3.071168*	-2.110140**	-2.181398**
	[0.0001]	[0.0021]	[0.0335]	[0.0281]
	South Asia			
	IN	**PKS**	**SH**	
IN	-1.580819	-2.371373**	-1.845463***	
	[0.1073]	[0.0172]	[0.0619]	
PKS	-1.261320	-1.507921	-2.055521**	
	[0.1911]	[0.1235]	[0.0382]	
SH	-2.03245**	-2.531419**	-2.021504**	
	[0.0404]	[0.0110]	[0.0415]	
	East Asia			
	CH	**HK**	**JP**	**KR**	**TW**
CH	-1.803684***	-1.998939**	-1.068839	-1.669803**	-1.989190**
	[0.0678]	[0.0437]	[0.2582]	[0.0899]	[0.0447]
HK	-0.209447	-0.278624	-1.832116***	-2.112435**	-2.512826**
	[0.6109]	[0.5858]	[0.0638]	[0.0333]	[0.0117]
JP	-0.785755	-2.226429**	-1.148732	-1.910752***	-1.689738***
	[0.3759]	[0.0259]	[0.2290]	[0.0535]	[0.0863]
KR	-3.061020*	-1.991156**	-0.634101	-2.649362*	-0.486114
	[0.0022]	[0.0445]	[0.4427]	[0.0078]	[0.5051]
TW	-2.750535*	-0.946879	-2.531467**	-0.265420	-2.377884**
	[0.0058]	[0.3067]	[0.0110]	[0.5902]	[0.0169]

[, **, *** indicates significance at 1%, 5% and 10% respectively with p-values in parenthesis]*

Exhibit V: Granger Causality Test [F-statistics]

	Explanatory Variable			
	Southeast Asia			
Market Explained	**MLY**	**IND**	**PHP**	**SG**
MLY	-	19.9971*	5.74919*	9.24164*
	-	[0.0000]	[0.0001]	[0.0000]
IND	0.78428		0.87751	2.16502***
	[0.5353]	-	[0.4765]	[0.0705]
PHP	9.85122*	20.6007*		27.2479*
	[0.0000]	[0.0000]	-	[0.0000]
SG	0.97207	2.35912***	2.28334***	-
	[0.4215]	[0.0514]	[0.0582]	
	South Asia			
	IN	**PKS**		**SH**
IN		0.14063		[0.8688]
	-	1.46718		[0.2308]
PKS	2.09448			2.45361***
	[0.1233]	-		[0.0862]
SH	5.21624*	0.86780		
	[0.0055]	[0.4200]		-
	East Asia			
	CH	**HK**	**JP**	**KR**	**TW**
CH	-	2.06737***	0.95297	0.33344	1.37324
		[0.0825]	[0.4434]	[0.8556]	[0.2406]
HK	4.27926*	-	0.93354	5.82514*	0.53084
	[0.0019]		[0.4434]	[0.0001]	[0.7131]
JP	0.97338	1.45957	-	3.39247*	0.89386
	[0.4208]	[0.2119]		[0.0089]	[0.4667]
KR	2.33595***	3.10267**	0.42100	-	3.23971**
	[0.0533]	[0.0147]	[0.7936]		[0.0116]
TW	0.36005	9.53940*	2.635711**	4.53395*	-
	[0.8372]	[0.0000]	[0.0325]	[0.0012]	

[, **, *** indicates significance at 1%, 5% and 10% respectively with p value in parenthesis]*

Exhibit VI: Johansen Co-integration Test

[With Linear trend]

H_0	H_1	Trace Statistic	0.05 Critical Value	Max-Eigen Statistic	0.05 Critical Value
		Southeast Asia			
r=0	*r>1*	26.65675	47.85613	3.38228	27.58434
rd"1	*r>2*	13.27447	29.79707	10.08568	21.13162
rd"2	*r>3*	3.188789	15.49471	2.825209	14.26460
		South Asia			
r=0	*r>1*	13.26601	29.79707	11.41116	21.13162
rd"1	*r>2*	1.854844	15.49471	1.638326	14.26460
rd"2	*r>3*	0.216518	3.841466	0.216518	3.841466
		East Asia			
r=0	*r>1*	59.20090	69.81889	31.79454	33.87687
rd"1	*r>2*	27.40636	47.85613	18.31360	27.58434
rd"2	*r>3*	9.092753	29.79707	7.43324	21.13162
		Asia			
r=0	*r>1*	604.1600*	334.9837	164.5104*	76.57843
rd"1	*r>2*	439.6496*	285.1425	117.0799*	70.53513
rd"2	*r>3*	322.5696*	239.2354	94.61742*	64.50472
rd"3	*r>4*	227.9522*	197.3709	68.54783*	58.43354

In the long term regional blocks are not showing any sign of Cointegration among them [Ng T.H. 2002] as null hypothesis of no Cointegration can't be rejected by trace and maximum-Eigen value statistic and the markets can drift away arbitrarily. This is in line with Chan *et al.* [1997] that economic or regional ties may not lead the countries to greater co-integration. Results seem to support the hypothesis that less segmented market may lead to greater co-integration [Chan *et al.* 1997] as for Asia as a whole is showing as large as 4 cointegrating factors in DGP (data generation process). It can be inferred from the results that regional impact in Asia is null.

Error Correction Form of standard VAR can provide better set of information regarding short-run dynamics between the series wherein short run deviation in one period is adjusted with lagged value of other variable. Exhibit VII deals with this behavior of markets and if the adjustment coefficient is zero this is same as conducting VAR in first difference. It can be inferred from the results that even if countries are not co-integrated in the long run, but short run dynamics do exist in all the markets.

