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COINTEGRATION OF STOCK MARKET RETURNS: A Case of Asian Countries

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The purpose of this study is to investigate the cointegration of stock market returns within and between the developed, emerging and frontier Asian countries for the period 1995 to 2014. The sub-periods including 1997-98 and 2008 to 2011 (crises periods) and 1995-96, 1999 to 2007, and 2012 to 2014 (tranquil periods) are also investigated. Applying the ARDL cointegration approach, the evidence of significant linkage within and between these Asian countries is obtained, over the long-run. Further, the ECM or the VAR techniques for the short-run dynamics, the short-term causal relationships of stock market returns, between most of the sampled Asian stock markets, are also used. It is also observed that those pairs of countries which do not show the stock market returns cointegration in the periods of tranquil; exhibit cointegration in the periods of financial crises, due to contagion or spillover of asset prices. The outcome of this study would be useful for economists, policy makers and investors to assess the international shocks and improve risk management and increase their portfolio diversification benefits.

I. Introduction

During the last few decades the movement towards a harmonized stock market has increased, due to tight economic and financial integration among the worldwide countries. The rise of many emerging economies has opened further channels for cross country relations. Other sources which contribute to integration of economies are technological advances, market liberalization and exclusion of legal control. As countries of the world have become economically integrated, this integration has significant influence on the stock market movements. The financial integration has a crucial role in shock transmission among the countries in accelerating financial crises and has significant implication for portfolio investment [Forbes and Rigobón (2002), Kenourgios and Samitas (2011)]. Any major shock in one country stock market may pass to the stock markets of countries to which it is economically integrated. Thus, the study of cointegration of stock market returns is crucial for understanding the degree of economic integration and interdependency of the stock markets of different economies of the world.

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Asia documents a very dynamic part in a global economy and despite this some countries have slow growth due to slow demand from developed countries. Asian countries rebalanced their source of growth towards regional demand which resulted in cross-border trade and investment which boosted the Asian countries economic integration. The level of economic integration differs in different parts of Asia. East Asia is one of the most integrated economic region in the world due to intertwine of free-trade agreements. South Asia is less economically integrated due to political tension, mistrust and short of infrastructure, connectivity between the countries. Southeast Asian countries show strong intra-regional integration and adopt an outward-oriented strategy under supervision of the Association of Southeast Asian Nations (ASEAN). Central Asian countries have less level of economic integration relative to other parts of Asia, but this integration has the possibility to increase, due to growth in the intraregional trade and investment. Due to difference in the economic integration in different parts of Asia, a natural question arises that; are there any potential portfolio diversifications benefits for international investors in Asia? Therefore, this question accentuates the need to study the cointegration of stock market returns in Asia.

The study of cointegration stock market return takes into consideration whether an investor is interested in short-term or long-term investment [Candelon, et al. (2008)]. Short-term investors are normally interested in high frequencies of cointegration of stock market returns, i.e., short-run fluctuations; whereas, the long-term investors consider the low frequencies of cointegration of stock returns (long-run fluctuations). The second aspect is the identification of contagion which shows that allocation of assets is dependent on regime. The benefits of international portfolio diversification are greater in the period of large shocks than in the period of little turmoil.

The purpose of this study is to examine the cointegration of stock market returns in Asia in short- and long-run using Autoregressive Distributed Lag (ARDL) approach. Most of the past studies on this topic have used the cointegration techniques developed by Engle and Granger (1987), Gregory and Hansen (1996) and Johansen (1988). As revealed by recent literature of different areas the ARDL technique gives reliable estimates than any other cointegration approach. This study contributes to literature of stock market cointegration in twofold. First, contrary to the previous studies, it analyze the cointegration in Asian stock markets over different economic regimes including major crises; i.e., Asian crises 1997, the Russian crises 1998, Global crises 2008 and Euro-zone crises 2011; and in the period of tranquil to get further evidence on Asian stock market cointegration. Second, several research studies including Chiang and Zheng. (2010), Gupta and Donleavy (2009) shows that due to strong stock market integration of developed countries investor prefer to invest in emerging markets. Therefore, investment is floated to emerging markets to avail benefits of international diversifications because they perceive that devel-

oped and emerging markets are less integrated as this concept is further expanded to frontier markets. It analyze the stock market cointegration within and between the developed, emerging and frontier Asian economies because of the difference in basic characteristics of stock markets, such as, market size, liquidity, market accessibility and geographical location.

Initially, the paper presents an introduction in Section I. Literature review is presented in Section II, while the methodology is developed in Section III. Analysis and discussion are presented in Section IV and finally, the paper gives conclusion in Section V.

II. Literature Review

As concerned the stock market integration, the modern portfolio theory by Markowitz (1952) and the Capital Asset Pricing Model (CAPM) developed by Sharpe (1964) and Lintner (1965) emphasized that investors can minimize risk of their portfolios by investing their funds in various categories of assets that would show different behavior to the same events. In line with this, Grubel (1968) and Levy, and Sarnat (1970) argued that normally investors invest in the international market, due to the fact that correlation between assets is less than it is experienced for stocks in domestic market. This low level of cointegration among the international stock market is a key for foreign investment, but this correlation is not constant and changes over time, which affects the concept of risk diversification. Due to increase in globalization, correlation among the international stock market increased during the last two decades, King et al. (1994) made an attempt regarding this but their results did not show any evidence of increased correlation among equity assets. Similar conclusions were drawn by Solnik, et al. (1996) who examined the stock market integration between foreign equities and the US stock market.

The cointegration of stock market returns between the developed economies is strong and list some increase in the recent years. This has made the investors to find emerging stock markets with the hope for weak correlation among such markets and their corresponding developed markets. Various studies reveal that now investors turn their capital towards the emerging markets of developed economies [e.g., Chang, et al. (2008), Gupta and Donleavy, (2009)]. Some studies suggest that financial markets are not much integrated, whereas, other researchers claims that because of the number of factors, financial integration goes up. Voronkova (2004) conducted an empirical study to investigate the long-term stock market integration between emerging economies of Central Europe and the developed economies like Europe and USA, using cointegration technique developed by Gregory and Hansen (1996). The results points out the strong evidence between developed and emerging economies after controlling for structured breaks. Aggarwal and Kyaw (2005) examined the stock market integration in three countries i.e., USA, Canada, and Mex-

ico before and after the creation of NAFTA in 1993. On the basis of Johansen's (1988) cointegration approach, they found the financial integration among them, only after the formation of NAFTA.

Many authors support the concept of diversification in emerging markets. For example, Conover, et al. (2002) suggested that emerging stock markets are valuable for US investor's portfolio of developed countries market stocks. They concluded that when equities of emerging countries are added to the portfolio, returns are raised by approximately 1.5 per cent per annum. Goetzmann and Kumar (2008) pointed out that due to globalization, benefits of diversification are limited and they can be achieved further by future investment in the emerging equity markets. Driessen and Laeven (2007) found that there are huge benefits for international investors in developing economies. The implication of the studies discussed above is that the payback of portfolio diversification increase investment in developed markets by upgrade them into the emerging markets and vice versa.

According to Forbes and Rigobon (2002), there will be a strong relation between the international stock markets during the period of tranquility as well as crisis that can result in lower diversification advantages. In similar context, Arouri, et al. (2013), examined the short-term integration and equity contagion among Latin American and the United States countries over the period 1988 to 2009, using DCC-GARCH model. The outcome of this study showed dynamic cointegration among these markets and in most cases, rejects the hypothesis of contagion for the crises. Kenourgios and Samitas (2011) studied the cointegration among the emerging Balkan stock markets, developed European and the United States markets over the period 2000–2009 using cointegration techniques and the Cappiello, et al. (2006) DCC-GARCH model. The outcome of the study showed long-run linkage among the Balkan stock markets and the high stock market correlation between the regime of 2008 (global financial crisis). The authors emphasized the vital implications of their results for international portfolio diversification. In the recent years, Horvath and Petrovski (2013) investigated the extent of short-run cointegration between Western and South-Eastern European stock markets based on multivariate GARCH model over the period 2006–2011. The results revealed high degree of cointegration among the emerging markets but low linkage between the emerging and developed countries, except in the case of Croatia which showed strong correlation with Western Europe. The astonishing aspect of this study is that global financial crisis of 2008 does not put forth any impact on cointegrations among the stock markets. Gjika and Horvath (2013) worked on the same topic and looked at the short-run cointegrations among the Central Europe and Euro area, using daily stock returns and the DCC-GARCH model, over the period 2001-2011. They found strong cointegration among these markets and the significant impact of global financial crises on the cointegrations. The indication of asymmetry is also found in conditional variance and correlations through stock returns. The findings of the study have

practical implications. It highlights the fact that during the time of instability, the benefits of diversification of investors decreases disproportionally.

