International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2017, 7(3), 684-705.

Association of South-East Asian Nations-US Stock Market Associations in and Around US 2007-09 Financial Crisis: An Autoregressive Distributed Lag Application for Policy Implications

Ranjan Dasgupta*

Xavier University Bhubaneshwar, Xavier Square, Bhubaneshwar, Odisha, India. *Email: ranjandasgupta@ximb.ac.in

ABSTRACT

This study examines portfolio diversification and arbitrage opportunities available to international investors in 16 Asian and US stock markets by using most advanced autoregressive distributed lag methods in and around recent US sub-prime crisis of 2007-09 with selected structural breaks. Results show that in overall and during-the-crisis period these markets were co-integrated in long-run and there were not enough portfolio diversification opportunities for international investors like other sub-periods. The Indian and Chinese markets were strongest contenders among Asian and US to attract foreign inflows. In short-run, these markets show dynamic adjustments generally within 1 month which neutralizes arbitrage opportunities.

Keywords: Asian and US Stock Markets, Autoregressive Distributed Lag, Co-integrations, Market Efficiency, Portfolio Diversification, US 2007-09 Crisis
JEL Classifications: C32, G15

1. INTRODUCTION

Co-integration and linkages of international stock markets has been a serious proposition for the policy-makers, investors, academicians and researchers worldwide especially post-liberalization in the 90s in most parts around the world. This was aggravated post-1987 October crash (Kanas, 1998) and following 1997 Asian financial crisis (Chi et al., 2006; Jang and Wonsik, 2002). Three key questions arise in financial economics for this kind of studies to work upon. Firstly, what are the implications of rapid transmission of some national financial disturbances to the international stock markets integration? Secondly, what are the implications of such integration towards efficiency of respective country-specific stock markets? Lastly, what are the implications of such integration for the international investors to profitably adopt and mould their portfolio diversification strategies?

It is obvious that the shift of cross-border equity flows through portfolio diversification is accompanied by enhanced information flows and hence greater market efficiency. Hooy and Lim (2009) also suggested a positive association between market integration and informational efficiency. Dwyer and Wallace (1992) define market efficiency as the lack of arbitrage opportunities. Thus, it is evident that efficient markets are generally co-integrated. Also, the removal of barriers between international markets would lead to a tendency towards the equalization of the price of risk. So, here I have followed Kearney and Lucey (2004) idea of equalization of the rates of returns to define co-integration as it is a direct approach based on the law of one price which implies that stock market indices having same risk characteristics should command similar returns under the condition of unrestricted international capital flows. The Reserve Bank of India (2007) also observes in this regard that the unification of various stock markets leads to convergence of risk-adjusted returns.

However, if such markets become more closely linked in the sense that there are stronger co-movements of equity prices across markets, then this may result in changes to optimal international portfolio diversification strategies. Chowdhry et al. (2007) and Kearney and Lucey (2004) suggest that co-integrated stock markets reduce the benefits of international portfolio diversification in the long-run. This is so because the existence of common stochastic factors limits the amount of independent variation in stock prices (Chen et al., 2002). Hassan and Naka (1996) also prove that gains from portfolio diversification continue to accrue although in the short-run, but not in the long-run. Thus, from the standpoint of their portfolio diversification objective, investors cannot benefit from arbitrage activities in the long-run. Akdogan (1992) also pointed out that a complete integration of capital markets also implies the absence of arbitrage opportunities. Statistically, stock markets are integrated when they share long-run equilibrium relationships (Bachman et al., 1996; Yusof and Majid, 2006). From a policy perspective, co-integrated stock markets contribute to financial stability, since they cannot deviate too far from the long-run equilibrium path (Ibrahim, 2005). So, it is indispensable to investigate whether markets are co-integrated in the long-run and having short-run dynamic relationships to find out whether there is any available opportunity for the international investors to gain from portfolio diversification or arbitrage process outside their borders.

Earlier studies by Hilliard (1979), Lessard (1976) and Ripley (1973) generally found low correlations between national stock markets, thereby supporting the benefits of international diversification. However, as mentioned earlier post- October 1987 crash most studies found evidence of co-integration and short- and long-run associations in between international stock markets. For example, Lee and Kim (1994) examined the effect of the October 1987 crash and concluded that national stock markets became more interrelated after the crash and found that the co-movements among national stock markets were stronger when the US stock market is more volatile. The emerging stock markets are also found to be more closely integrated with other developing and developed markets than ever before. In this regard, Mukhopadhyay (2009) found that market integration is more prominent among markets which are at comparable development stage.