The orthogonalized procedure of VAR decomposes forecast error variance and shows importance of foreign innovation in explaining variation in other markets. Results in Exhibit VIII shows that markets are pretty exogenous as a very high percentage of variance is explained by its own innovations except Malaysia which prevails to be the most interactive market with large variation being explained by foreign innovation. The result goes against the finding of [Roca *et al.* 1998] wherein Malaysia emerged as least interactive market. Whereas China appears to be most isolated country with larger proportion of its variance being explained by its own shocks [Raju *et al.* 2009]. Hong-Kong accounts for the highest foreign source variance explaining country except for China, Pakistan and Srilanka. Singapore and Malaysia allow free movement of capital in and out of the country and Malaysia has been ranked as highest integrated market by World Bank [1997]. In Southeast Asia and South Asia after Hongkong India emerged as second most influential country due to its higher growth prospects, whereas in East Asia Singapore take the second position after Hong-Kong.

Exhibit VII: Vector Error Correction Causality Test

	Explanatory Variable			
	Southeast Asia			
Market Explained	**MLY**	**IND**	**PHP**	**SG**
MLY	-	-0.004831	0.002726	-0.006021
		[-1.87987]	[1.47973]	[-2.56888]
IND	0.003047	Δ -	-0.000822	-0.001041
	[0.97264]		[-0.89666]	[-1.11362]
PHP	0.003066	0.002633	-	-0.001643
	[-1.52171]	[3.26140]		[-1.31522]
SG	0.001141	0.001594	0.002025	-
	[0.048630]	[2.12796]	[1.69161]	
	South Asia			
	IN	**PKS**	**SH**	
IN	-	-0.001773	-0.002309	
		[-1.38731]	[-1.63919]	
PKS	0.0000	-	-0.002069	
	[0.00281]		[-2.00481]	
SH	-0.001805	-0.000411	-	
	[-1.14086]	[-0.35398]		
	East Asia			
	CH **HK**	**JP**	**KR**	**TW**
CH	- 0.003172	0.003800	-0.003257	-0.000950
	[-2.30369]	[3.58006]	[-2.58995]	[-2.20791]
HK	-0.001740	-	0.002331	-0.003350
	[-1.14108]		[1.28018]	[-1.07700]
JP	0.001092	-0.000990	-	-0.000522
	[1.30915]	[-0.61523]		[-0.57424]
KR	-0.001401	-0.000466	-0.001362	-
	[-0.89491]	[-0.14121]	[-1.6802]	
TW	0.000346	0.000592	-0.002068	0.000956
	[0.82150]	[0.38749]	[-1.35396]	[2.70714]

[t-statistic in parenthesis]

Exhibit VIII: Variance Decomposition Analysis
[10-day Time horizon]

	MLY	IND	PHP	SG	IN	PKS	SH	CH	HK	JP	KR	TW
						Southeast Asia						
MLY	**29.82**	2.66	0.28	1.20	7.73	1.04	0.28	6.94	42.96	1.39	2.32	2.51
IND	0.90	**50.33**	2.04	2.87	7.11	0.73	0.26	3.77	28.60	0.31	1.05	2.03
PHP	0.13	1.66	**68.85**	2.24	1.84	1.74	0.47	2.75	19.01	0.57	0.68	0.04
SG	1.58	3.22	2.88	**36.81**	7.56	0.08	1.32	0.95	42.60	0.78	1.83	0.38
						South Asia						
IN	1.30	0.76	8.02	1.00	**63.11**	0.28	1.62	4.39	17.25	0.69	0.12	1.47
PKS	0.43	0.60	0.48	2.28	3.28	**82.23**	0.19	0.39	5.41	1.84	2.68	0.19
SH	0.17	1.33	1.48	3.61	6.02	1.26	**81.75**	0.44	2.21	0.76	0.60	0.37
						East Asia						
CH	0.40	0.96	0.47	4.37	0.12	2.29	0.16	**89.76**	0.38	0.36	0.24	0.49
HK	3.07	0.58	1.78	4.12	5.96	0.51	0.66	3.23	**78.23**	0.37	0.77	0.69
JP	0.82	3.41	1.77	5.61	7.82	0.06	0.36	0.97	27.63	**51.09**	0.20	0.25
KR	4.22	0.56	7.00	8.55	7.92	0.14	1.20	0.95	32.29	0.94	**36.10**	0.14
TW	0.09	1.07	1.21	10.78	0.61	0.08	0.21	6.59	17.77	0.90	3.20	**57.49**

4. Summary and Conclusion

Growing co-integration wipe out benefit from international diversification, a mechanism to reduce risk of the portfolio below the optimum level attained through local diversification. Hence, plethoras of studies have been conducted to test level of co-movement among the countries. Present study has been conducted with an aim to find out possibilities of regional diversification as opposed to global diversification by testing level of co-integration among the member countries in regional block of Asia. Results suggest that regional co-integration in Asia doesn't exist in the long-run being not even a single co-integrating factor could be detected. However, Asia as a whole is highly co-integrated with as many as four co-integrating factor. The investors residing in developed region such as Malaysia, Singapore, Hong-Kong needs to diversify their funds beyond regional limits as these countries tend to exhibit high level of causality or long-run equilibrium with the other member countries in their respective region. Results sound positive for emerging countries such as Taiwan, Philippines, India, China and Korea due to having long-term impact within their regional blocks which may be the result of constant efforts towards furtherance of liberalization in the restricted markets. This requires more attention with respect to diversifying their funds internationally. Least developed countries such as Pakistan, Srilanka are still providing opportunities in their region as correlation tend to be low with member countries.

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