Some empirical studies are carried out for Asian countries. Chelley-streely (2004) studied the speed of integration of equity markets among the Asia-Pacific developed and emerging markets. The findings revealed that the speed of integration is faster among the emerging markets than between the developed and emerging markets of the Asia-Pacific region. After the financial crisis of Asian region in 1997, Chi, et al. (2006) confirmed that stock market integration of emerging Asian economies with Japan and United States has increased. Research study by Li, et al. (2008) indicated that integration of financial markets of East Asian countries has improved than before. In the same fashion, Singh, et al. (2010) explored the return and volatility transmission across the stock markets of Asia and North America. Kim, et al. (2006) found lower level of stock market integrations among Asian countries than the international stock market using gravity and consumption risk-sharing models. Jeon, et al. (2006) pointed out that degree of financial integration among the East Asian economies has increased in the recent years. Guillaumin (2009) also found high equity market integration in the East Asia, using Feldstein-Horioka model. Dhanaraj and Gopalaswamy (2013), Loh (2013), and Yu, et al. (2010) explored the stock market integration among various developed and emerging Asian stock markets and found them of different degrees between the developed and emerging equity markets.

Most of the empirical studies do not lead to reliable conclusions about evidence for degree of stock market integration in the Asian region. A good number of studies on issues of financial market integration in Asia proposed that stock markets of Asian countries are only weakly integrated with the region in comparison with global markets, while others show strong integration. The difference in integration can be due to institutional economics, as well as, the political difference among the Asian countries. Further, the cointegration of stock return is regime dependent. Therefore, the current study provide a new look on the cointegration of stock market returns in Asia by classifying Asian countries as developed, emerging and frontier countries. These three groups have different economic situations and stock market characteristics. As opposed to previous studies, the current study also analyze the stock market cointegration during the periods of crises and tranquil to robust the results. Along with the above contribution, the proposed study also has methodological contribution to the literature of cointegration using ARDL model which provides reliable estimates as compared to the other cointegration techniques.

III. Methodology

The proposed study considers the Autoregressive Distributed Lag (ARDL) approach to examine the cointegration of stock market returns in long-run, as well as,

the short-term Granger causality. The ARDL approach was developed by Pesaran, et al. (2001) and has several advantages over the other cointegration techniques. First, the ARDL approach does not require the pre-testing for classification into *I(1)* or *I(0)*, like other cointegration tests and can be applied to variable of order *I(1)* and/or *I(0)*. Second, this model furnishes the evidence of long-term cointegration, as well as, the long-term coefficients. Third, this model avoid problems of endogenous regressors and serial correlation of residuals which are present in techniques like Engle and Granger (1987). Finally, the ARDL approach permits to use different number of lags for different variables which is not possible with other cointegration techniques.

1. The ARDL model for Cointegration

The following ARDL model has been used for analyzing the cointegration between different stock markets:

$$\Delta lnY_t = \alpha+\beta t+\gamma lnY_{t-1}+\sum_{k=1}^{n}\gamma_k lnX_{k,t-1}+\sum_{i=1}^{p}\pi_i \Delta lnY_{t-i}+\sum_{k=1}^{n}\sum_{i=0}^{pk}\theta_k \Delta lnX_{k,t-i}+\varepsilon_t \qquad (1)$$

In the above equation ΔlnY and ΔlnX_k are natural log of dependent and independent variables respectively, where $k=1, 2,....., n$ and n is the number of independent variables; γ and γ_k are long-run while π_i and θ_k are the short-run coefficients. The optimal numbers of lags ($\hat{p}$, $\hat{p}_1$, $\hat{p}_2$, … …, $\hat{p}_n$) are determined using Schwarz Information Criterion.

In order to find cointegration between variables, the null hypothesis is formulated as $\gamma = \gamma_1 = \gamma_2 = ……. = \gamma_n = 0$. For this purpose two sets of critical value *I(0)* and *I(1)* are found. The null hypothesis is rejected if the observed F-statistics is greater than the upper bound critical value. It is concluded that there is cointegration between the variables.

Cointegration results are further proved with following Error correction model:

$$\Delta Y_t = \vartheta\,(1, \hat{p})\, EC_{t-1}+ \delta\Delta v_t + \sum_{j=1}^{\hat{p}-1}\vartheta_j^*\ \Delta Y_{t-j}+\sum_{k=1}^{k}\sum_{j=0}^{\hat{q}-1}\beta_{ij}^*\,\Delta X_{i,t-j}+ \varepsilon_t \qquad (2)$$

where $\vartheta(1,\hat{p})$ shows the speed of adjustment towards long-run equilibrium, ϑ_j^* and β_{ij}^* are short-run coefficients and v_t vector of deterministic variables.

2. The Granger Causality

If the analysis provides the evidence of cointegration between the variables, then Vector Error Correction (VEC) model is used to estimate the Granger causality between the variables. If no evidence of cointegration is found, the Vector Autoregressive (VAR) model is used, provided both variables are *I(1)*. In order to find the

Granger causality between the two variables, the following VEC model is used:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{n} \beta_i \Delta Y_{t-i} + \sum_{i=0}^{n} \varphi_i \ \Delta X_{t-i} + \theta_1 EC_{t-1} + e_t \quad (3)$$

where e_t shows the residuals which are independently and normally distributed (i.i.d), EC_{t-1} is the Error correction term which is the outcome of long-run cointegration relationship. β_i, φ_i and θ_1 are the parameters of interest where θ_1 shows the speed of adjustment towards equilibrium after a shock. The F-statistics of the lagged independent variables reveal the significance of short-term causality. The short-run causality is estimated by H_0:$\varphi_i = 0$.

3. The Sample and Data

This study considers the developed markets (Hong Kong, Japan and Singapore), emerging markets (China, India, Indonesia and Korea) and the frontier markets (Pakistan and Sri Lanka) of Asia over the period January 1995 to December 2014 using daily frequency of data. The return data is taken from Morgan Stanley Capital International (MSCI) database. To avoid heterogeneity across equity markets and currency risk the data is expressed in US dollar. The cointegration during crises (Asian crises 1997, the Russian crises 1998, Global crises 2008 and Euro-zone crises 2011) and the tranquil periods are examined. For this purpose 1997-1998 and 2008-2011 are taken as crises periods and 1995-1996, 1999-2007 and 2012-2014 are taken as tranquil periods.

IV. Analysis and Discussion

The dynamic patterns of stock market returns of the sampled Asian countries is shown in Figure 1, which reveals that stock market returns of all countries experience common trend behavior showing that there is some cointegration relationship between the selected equity markets. All equity markets are highly affected by the Asian Crises of 1997 and the Global Crises of 2008, which gained some recovery in the post crises periods. The time paths of equity returns indicate high instability and volatility in the periods of crises. Thus, the initial analysis indicates that there is a potential cointegration among the developed, emerging and frontier Asian equity markets.

Table 1 shows the descriptive statistics of equity returns over the entire period of study. Hong Kong and Japan equity markets report the highest average equity returns but Japan is the least volatile due to lowest standard deviation in comparison to the other Asian markets which indicate that the stock market of Japan is more attractive for investors on the basis of risk-return trade-off. The coefficient of skewness for most of the equity markets is negative and gives an indication of extensive negative returns. Ex. kurtosis reveals that most of the data sets have platykurtic distribution, i.e., having values wider distributed around the mean.