So, here I want to investigate how stock markets long-run co-integration and short-run relationships were evident in between the US and 16 selected developing Asian stock markets including India and China during the overall study period (i.e. January, 2005-June, 2012). Theoretically, the data would preferably be in a longer time-interval and over a long period of time for co-integration analysis (Hooker, 1993; Lahiri and Mamingi, 1995). So, I have taken monthly transformed log returns data for a lengthy 7½ year. This has also avoided its noisy nature. However, Click and Plummer (2005), Gerlach et al. (2006) and Hakkio and Rush (1991) conclude that data frequency does not have a significant impact on co-integration analysis.

As the United States of America (USA or US) is the most influential market all over the world (Morales et al., 2009) especially has strong integration impact on Asia-Pacific markets (Atmadja et al., 2010), here I have selected US Standard and Poor (S&P) 500 benchmark Index to study selected Asian stock markets co-integrations and associations in relation to the US market. However, the most important consideration for selection of the US S&P 500 index here is that I am investigating the Asian markets short- and long-run relationships and co-integrations amidst very recent sub-prime financial crisis which was also originated in the US financial sector in July, 2007 (Dasgupta, 2013) and caused a serious collapse in international stock markets in January, 2008 (Gokay, 2009). However, over the crisis period as a whole (i.e. July 2007-August 2009 [Goldstein and Xie, 2011]), it was found that the decline for the emerging Asia index (−-17%) was considerably smaller than that for emerging Europe (−-42%), but larger than that for Latin America (−-7%). Within emerging Asia, the largest stock market declines (over the crisis period as a whole) have occurred in Singapore (−-27%), Thailand (−-21%), and the Philippines (-21 per cent), whereas India has had the best performance (Goldstein and Xie, 2011). On the other hand, the global crisis has had a profound impact on the Asia and Pacific region on its exports. Most countries in the region were showing double-digit declines in exports. Taipei-China saw the biggest fall, over 40% year-on-year in December and January, 2009 while large declines were seen in Japan, the Republic of Korea, Singapore, Indonesia, Thailand, Malaysia and "Hong Kong, China" as well. Even those countries that are faring relatively better were experiencing large export declines, including China and India. Along with the drop in exports, industrial production was also falling in year-on-year terms in almost all Asian countries, with the notable exception of China. Especially large declines were observed in Taipei-China, Japan, Malaysia, the Republic of Korea and Singapore. The serious consequences were present till mid-2009 and in the last half of the same year the world more specifically Asian stock markets begun to revive (IMF, 2009).

So, most of the developing Asian economies like India, China, Japan, the Republic of Korea and Association of South-East Asian Nations (ASEAN) countries have to be incorporated to investigate their co-integrations and associations with the US here. But, selection of some other Asian markets including the middle-east ones along with the US, Indian and Chinese markets under a study for the first time is also relevant, pioneering and timely. This is so because post-liberalization of equity markets in many Asian emerging economies during the 1980s, there has been a rising interest among international investors to invest in these markets to gain from portfolio diversification process through regional shift of funds. Their interest in the Asian emerging markets is justified based on the growth potential of these developing markets and thereby diversification of portfolio risks with above average returns.