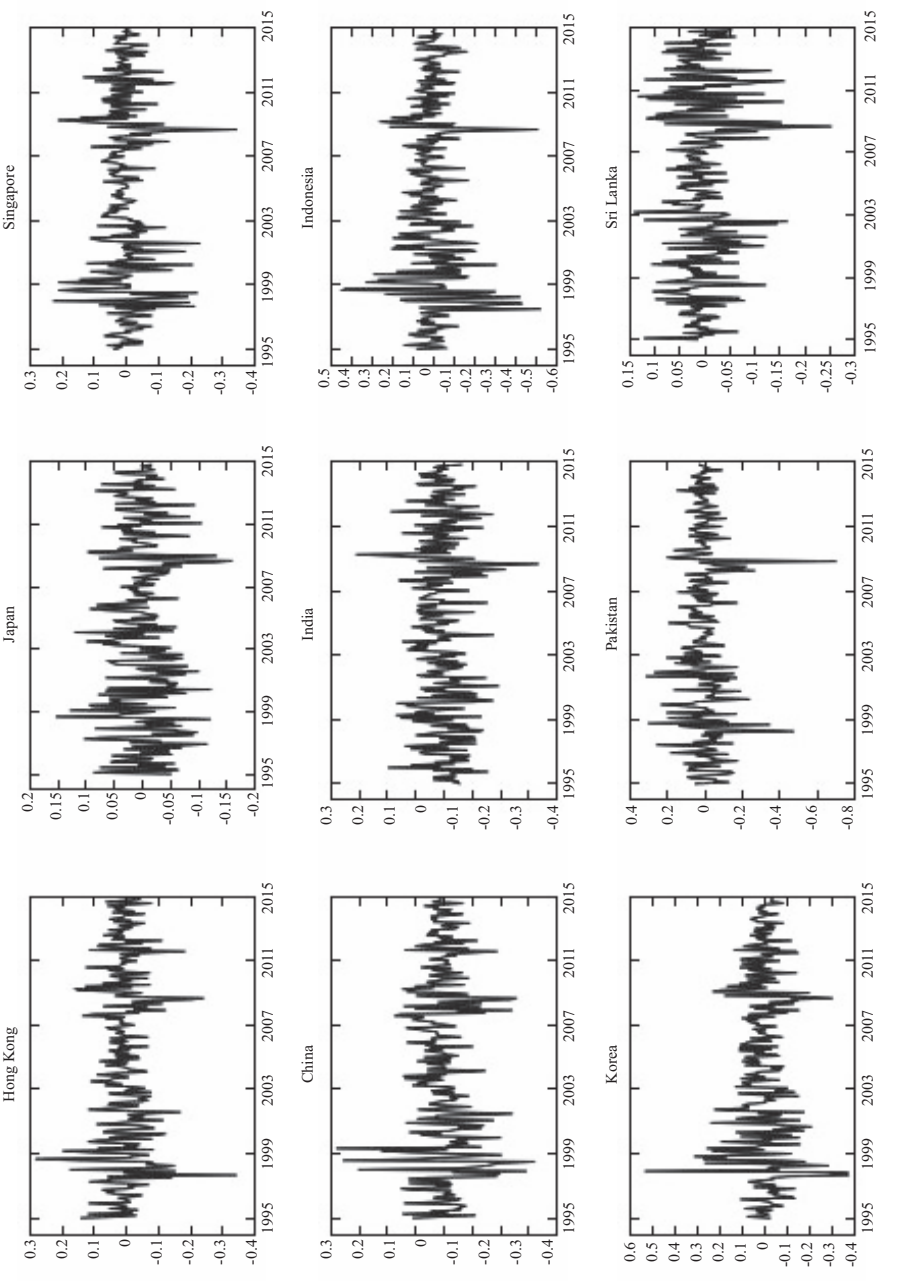

Figure 1

Dynamic Patterns of Stock Market Returns

TABLE 1

Descriptive Statistics of Sampled Asian Countries
Stock Market Returns Over the Entire Period

	Mean	Std. Dev.	C.V.	Skewness	Ex. Kurtosis
Hong Kong	7.253	0.119	0.010	-0.252	-0.298
Japan	6.862	0.044	0.002	-0.322	-0.096
Singapore	6.676	0.050	0.003	0.514	-0.779
China	3.327	0.070	0.014	0.269	-0.780
India	3.841	0.100	0.019	-0.387	-0.721
Indonesia	5.241	0.104	0.013	-0.140	-0.976
Korea	4.173	0.138	0.024	-0.936	0.171
Pakistan	5.177	0.133	0.019	-1.274	1.048
Sri Lanka	3.749	0.148	0.029	-0.029	-0.909

TABLE 2

Unconditional Correlation between the Sampled
Asian Market Returns Over the Entire Period

	Hong Kong	Japan	Singa-pore	China	India	Indo-nesia	Korea	Pak-istan	Sri-Lanka
Hong Kong	1	-	-	-	-	-	-	-	-
Japan	0.372**	1	-	-	-	-	-	-	-
Singapore	0.849**	0.418**	1	-	-	-	-	-	-
China	0.644**	0.474**	0.702**	1	-	-	-	-	-
India	0.788**	0.186**	0.796**	0.538**	1	-	-	-	-
Indonesia	0.734**	0.336**	0.814**	0.777**	0.693**	1	-	-	-
Korea	0.745**	0.238**	0.799**	0.459**	0.816**	0.714**	1	-	-
Pakistan	0.558**	0.450**	0.622**	0.548**	0.604**	0.645**	0.634**	1	-
Sri Lanka	0.675**	0.177**	0.727**	0.614**	0.737**	0.773**	0.721**	0.638**	1

**indicates significance level at 5 per cent.

The unconditional correlation between the different Asian stock markets is depicted in Table 2. The results show that all correlation coefficients are positive which indicate that stock markets are positively correlated with one another. These positive correlations give an initial insight of the stock return cointegration between different Asian stock markets, but this relation cannot be determined with correlation analysis. Therefore, for this purpose, this study further consider the ARDL approach of cointegration in order to gain a valid conclusion about cointegration of the stock market returns.

The ARDL approach cannot be applied to the series if they are integrated of order two or more [Ang (2007)]; therefore, the ADF unit test developed by Said and Dickey (1984), is applied on the series to check whether the ARDL technique can be applied or not. Results of ADF unit root test (Table 3) reports that all series of stock price returns are integrated to order one, I(1), and thus, the ARDL approach can be applied in order to see the cointegration between the stock markets.

First, the developed Asian stock market (Hong Kong, Japan and Singapore) is considered to see whether there is a cointegration of stock market returns between them or not. For this purpose the multivariate cointegration analysis and the bivariate cointegration analysis are performed; for multivariate analysis three models are taken. Model 1: the Hong Kong stock return is taken as dependent variable and the other two markets are as independent variables;[1] Model 2: the Japan stock return is the dependent variable; and Model 3: the Singapore stock market return is the dependent variable. The results of multivariate ointegration analysis (Table 4) reveal that all these three models report the evidence of cointegration between the developed Asian countries over the entire period, as well as in sub-periods; except the tranquil period of 1995-1996. Further, the bivariate analysis in Table 5 also reveals the same results, showing that there is a long-run equilibrium relation between the stock market returns in the developed Asian stock markets. The short-term Granger causality test results (Table 6) show that there is a short-term casualty between the developed Asian countries over the entire period and the sub-periods, particularly in the crises periods except the tranquil period of 1995-1996.

TABLE 3

Augmented Dickey-Fuller Unit Root Tests Over the Entire Period

	At level		At first difference	
	With constant	With constant & trend	With constant	With constant & trend
Hong Kong	-1.746	-2.732	-16.253***	-16.221***
Japan	-2.201	-2.157	-8.512***	-8.533***
Singapore	-1.192	-2.143	-16.472***	-16.465***
China	-1.319	-1.623	-16.476***	-16.522***
India	-0.726	-2.583	-16.531***	-16.511***
Indonesia	-1.094	-2.074	-13.110***	-13.167***
Korea	-1.218	-2.813	-8.981***	-8.980***
Pakistan	-1.919	-2.545	-17.920***	-17.955***
Sri Lanka	-1.301	-2.805	-10.793***	-10.848***

***indicates significance level at 1%.

[1] For all models, Breusch-Godfrey serial correlation LM test and CUSUM stability test was performed (results are not reported here) to check the validity of the models. It was found that all models are correctly specified.

TABLE 4

F-Statistics for Multivariate Cointegration along with Estimates of Error Correction Term (developed-developed countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
Model 1	5.518*	9.028***	6.844**	14.863***	6.890**	6.918**
	(-0.052***)	(-0.110***)	(-0.085***)	(-0.133***)	(-0.065***)	(-0.068***)
Model 2	2.030	5.822*	7.905***	6.928**	5.691*	6.018**
	-	(-0.049***)	(-0.090***)	(-0.056***)	(-0.046***)	(-0.049***)
Model 3	3.866	11.755***	8.993***	12.150***	9.991***	6.047**
	-	(-0.136***)	(-0.105***)	(-0.156***)	(-0.101***)	(-0.057***)

Note: The first value of each model shows the F-statistics and the second value in brackets shows the estimate of error correction term. The lower bound critical values are 4.19 (10%), 4.87 (5%) and 6.34 (1%), whereas the upper bound critical values are 5.06 (10%), 5.85 (5%) and 7.52 (1%), [see Pesaran, et al. (2001)]. ***indicates significance level at 1%, **indicates significance level at 5%, *indicates significance level at 10%.