The existing literature is also unanimous in validating that in during-the-crisis periods generally a stronger short and long-run relationship is found than that of before and after such crises globally (Dasgupta, 2013; 2014; Yang et al., 2002). However, in comparison to pre-crisis period, post-crisis co-integration is more prominent in empirical studies (Cheng and Glascock, 2006). So, it is necessary to examine the truth behind this observation in relation to the selected Asian markets and the corresponding US influence in different study-periods. Thereby, I have also investigated these relationships by following a balanced time-period approach for – pre-crisis (January, 2005-June, 2007), during-the-crisis (July, 2007-December, 2009) and post-crisis (January, 2010-June, 2012) period. This is also in line with suggestions of many past empirical studies (Bekaert et al., 2002; Forbes and Rigobon, 2002; Karolyi and Stultz, 1996; Lee and Kim, 1994; Lin et al., 1994; Longin and Solnik, 1995; 2001) that integration and dynamic adjustments of international stock markets is a time-varying concept. So, longitudinal studies should be undertaken to get authentic results. This also gives a precise knowledge for investment decision making to international investors to adopt their respective portfolio diversification and arbitrage strategies during different crisis sub-periods especially during-the-crisis period in the future. I have also given a special emphasis to the Indian and Chinese stock market's relationships with its Asian peers along with the US market in the overall study-period and in all sub-periods to find which of these markets was being and would be the most favorable portfolio diversification destination to international and especially to Asian and US investors. To validate my results or find out the contradictions if any, I have compared my results with few similar and relevant past studies from earlier time-periods especially that of 1997 Asian financial crisis and also current US crisis.

It is conclusive that empirical literature on stock market integration is abundant and results vary according to variable specification, research methodology adopted, participating countries and time-period and situations of such studies. Another critical point is that some of these studies which analyzed a group of countries (regional, trade-relationships, etc.) provide only general conclusions or overall trends rather than results for each country. Thus, this study attempts to partially fill the research gaps in the existing relevant literature and to provide most recent empirical evidence on short- and long-run associations and co-integrations in between the Asian and US stock markets.

More specifically, this study contributes to the existing literature in several ways. First, my data is comprehensive in its time and period-coverage. It covers a lengthy time-period of 7½ years and covers pre-, during- and post-US subprime crisis periods and different short- and long-run associations in between the Asian and US markets in all these periods. Also, I have undertaken less noisy monthly log returns data. Secondly, unlike previous studies, I revisit the issue of Asian and US co-integration and associations with the more advanced and robust autoregressive distributed lag (ARDL) techniques as developed by Pearson et al. (2001). Thirdly, my findings provide useful information for the Asian and US investors in formulating their international portfolio diversification strategies in future under different such periods. This would also help the international investment managers, brokers and fund houses irrespective of their country-origin. Similarly, this would be of immense help for multinational capital budgeting decisions, foreign risk exposures and financial stability judgment for the interested parties. Fourthly, India and China are chosen as the focal point to represent Asian emerging markets which are also a departure from most of the previous empirical studies that tend to focus on more developed Asian markets like Japan and Singapore. Lastly, this study examines the impact of the recent US subprime financial crisis on the short- and long-run associations of Asian markets under balanced time-period and overall. This is an extension of the earlier relevant literature. It is also interesting and new to analyze the impact of the crisis that starts in the developed US market on the emerging Asian markets. Most earlier studies have worked on the impact of 1997 Asian crisis on the developed Asian markets.

The rest of the paper is organized as follows. Section 2 discusses research methodology used for investigation, analysis and interpretation purposes. Section 3 reports data descriptions, empirical results and subsequent discussions followed by conclusion and policy implications in Section 4.

2. DATA DESCRIPTIONS AND RESEARCH METHODOLOGY

Here, I have used the monthly stock indices closing values to calculate natural log returns for the period of January, 2005-June, 2012. I have undertaken monthly data instead of daily and weekly data to avoid the problem of too much noise and non-synchronous infrequent trading (Ibrahim, 2005). The Asian and US stock markets are represented by the CNX Nifty Index (NIFTY - India), the Karachi 100 Index (K100 - Pakistan), the CSE All Share Index (CSEALL - Sri Lanka), the Jakarta Composite Index (JACO - Indonesia), the Kuala Lumpur Stock Exchange Composite Index (KLCO - Malaysia), the PSE Composite Index (PSECO - Philippines, the Straits Times Index (ST - Singapore), the SET50 Index (SET50 - Thailand, the Korea Composite Stock Price Index (KOSPI - The Republic of Korea), the Taiwan Weighted Index (TW - "Taiwan Province of China"), the Nikkei 225 Index (N225 - Japan), the Tadawul All Share Index (TASI - Saudi Arabia), the Abu Dhabi General Index (ADG - UAE), the TSE 50 Index (T50 - The Islamic Republic of Iran), the Kuwait Price Index (KPI - Kuwait, the Shanghai Composite Index (SHCO – China) and the S&P 500 Index (SP - USA). Some other Asian stock markets like Bangladesh, Nepal, Iraq, "Hong Kong, China," Labanon, Syria, etc. have not been considered here due to either their less significant nature or non-availability of required data. I have also undertaken the ARDL co-integration tests under two sets of equations as more than ten variables can't be fitted in Microfit 4.1 or in EVIEWS 7. In one set of equations, the South Asian Association of Regional Cooperation representatives and its ASEAN counterparts along with the US and China is included. In the other set, all other selected Asian countries along with India and the US are incorporated. Thus, Asian majors of India and China along with the US market returns are focal point here.