TABLE 5

F-Statistics for Bivariate Cointegration along with Estimates of Error Correction Term (developed-developed countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
Hong Kong/ Japan	5.214	12.476***	11.401***	15.341***	10.328***	8.914**
	-	(-0.095***)	(-0.082***)	(-0.224***)	(-0.059***)	(-0.061***)
	5.222	11.426***	7.338*	18.030***	6.952*	5.790
	-	(-0.137***)	(-0.012***)	(-0.256***)	(-0.019***)	-
Hong Kong/ Singapore	5.527	10.937***	16.483***	12.283***	14.980***	20.764***
	-	(-0.076***)	(-0.143***)	(-0.113***)	(-0.136***)	(-0.202***)
	5.069	13.888***	18.550***	11.942***	14.176***	17.518***
	-	(-0.222***)	(-0.140)	(-0.214***)	(-0.158***)	(-0.097***)
Japan/ Singapore	7.589**	16.356***	11.879***	10.955***	9.961***	10.334***
	(-0.038***)	(-0.084***)	(-0.130***)	(-0.169***)	(-0.073***)	(-0.116***)
	3.857	12.392***	16.048***	15.330***	15.744***	11.188***
	-	(-0.161***)	(-0.076***)	(-0.226***)	(-0.114***)	(-0.133***)

Note: The first value of each model shows the F-statistics and the second value in brackets shows the estimate of error correction term. Also, in each cell, the first value of F-statistics and ECM term belong to the model when first country equity of the countries equity pair is taken as dependent variable and second value of F-statistics and ECM term belong to the model when second country equity of the countries equity pair is taken as dependent variable. The lower bound critical values are 5.59 (10%), 6.56 (5%) and 8.74 (1%) whereas the upper bound critical values are 6.26 (10%), 7.30 (5%) and 9.63 (1%) [see Pesaran et al. (2001)]. ***indicates significance level at 1%, **indicates significance level at 5%, *indicates significance level at 10%.

TABLE 6

F-Statistics Short-run Granger Causality
(developed-developed countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
Hong Kong/ Japan	1.561[var] 0.148[var]	11.543*** 7.568***	10.811*** 11.280***	1.236 9.030***	11.518*** 7.261***	9.199*** 4.881***[var]
Hong Kong/ Singapore	1.650[var] 2.166[var]	10.825*** 11.158***	11.398*** 12.821***	11.769*** 10.823***	10.415*** 7.505***	10.685*** 8.951***
Japan/ Singapore	2.404[var] 0.826[var]	13.163*** 11.261***	7.649*** 10.093***	7.858*** 9.170***	6.543*** 9.234***	11.670*** 2.810

Note: In each cell, the first value of F-statistics belongs to the model when first country equity of the countries equity pair is taken as dependent variable and second value of F-statistics belong to the model when second country equity of the countries equity pair is taken as dependent variable. [var] indicates Granger causality estimated by VAR model, ***indicates significance level at 1%, **indicates significance level at 5%.

TABLE 7

F-Statistics for Multivariate Cointegration along with Estimates of
Error Correction Term (emerging-emerging countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
Model 4	1.670 -	10.914*** (-0.140***)	9.903*** (-0.098***)	11.709*** (-0.149***)	4.045	13.039*** (-0.123***)
Model 5	1.387 -	11.788*** (-0.178***)	10.928*** (-0.079***)	13.629*** (-0.231***)	6.809*** (-0.060***)	9.970*** (-0.095***)
Model 6	1.862 -	13.845*** (-0.159***)	13.401*** (-0.116***)	15.804*** (-0.265***)	2.939	11.115*** (-0.101***)
Model 7	2.570 -	10.145*** (-0.153***)	9.554*** (-0.064***)	17.096*** (-0.224***)	6.655*** (-0.048***)	8.928*** (-0.076***)

Note: The first value of each model shows the F-statistics and the second value in brackets shows the estimate of error correction term. The lower bound critical values are 3.47 (10%), 4.01 (5%) and 5.17 (1%) whereas the upper bound critical values are 4.45 (10%), 5.07 (5%) and 6.36 (1%); [see Pesaran et al. (2001)]. ***indicates significance level at 1%, **indicates significance level at 5%, *indicates significance level at 10%.

Second, the emerging Asian stock markets (China, India, Indonesia and Korea) have been taken to investigate the cointegration of stock market returns between them. Table 7 depicts multivariate analysis where four models are considered, i.e., Model 4: the Chinese stock price is the dependent variable and the other three equities are independent variables; Model 5: the Indian stock price is taken as dependent variable; Model 6: the Indonesian stock price is the dependent variable; and, Model 7: the Korean stock price is taken as dependent variable. The results indicate that taking Hong Kong stock returns and Indonesian stock returns as dependent variables (Models 4 and 6), the cointegration is found for the entire period and the three sub-periods (1997-1998 and 2008-2011; and the tranquil period 1999-2007) but however find no evidence of cointegration are found in tranquil periods of 1995-1996 and 2012-2014. Taking the stock market returns of India and Korea (Model 5 and 7), the analysis shows that there is a cointegration relationship between all the emerging Asian markets over the entire period and the sub-periods except the tranquil period of 1995-1996. The bivariate analysis (Table 8) shows that all pairs of stock market returns of emerging Asian countries reveal cointegration over the entire period and the three sub–periods (crises periods of 1997-1998 an-d 2008-2011; tranquil period 1999-2007). The bivariate cointegration in tranquil periods of 1995-1996 and 2012-2014, except one pair, i.e., India/China. The results show much more opportunity of diversification for international investors having emerging countries portfolios during the tranquil period. Table 9 depicts the short-term causality of stock market return between the emerging countries of Asia. The results provide evidence of short-term causality relationship between the emerging Asian countries.

Third, the stock market return cointegration was analyzed between the frontier Asian countries (Pakistan and Sri Lanka). Table 10 reports a long-term cointegration relationship between the stock market returns of frontier Asian countries over the entire period and the sub-periods of the study in both cases, i.e., taking Sri Lankan stock price and Pakistan stock price as dependent variables. The short-term Granger causality results indicate that there is a short-term causality relationship of stock market return between the frontier Asian countries over the entire period and in the sub-periods.

Fourth, the developed and emerging Asian stock markets are considered to see whether there is a cointegration of stock market returns between them or not. For the purpose of multivariate analysis four models are taken, i.e., Model 8: the China stock return is taken as dependent variable and the four developed market returns are taken as independent variables; Model 9: the Indian stock return is the dependent variable; Model 10: the Indonesian stock market return is the dependent variable; Model 11: the Korean stock price is taken as dependent variable. Results in Table 12 indicate that taking Hong Kong stock returns and Korean stock returns, as dependent variables (Models 8 and 11), cointegration is found over the entire periods

and three sub-periods (crises period of 1997-1998 and 2008-2011; tranquil period 1999-2007) but there is no evidence of cointegration in tranquil periods of 1995-1996 and 2012-2014. Taking the stock market returns of India and Indonesia (Model 9 and 10) the analysis shows that there is cointegration between all the developed and emerging Asian markets, over the entire period and the sub-periods, except the tranquil period of 1995-1996. The bivariate analysis in Table 13 shows that all pairs of stock market returns of developed and emerging Asian countries reveal cointegration over the entire period and over the crises periods; but most of the developed and emerging countries pairs do not show cointegration in tranquil periods. This indicates that shocks are transmitted more frequently between the developed and emerging Asian countries only in the periods of crises and not in the periods of peace. Thus, the international investors should have an opportunity to gain diversification benefits in tranquil period when they consider the equities of developed and emerging Asian countries as part of their portfolios.

Results of the short-term Granger causality tests (Table 14) shows the short-term causality between the developed and emerging Asian countries over the entire period and the sub-periods, particularly in the crises periods. Although, we do not find the long-term equilibrium relationship between the developed and emerging Asian countries during the tranquil period of 1995-1996, yet there is a short-term causality between some pairs like Indonesia/Hong Kong, Korea/Hong Kong, Korea/Japan and China/Singapore, during this period. Another important finding is obtained from the cointegration analysis between stock market returns of developed and emerging countries. The developed and emerging pairs showing cointegration can be seen in most cases where unidirectional causality is found, i.e., the emerging stock market is taken as dependent variable and the developed stock market returns as explanatory variable, but not in the opposite case. Thus, it shows the dominant nature of developed Asian stock markets over the emerging markets.

Fifth, the developed and frontier Asian stock markets are taken to investigate the cointegration of stock market returns between them. Table 15 depicts the multivariate analysis where two models are considered, i.e., Model 12: the Pakistani stock price is the dependent variable and the three developed equities are independent variables; Model 13: the Sri Lankan stock price is taken as dependent variable. The results of multivariate cointegration analysis reveals that the two models report evidence of cointegration among the developed and frontier Asian countries over the entire period, as well as, in the sub-periods except the tranquil period of 1995-1996. Furthermore, the bivariate analysis in Table 16 also reveals the same result, showing that there is a long-run cointegration of stock market returns between the developed and frontier Asian stock markets, except the tranquil period of 1995-1996. Here, it can also be seen that in most cases the cointegration relationship is found when frontier stock return is taken as dependent variable, but no cointegration is found when the developed stock return is considered as dependent variable. Thus,

TABLE 8

F-Statistics for Bivariate Cointegration along with Estimates of Error Correction Term (emerging-emerging countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
India/	6.046	13.617***	8.849**	17.773***	7.052**	11.361***
China	-	(-0.161***)	(-0.101***)	(-0.168***)	(-0.078***)	(-0.113***)
	5.483	11.643***	8.201**	16.430***	8.113**	7.906**
	-	(-0.099***)	(-0.077***)	(-0.153***)	(-0.082***)	(-0.071***)
Indonesia/	4.063	15.001***	10.289***	10.933***	4.173	11.841***
China	-	-0.180***)	(-0.163***)	(-0.144***)	-	(-0.157***)
	6.646	12.216***	7.103*	8.689**	3.633	9.459***
	-	(-0.110***)	(-0.062***)	(-0.098***)	-	(-0.133***)
Korea/	4.295	11.608***	11.533***	13.108***	5.106	7.956**
China	-	(-0.153***)	(-0.138***)	(-0.144***)	-	(-0.061***)
	5.881	9.031**	8.127**	9.130**	4.165	5.863
	-	(-0.138***)	(-0.059***)	(-0.121***)	-	-
India/	5.789	7.403**	7.778**	13.711***	4.104	10.556***
Indonesia	-	(-0.063***)	(-0.054***)	(-0.164***)	-	(-0.167***)
	3.489	10.438***	6.549*	11.523***	4.431	8.716**
	-	(-0.098***)	(-0.026***)	(-0.133***)	-	(-0.093***)
India/	6.389	7.876**	10.470***	10.578***	6.024	14.519***
Korea	-	(-0.051***)	(-0.137***)	(-0.152***)	-	(-0.154***)
	5.333	8.119**	9.843***	7.754**	5.033	11.957***
	-	(-0.066***)	(-0.093***)	(-0.074***)	-	(-0.116***)
Indonesia/	3.928	11.493***	8.969**	6.934*	4.441	8.377**
Korea	-	(-0.098***)	(-0.105***)	(-0.068***)	-	(-0.148***)
	6.658	9.298**	11.283***	8.547**	3.344	10.793***
	-	(-0.083***)	(-0.153***)	(-0.123***)	-	(-0.178***)

Note: The first value of each model shows the F-statistics and the second value in brackets shows the estimate of error correction term. Also, in each cell, the first value of F-statistics and ECM term belong to the model when first country equity of the countries equity pair is taken as dependent variable and second value of F-statistics and ECM term belong to the model when second country equity of the countries equity pair is taken as dependent variable. The lower bound critical values are 5.59 (10%), 6.56 (5%) and 8.74 (1%) whereas the upper bound critical values are 6.26 (10%), 7.30 (5%) and 9.63 (1%) [see Pesaran et al. (2001)]. ***indicates significance level at 1%, **indicates significance level at 5%, *indicates significance level at 10%.

TABLE 9

F-Statistics Short-run Granger Causality
(emerging-emerging countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
India/	1.151[var]	11.368***	10.743***	12.898***	8.761***	12.558***
China	1.521[var]	8.635***	8.181***	8.793***	1.245	9.920***
Indonesia/	1.467[var]	11.136***	7.564***	13.670***	3.696***[var]	8.629***
China	1.590[var]	7.970***	4.533**	14.921***	2.064[var]	11.025***
Korea/	1.735[var]	10.183***	10.069***	8.682***	4.007***[var]	9.942***
China	1.396[var]	6.370***	5.408***	11.151***	2.711[var]	4.385***[var]
India/	0.768[var]	13.529***	8.960***	11.055***	1.257[var]	13.839***
Indonesia	1.285[var]	9.150***	7.530***	9.112***	0.901[var]	5.755***
India/	0.989[var]	8.907***	11.101***	12.715***	6.161***	8.748***
Korea	0.911[var]	10.032***	10.693***	7.561***	1.162[var]	1.801
Indonesia/	1.405[var]	11.112***	11.325***	15.885***	1.020[var]	15.192***
Korea	1.544[var]	8.146***	10.307***	14.926***	1.982[var]	9.950***

Note: In each cell, the first value of F-statistics belongs to the model when first country equity of the countries equity pair is taken as dependent variable and second value of F-statistics belong to the model when second country equity of the countries equity pair is taken as dependent variable. [var] indicates Granger causality estimated by VAR model, ***indicates significance level at 1%, **indicates significance level at 5%.

TABLE 10

F-Statistics for Bivariate Cointegration along with Estimates
of Error Correction Term (frontier-frontier countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
Pakistan/	7.185*	11.403***	11.774***	8.461**	14.473***	9.607**
Sri Lanka	(-0.063***)	(-0.135***)	(-0.119***)	(-0.124***)	(-0.116***)	(-0.070***)
	6.449*	16.229***	15.401***	11.469***	8.173**	14.678***
	(-0.049***)	(-0.161***)	(-0.146***)	(-0.139***)	(-0.051***)	(-0.115***)

Note: The first value of each model shows the F-statistics and the second value in brackets shows the estimate of error correction term. Also, in each cell, the first value of F-statistics and ECM term belong to the model when first country equity of the countries equity pair is taken as dependent variable and second value of F-statistics and ECM term belong to the model when second country equity of the countries equity pair is taken as dependent variable. The lower bound critical values are 5.59 (10%), 6.56 (5%) and 8.74 (1%) whereas the upper bound critical values are 6.26 (10%), 7.30 (5%) and 9.63 (1%); [see Pesaran et al. (2001)]. ***indicates significance level at 1%, **indicates significance level at 5%, *indicates significance level at 10%.

TABLE 11

F-Statistics Short-run Granger Causality
(frontier-frontier countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
Pakistan/	1.865	10.098***	6.578***	11.627***	1.405	9.106***
Sri Lanka	1.780	11.63***	7.043***	13.783***	1.739	10.834***

Note: In each cell, the first value of F-statistics belongs to the model when first country equity of the countries equity pair is taken as dependent variable and second value of F-statistics belong to the model when second country equity of the countries equity pair is taken as dependent variable. ^{var} indicates Granger causality estimated by VAR model, ***indicates significance level at 1%, **indicates significance level at 5%.

TABLE 12

F-Statistics for Multivariate Cointegration along with Estimates
of Error Correction Term (developed-emerging countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
Model 8	3.649	9.334***	4.743*	7.251***	5.390**	6.362***
	-	(-0.124***)	(-0.070***)	(-0.089***)	(-0.078***)	(-0.082***)
Model 9	3.167	8.627***	6.272**	7.931***	1.844	7.214***
	-	(-0.118***)	(-0.103***)	(-0.150***)	-	(-0.105***)
Model 10	1.508	8.186***	6.958***	11.670***	3.392	6.470***
	-	(-0.101***)	(-0.070***)	(-0.165***)	-	(-0.067***)
Model 11	2.279	8.797***	2.017	10.528***	5.297**	5.593***
	-	(-0.165***)	-	(-0.185***)	(-0.076***)	(-0.080***)

Note: The first value of each model shows the F-statistics and the second value in brackets shows the estimate of error correction term. The lower bound critical values are 3.47 (10%), 4.01 (5%) and 5.17 (1%) whereas the upper bound critical values are 4.45 (10%), 5.07 (5%) and 6.36 (1%); [see Pesaran et al. (2001)]. ***indicates significance level at 1%, **indicates significance level at 5%, *indicates significance level at 10%.

TABLE 13

F-Statistics for Bivariate Cointegration along with Estimates of Error Correction Term (developed-emerging countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
China/	3.993	9.912***	6.988*	11.258***	10.845***	9.387**
Hong Kong	-	(-0.105***)	(-0.051***)	(-0.138***)	(-0.103***)	(-0.106***)
	4.261	11.610***	4.898	9.250**	11.856***	7.780**
	-	(-0.185***)	-	(-0.122***)	(-0.137***)	(-0.055***)
India/	4.218	9.304**	11.062***	10.645***	7.451**	14.337***
Hong Kong	-	(-0.087***)	(-0.110***)	(-0.140***)	(-0.067***)	(-0.138***)
	2.653	8.663**	8.650**	7.861**	4.154	11.083***
	-	(-0.074***)	(-0.066***)	(-0.106***)	-	(-0.123***)
Indonesia/	5.978	6.679*	7.705**	13.166***	4.249	11.153***
Hong Kong	-0.037	(-0.049***)	(-0.091***)	(-0.172***)	-	(-0.138***)
	4.182	5.602	3.722	10.345***	4.828	8.029**
	-	-	-	(-0.107***)	-	(-0.123***)
Korea/	4.816	15.006***	10.717***	15.264***	10.105	12.562***
Hong Kong	-	(-0.164***)	(-0.079***)	(-0.170***)	(-0.146***)	(-0.157***)
	3.914	11.702***	9.185**	11.022***	8.662**	9.093**
	-	(-0.146***)	(-0.073***)	(-0.146***)	(-0.113***)	(-0.095***)
China/	3.418	10.526***	4.706	12.973***	10.971***	11.772***
Japan	-	(-0.133***)	-	(-0.149***)	(-0.097***)	(-0.117***)
	4.094	7.204*	6.733*	10.679***	8.533**	7.303**
	-	(-0.057***)	(-0.038***)	(-0.102***)	(-0.118***)	(-0.054***)
India/	4.815	12.677***	7.650**	14.062***	5.846	7.498**
Japan	-	(-0.155***)	(-0.041***)	(-0.170***)	-	(-0.049***)
	2.637	10.117***	3.721	9.315***	4.021	7.114*
	-	(-0.095***)	-	(-0.114***)	-	(-0.045***)
Indonesia/	4.581	11.468***	10.940***	11.886***	4.582	7.907**
Japan	-	(-0.135***)	(-0.107***)	(-0.142***)	-	(-0.049***)
	3.113	9.258**	9.385**	9.359**	4.890	5.889
	-	(-0.082***)	(-0.079***)	(-0.078***)	-	-
Korea/	4.675	9.698***	6.785*	10.023***	7.114*	6.682*
Japan	-	(-0.104***)	(-0.045***)	(-0.095***)	(-0.042***)	(-0.039***)
	5.318	6.434*	7.727**	8.328**	3.890	2.561
	-	(-0.077***)	(-0.047***)	(-0.070***)	-	-
China/	2.730	8.892**	12.269***	13.772***	6.411*	11.498***
Singapore	-	(-0.124***)	(-0.165***)	(-0.155***)	(-0.051***)	(-0.169***)
	4.334	7.989**	10.234***	10.692***	4.103	8.980**
	-	(-0.105***)	(-0.119***)	(-0.142***)	-	(-0.146***)
India/	4.729	10.082***	7.533**	14.554***	7.502**	10.846***
Singapore	-	(-0.109***)	(-0.065***)	(-0.158***)	(-0.066***)	(-0.091***)
	4.882	9.162**	6.822*	11.379***	6.107	8.778***
	-	(-0.086***)	(-0.055***)	(-0.129***)	-	(-0.074***)
Indonesia/	5.602	12.291***	11.034***	14.651***	3.658	9.692***
Singapore	-	(-0.154***)	(-0.079***)	(-0.176***	-	(-0.078***)
	3.380	11.153***	9.306**	13.210***)	4.766	7.877**
	-	(-0.119***)	(-0.058***)	(-0.140***	-	(-0.050***)
Korea/	4.822	14.007***	10.093***	10.506***	7.556**	12.822***
Singapore	-	(-0.139***)	(-0.090***)	(-0.170***)	(-0.046***)	(-0.138***)
	3.489	9.323**	7.775**	8.678**	4.891	10.908***
	-	(-0.114***)	(-0.045***)	(-0.099***)	-	(-0.085***)

Note: The first value of each model shows the F-statistics and the second value in brackets shows the estimate of error correction term. Also, in each cell, the first value of F-statistics and ECM term belong to the model when first country equity of the countries equity pair is taken as dependent variable and second value of F-statistics and ECM term belong to the model when second country equity of the countries equity pair is taken as dependent variable. The lower bound critical values are 5.59 (10%), 6.56 (5%) and 8.74 (1%) whereas the upper bound critical values are 6.26 (10%), 7.30 (5%) and 9.63 (1%); [see Pesaran et al. (2001)]. ***indicates significance level at 1%, **indicates significance level at 5%, *indicates significance level at 1%.

TABLE 14

F-Statistics Short-run Granger Causality
(developed-emerging countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
China/	2.470^{var}	9.409***	9.889***	11.310***	7.501***	11.105***
Hong Kong	1.222^{var}	6.152***	1.860	8.653***	1.205	9.989***
India/	1.424^{var}	13.637***	8.188***	11.941	9.427***	13.034***
Hong Kong	1.549^{var}	9.863***	7.841***	7.639***	1.770^{var}	7.334***
Indonesia/	5.932***^{var}	10.064***	9.154***	10.622***	1.531^{var}	10.027***
Hong Kong	1.206^{var}	6.201***	4.784***	8.201***	1.663^{var}	11.590***
Korea/	5.630 ***^{var}	10.945***	16.391***	10.933***	9.077***	12.628***
Hong Kong	1.780^{var}	6.400***	12.268***	9.988***	1.295	1.469
China/	1.325^{var}	8.686***	4.762***^{var}	9.055***	8.794***	11.098***
Japan	1.787^{var}	7.625***	10.112***	8.858***	10.742***	8.831***
India/	1.432^{var}	10.114***	11.215***	12.211***	5.366***^{var}	13.590***
Japan	1.540^{var}	7.909***	4.451***^{var}	7.614***	1.451^{var}	2.054
Indonesia/	1.872^{var}	13.279***	11.801***	11.250***	1.316^{var}	9.182***
Japan	1.596^{var}	8.822***	1.229	5.818***	1.889^{var}	1.234^{var}
Korea/	4.240***^{var}	12.431***	11.200***	10.625***	10.382***	7.602***
Japan	1.276^{var}	11.166***	2.018	8.954***	4.330***^{var}	5.836***^{var}
China/	4.271***^{var}	9.190***	11.225***	9.190***	11.498***	11.822***
Singapore	1.716^{var}	10.968***	8.827***	7.637***	1.042^{var}	9.466***
India/	1.229^{var}	10.022***	9.606***	11.944***	9.907***	10.142***
Singapore	1.722^{var}	9.959***	1.837	9.028***	4.310***^{var}	9.066***
Indonesia/	2.189^{var}	13.422***	13.624***	11.189***	1.243^{var}	12.582***
Singapore	2.140^{var}	8.834***	10.264***	9.046***	1.147^{var}	1.572
Korea/	1.654^{var}	12.584***	9.182***	11.866***	8.987***	8.309***
Singapore	1.566^{var}	9.218***	1.483	6.655***	2.023^{var}	9.149***

Note: In each cell, the first value of F-statistics belongs to the model when first country equity of the countries equity pair is taken as dependent variable and second value of F-statistics belong to the model when second country equity of the countries equity pair is taken as dependent variable. ^{var} indicates Granger causality estimated by VAR model, ***indicates significance level at 1%, **indicates significance level at 5%.

TABLE 15

F-Statistics for Multivariate Cointegration along with Estimates of Error Correction Term (developed-frontier countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
Model 12	1.668	6.526***	5.930**	6.614***	5.101**	7.422***
	-	(-0.090***)	(-0.068***)	(-0.099***)	(-0.062***)	(-0.109***)
Model 13	1.950	7.755***	6.177**	6.934***	4.524*	7.593***
	-	(-0.123***)	(-0.071***)	(-0.081***)	(-0.038***)	(-0.141***)

Note: The first value of each model shows the F-statistics and the second value in brackets shows the estimate of error correction term. The lower bound critical values are 3.47 (10%), 4.01 (5%) and 5.17 (1%) whereas the upper bound critical values are 4.45 (10%), 5.07 (5%) and 6.36 (1%); [see Pesaran et al. (2001)]. ***indicates significance level at 1%, **indicates significance level at 5%, *indicates significance level at 10%.

indicating that frontier markets are significantly influenced by changes in the stock returns of developed Asian countries.

Table 17 depicts the short-term causality relationship of stock market returns between the developed and frontier countries of Asia. The results provide evidence of short-term causality between the emerging Asian countries, except the tranquil period of 1995-1996. Furthermore, over the entire period and the periods of tranquil, there is mostly the unidirectional short-term causality running from developed to frontier Asian countries showing that any shock in the stock prices of developed Asian countries has significant impact on stock prices of frontier Asian countries in short-term. However, changes in the stock prices of frontier Asian countries have no impact on stock prices of developed Asian countries.

Finally, it is analyzed that stock market return cointegration between the emerging and frontier Asian countries. Table 18 reports the multivariate cointegration analysis. Results of Model 18 (taking Pakistani stock return as dependent variable) indicate that there is a long-run cointegration relationship between Pakistani and the emerging stock markets over the entire period and in the three sub-periods (crises period of 1997-1998 and 2008-2011; tranquil period 1999-2007). However, there is no cointegration relation between them in tranquil periods of 1995-1996 and 2012-2014. Similarly, taking the stock market returns of Sri Lanka, the results of Model 15 reveals cointegration relationship between the equity returns and the emerging Asian stock returns. The bivariate analysis between the frontier and emerging Asian stock markets (Table 19) depicts that all the emerging frontier stock market pairs show cointegration in all the sub-pairs, over the entire period except Pakistan/Indonesia and Sri Lanka/Indonesia pairs. They show no cointegration be-

tween them in the tranquil period of 1995-1996 and 2012-2014. The short-term Granger causality results are shown in Table 20, which indicate that there is a short-term causality of stock market return between the emerging and frontier Asian countries over the entire period and in the sub-periods.

The existence of stock market cointegration across Hong Kong, Japan and Singapore is due to the fact that these countries have very strong trade, investment and

TABLE 16

F-Statistics for Bivariate Cointegration along with Estimates of Error Correction Term (developed-frontier countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
Pakistan/	2.867	13.413***	7.461**	11.259***	12.220***	8.023**
Hong Kong	-	(-0.152***)	(-0.051***)	(-0.149***)	(-0.165***)	(-0.044***)
	4.136	6.528*	3.428	9.748***	3.118	6.956*
	-	(-0.065***)	-	(-0.114***)	-	(-0.039***)
Sri Lanka/	4.329	13.276***	7.772**	11.952***	16.196***	12.368***
Hong Kong	-	(-0.119***)	(-0.064***)	(-0.137***)	(-0.152***)	(-0.082***)
	3.482	8.727**	3.627	10.106***	11.143***	4.263
	-	(-0.078***)	-	(-0.099***)	(-0.088***)	-
Pakistan/	3.728	10.941***	7.979**	12.193***	11.666***	7.168*
Japan	-	(-0.112***)	(-0.064***)	(-0.169***)	(-0.118***)	(-0.060***)
	2.960	8.890**	6.460*	8.544**	8.188**	6.147
	-	(-0.078)	(-0.400***)	(-0.113***)	(-0.063***)	-
Sri Lanka/	4.458	11.954***	8.953**	14.995***	8.077**	5.636
Japan	-	(-0.163***)	(-0.137***)	(-0.126***)	(-0.068***)	-
	4.262	7.122*	1.684	12.112***	3.430	3.578
	-	(-0.049***)	-	(-0.097***)	-	-
Pakistan/	6.104	13.202***	7.019*	16.117***	5.760	8.146**
Singapore	-	(-0.146***)	(-0.061***)	(-0.173***)	-	(-0.069***)
	4.887	7.777**	4.448	13.862***	2.702	3.436
	-	(-0.069***)	-	(-0.153***)	-	-
Sri Lanka/	3.935	9.813***	7.789**	12.471***	6.005	9.456**
Singapore	-	(-0.053***)	(-0.072***)	(-0.134***)	-	(-0.064***)
	3.680	7.946**	3.539	10.726***	4.193	4.638
	-	(-0.078***)	-	(-0.112***)	-	-

Note: The first value of each model shows the F-statistics and the second value in brackets shows the estimate of error correction term. Also, in each cell, the first value of F-statistics and ECM term belong to the model when first country equity of the countries equity pair is taken as dependent variable and second value of F-statistics and ECM term belong to the model when second country equity of the countries equity pair is taken as dependent variable. The lower bound critical values are 5.59 (10%), 6.56 (5%) and 8.74 (1%), whereas the upper bound critical values are 6.26 (10%), 7.30 (5%) and 9.63 (1%); [see Pesaran et al. (2001)]. ***indicates significance level at 1%, **indicates significance level at 5%, *indicates significance level at 10%.

TABLE 17

F-Statistics Short-run Granger Causality
(developed-frontier countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
Pakistan/ Hong Kong	1.455[var] 1.038[var]	8.365*** 6.323***	7.503*** 1.536[var]	8.168*** 7.658***	6.924*** 1.458[var]	6.109*** 1.254
Sri Lanka/ Hong Kong	1.290[var] 0.999[var]	10.237*** 6.608***	7.617*** 0.974[var]	8.951*** 7.673***	6.358*** 1.227	7.047*** 1.090[var]
Pakistan/ Japan	0.872[var] 0.580[var]	10.622*** 8.168***	6.809*** 1.276	8.030*** 6.876***	7.188*** 1.024	6.251*** 1.405[var]
Sri Lanka/ Japan	1.407[var] 0.915[var]	7.596*** 6.289***	6.052*** 1.604[var]	8.126*** 6.937***	6.702*** 1.583[var]	4.511***[var] 1.446[var]
Pakistan/ Singapore	3.923[var] 0.605[var]	6.269*** 6.615***	6.404*** 4.996***[var]	7.304*** 7.514***	5.355***[var] 1.109[var]	6.521*** 1.069[var]
Sri Lanka/ Singapore	1.029[var] 1.417[var]	7.922*** 8.651***	7.214 0.841[var]	7.433*** 9.056***	1.603[var] 1.384[var]	6.169*** 0.860[var]

Note: In each cell, the first value of F-statistics belongs to the model when first country equity of the countries equity pair is taken as dependent variable and second value of F-statistics belong to the model when second country equity of the countries equity pair is taken as dependent variable. [var] indicates Granger causality estimated by VAR model, ***indicates significance level at 1%, **indicates significance level at 5%.

TABLE 18

F-Statistics for Multivariate Cointegration along with Estimates
of Error Correction Term (emerging-frontier countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
Model 14	3.194 -	17.174*** (-0.256***)	9.959*** (-0.139***)	17.348*** -0.281	1.705 -	11.173*** (-0.090***)
Model 15	6.389*** (-0.050***)	9.239*** (-0.208***)	8.677*** (-0.122***)	12.152*** (-0.221***)	9.949*** (-0.071***)	12.155*** (-0.107***)

Note: The first value of each model shows the F-statistics and the second value in brackets shows the estimate of error correction term. The lower bound critical values are 3.03 (10%), 3.47 (5%) and 4.40 (1%), whereas the upper bound critical values are 4.06 (10%), 4.57 (5%) and 5.72 (1%) [see Pesaran et al. (2001)]. ***indicates significance level at 1%, **indicates significance level at 5%, *indicates significance level at 10%.

economic ties. Organizations, such as, Association of the Southeast Asian Nations (ASEAN), Hong Kong-Japan Business Co-operation Committee (HK-JBCC), the Japan-Hong Kong Business Co-operation Committee (J-HKBCC) and the Japan Singapore New-Age Economic Partnership Agreement (JSEPA) plays a curial role in economic and financial integration among these developed Asian countries. Due to the characteristics of high liquidity and low transaction costs, the developed stock markets of Asia are the dominant markets and have the capacity to generate significant information in the Asian region. Because of this reason many emerging and frontier Asian stock markets are being led by these stock markets.

As concern the emerging markets, the Chinese stock market integration with other Asian stock markets, China has always laid restrictions on inflow and outflow of money except payments which are linked with imports and exports. However, after the financial crises of 1997, China has taken some measures to remove restrictions over the capital account that resulted in the free long-term capital flows. In recent years China has adopted the strategy of selective liberalization and making progress to reduce control over the capital outflow. These reforms, in financial sector lead to openness of Chinese stock market to the foreign investors making Chinese stock prices more informative.

India has various bilateral trade and economic agreements with Asian countries. More than 1,000 foreign institutional investors participated in the Indian stock market and accounts for three-fourth of the daily trading activities. As the foreign investors operate in more than one country at the same time, the operation of foreign investors, bilateral trade and economic agreements of India contribute to its integration with other Asian stock markets. Taking the case of Korea, it also shows strong cointegration with developed, emerging and frontier Asian countries. The strong cointegration may be attributed to the fact that this country liberalized its capital account and implemented a free float exchange rate system after the Asian crises of 1997 which drastically increased the inflow and outflow of capital and the proportion of foreign shareholders in the equity market. Along with the equity market, the bond market of Korea also received tremendous flow of capital and foreign held share.

Like other emerging countries, Pakistan adopted the policies of liberalization and financial sector reforms in 1990s. These reforms contribute significantly to the economic growth of Pakistan and improved the credit rating of the country. This leads to gain the confidence of foreign investors. Further, improving relationship with other countries, offerings the successful GDR, boost in the coverage of Pakistan by foreign firms, foreign investment banks and diminishing investment barriers have significant contribution to integration of Pakistani stock market to other Asian stock markets. As concern Sri Lanka, its stock market has increased the number of foreign investors for the last two decades; after signing the cease fire agreement by the Government. There are no restrictions on investment in Sri Lankan stock market for foreigners. Also, Sri Lanka is an active member of the World Fed-

TABLE 19

F-Statistics for Bivariate Cointegration along with Estimates of error Correction Term
(emerging-frontier countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
Pakistan/ China	6.778*	15.513***	11.879***	11.159***	8.803**	15.632***
	(-0.044***)	(-0.151***)	(-0.105***)	(-0.126***)	(-0.098***)	(-0.113***)
	6.226	12.411***	8.337**	9.679***	7.895**	8.587***
	-	(-0.098***)	(-0.073***)	(-0.065***)	(-0.062***)	(-0.076***)
Sri Lanka/ China	9.013**	9.477**	7.728**	13.589***	7.153*	11.182***
	(-0.085***)	(-0.153***)	(-0.091***)	(-0.098***)	(-0.073***)	(-0.103***)
	6.968*	8.264**	8.451**	9.846***	4.938	8.043***
	(-0.080***)	(-0.068***)	(-0.052***)	(-0.078***)	-	(-0.066***)
Pakistan/ India	9.493**	12.891***	8.654**	13.140***	8.662**	9.321***
	(-0.085***)	(-0.136***)	(-0.086***)	(-0.173***)	(-0.054***)	(-0.077***)
	8.426**	10.958***	8.113**	11.095***	9.343**	13.514***
	(-0.080***)	(-0.098***)	(-0.059***)	(-0.146***)	(-0.078***)	(-0.113***)
Sri Lanka/ India	10.704***	14.386***	10.233***	10.707***	8.429**	14.743***
	(-0.109***)	(-0.185***)	(-0.114***)	(-0.112***)	(-0.063***)	(-0.119***)
	8.633**	12.515***	9.290**	8.864**	7.118*	10.313***
	(-0.081***)	(-0.119***)	(-0.139***)	(-0.089***)	(-0.040***)	(-0.102***)
Pakistan/ Indonesia	4.928	14.386***	12.109***	12.911***	3.178	10.540***
	-	(-0.091***)	(-0.147***)	(-0.191***)	-	(-0.140***)
	2.730	15.718***	11.478***	10.258***	4.693	7.594**
	-	(-0.121***)	(-0.118***)	(-0.137***)	-	(-0.099***)
Sri Lanka/ Indonesia	3.947	13.615***	8.696**	12.199***	4.369	9.347**
	-	(-0.096***)	(-0.061***)	(-0.133***)	-	(-0.093***)
	3.078	10.941***	8.062**	10.956***	5.001	6.231
	-	(-0.068***)	(-0.043***)	(-0.123***)	-	-
Pakistan/ Korea	6.793*	17.468***	11.773***	14.684***	11.309***	11.602***
	(-0.433***)	(-0.128***)	(-0.093***)	(-0.161***)	(-0.162***)	(-0.098***)
	6.525*	12.623***	8.035**	8.426**	9.938***	8.206**
	(-0.039***)	(-0.106***)	(-0.077***)	(-0.126***)	(-0.122***)	(-0.044***)
Sri Lanka/ Korea	8.893**	16.544***	8.428**	14.622***	6.182	8.059**
	(-0.071***)	(-0.105***)	(-0.085***)	(-0.116***)	-	(-0.036***)
	7.431**	14.458***	7.186*	12.598***	6.917*	5.313
	(-0.043***)	(-0.091***)	(-0.063***)	(-0.098***)	(-0.034***)	-

Note: The first value of each model shows the F-statistics and the second value in brackets shows the estimate of error correction term. Also, in each cell, the first value of F-statistics and ECM term belong to the model when first country equity of the countries equity pair is taken as dependent variable and second value of F-statistics and ECM term belong to the model when second country equity of the countries equity pair is taken as dependent variable. The lower bound critical values are 5.59 (10%), 6.56 (5%) and 8.74 (1%); whereas the upper bound critical values are 6.26 (10%), 7.30 (5%) and 9.63 (1%) [see Pesaran et al. (2001)]. ***indicates significance level at 1%, **indicates significance level at 5%, *indicates significance level at 10%.

TABLE 20

F-Statistics Short-run Granger Causality
(emerging-frontier countries of Asia)

	Tranquil period (1995-1996)	Crises period (1997-1998)	Tranquil period (1999-2007)	Crises period (2008-2011)	Tranquil period (2012-2014)	Entire period (1995-2014)
Pakistan/ China	8.427*** 4.973***var	11.053*** 8.706***	7.697*** 6.982***	15.882*** 13.397***	9.633*** 7.894***	11.820*** 9.822***
Sri Lanka/ China	6.067*** 1.053	9.639*** 6.889***	9.730*** 8.614***	19.054*** 12.346***	11.006*** 1.015var	13.923*** 1.749
Pakistan/ India	8.718*** 7.147***	7.791*** 7.246***	7.293*** 1.675	18.082*** 16.288***	8.433*** 7.973***	12.536*** 11.132***
Sri Lanka/ India	10.582*** 8.133***	10.708*** 8.893***	7.704*** 6.051***	15.191*** 14.690***	7.725*** 1.080	14.302*** 10.138***
Pakistan/ Indonesia	1.090var 1.468var	10.512*** 8.806***	6.413*** 0.956	11.894*** 9.721***	1.375var 1.211var	7.727*** 7.593***
Sri Lanka/ Indonesia	1.198var 0.894var	10.265*** 7.038***	1.066 1.316	12.375*** 7.933***	1.294var 0.529var	6.957*** 4.317***var
Pakistan/ Korea	1.654 1.476	11.886*** 10.250***	7.761*** 6.150***	13.829*** 11.896***	7.997*** 0.962	7.200*** 6.101***
Sri Lanka/ Korea	6.876*** 1.214	10.504*** 7.818***	6.852*** 7.906***	15.198*** 10.479***	5.733***var 1.902	6.610*** 4.733***var

Note: In each cell, the first value of F-statistics belongs to the model when first country equity of the countries equity pair is taken as dependent variable and second value of F-statistics belong to the model when second country equity of the countries equity pair is taken as dependent variable. var indicates Granger causality estimated by VAR model, ***indicates significance level at 1%, **indicates significance level at 5%

eration of Exchanges and the South Asian Federation of Exchanges which have aimed to develop the integrated stock market trading system.

The cointegration results are further verified by error correction terms where each significant as F-statistics have negative and significant EC value. Greater coefficients of EC term are observed in the periods of crises than in the period of tranquil which shows that stock prices adjust at high speed towards equilibrium in the period of crises. These results suggest that during the period of crises the opportunities for international diversification decrease substantially. The analyzing cointegration between the developed and emerging Asian countries, and between the developed and frontier Asian countries, observes higher error correction term values while taking the emerging Asian countries as dependent variables than the developed Asian countries. This shows that it takes less time by stock markets of the emerging Asian countries to adjust towards equilibrium position when any change occurs in the stock prices of developed Asian countries.

V. Conclusion

In this study, the cointegration of stock market returns within and between the developed, emerging and frontier Asian countries is analyzed over the period 1995-2014, using the ARDL cointegration approach. In order to gain more insight, the entire period is divided into sub-periods 1997-1998 and 2008-2011 (crises periods) and 1995-1996, 1999-2007 and 2012-2014 (tranquil periods). The general outcomes of the analysis are:

1. There a is clear evidence of long-run and short-run relationships of stock market returns between different Asian countries [consistent with Jeon, et al. (2006), Loh (2013), and Yu, et al. (2010)] due to the fact that over the last twenty years there is a great increase in closeness of economic relations among Asian countries, particularly in the fields of trade, finance and investment.
2. The changing behavior of the cointegration of stock market returns in different periods indicate that cointegration of stock market return is time variant phenomenon.
3. Those pairs of countries that do not show stock market returns cointegration in the periods of tranquil, exhibit cointegration in the periods of financial crises due to contagion or spillover of asset prices.
4. There is a possibility that two stock markets have long-term cointegrations between them but do not have the short-term cointegrations, and vice versa.
5. Consistent with Driessen and Laeven (2007) and Goetzmann and Kumar (2008), international investors have opportunity to gain diversification benefits having portfolio of developed-emerging Asian countries and/or developed-frontier Asian countries.

Results of this study will have some important practical implications, especially for economists, policymakers, and investors. This study will be useful for policymakers, to plan as to how the markets would react to international shocks and how to design reforms of the financial system. It is also helpful to investors to improve risk management and increase their returns through diversification of their portfolios. There are also some suggestions for future research work. In future the researchers can incorporate more cross sectional units and can also increase the time period of the study. One can also use the panel data cointegration technique to study the cointegration of stock returns which enables the researcher to consider both the cross-sectional and the time series dimension for analysis and avail the advantage of dynamic relationships.

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