Here, I investigate the selected Asian and US stock markets short- and long-run co-integration and associations by using monthly closing indices values (collected from econstat.com and other stock exchanges). I calculate monthly returns as the difference in the natural logarithm of such closing values for two consecutive trading months. Thus, it is calculated by:

$$R_t = \log(P_t/P_{t-1}) \quad (1)$$

Where, R_t is logarithmic monthly return at time t. P_{t-1} and P_t are monthly closing prices of the indices at two successive months, $t-1$ and t respectively.

Here, I estimate the model by using the ARDL or bounds testing procedure of co-integration as propagated by Pearson et al. (2001) to empirically analyze the long-run and short-run co-integration and dynamic adjustments among the selected Asian and US stock markets monthly log returns during the overall study period and in sub-periods.

The ARDL methodology is much more advantageous over the conventional co-integration tests like the Engle-Granger approach or the Johansen tests. Firstly, once I identify the lag order of the ARDL model, it is relatively simple to understand and involves easy computation in comparison with the Johansen and Juselius (1990) multivariate co-integration technique, as it permits the co-integration relationship to be estimated using ordinary least squares (OLS). Secondly, ARDL approach can work reliably irrespective of whether the regressors are purely stationary without any trend (thus integrated of order zero or I(0)) or with a unit root (a random walk) (therefore either integrated of order one or I(1)) or mutually co-integrated (Marashdeh, 2005). This procedure uses either the familiar Wald statistic or F-statistic in a generalized Dickey-Fuller (DF) type regression, which is used to test the significance of lagged levels of the considered variables in a conditional unrestricted equilibrium error correction model (ECM) (Pearson et al., 2001). However, ARDL results are spurious for I(2) or higher series. So, differencing is still required to reduce these to I(1). Thirdly, ARDL approach is much more efficient and provide robust results for small sample size (Marashdeh, 2005) where both the Engle and Granger (1987) and the Johansen (1988; 1991) co-integration methods are unreliable. Lastly, ARDL model allows the estimation of the long- and short-run components of it simultaneously (Kapingura et al., 2014). Also, like the Engle and Granger (1987) residuals-based co-integration test (Pattichis, 1999), it does not push the short-run dynamics into the residuals term.

Here, I have followed Pearson et al. (2001) as summarized in Choong et al. (2005) to apply the bounds test procedure by modeling the long-run equation (2) as a general vector autoregressive (VAR) model of order p, in x_t:

$$x_t = \alpha_0 + \beta_t + \sum_{i=1}^{p} \lambda_i x_{t-i} + \varepsilon_t,\ \ t = 1,2,3,\ldots,T \tag{2}$$

With α_0 representing a $(k + 1)$ vector of intercepts/drift and β denotes a $(k + 1)$ vector of trend coefficients.

Then, in line with Pearson et al. (2001), I derive the following vector ECM (VECM) corresponding to equation (2):

$$\Delta x_t = \alpha_0 + \beta_t + \prod x_{t-1} + \sum_{i=1}^{p} \Gamma_i x_{t-i} + \varepsilon_t\ ,\ t = 1,2,3,\ldots,T \tag{3}$$

Where the $(k + 1) \times (k + 1)$ matrices, i.e.,

$$\Pi = I_{k+1} + \sum_{i=1}^{p} \Omega_i \ \text{ and } \ \Gamma_i = -\sum_{j=i+1}^{p} \Omega_j\ ,\ i = 1,2,\ldots,p\text{-}1$$

Contain the long-run multipliers and short-run dynamic coefficients of the VECM.

Here, x_t is the vector of variables y_t and z_t respectively. Also, y_t is an I(1)/I(0) dependent variable defined as $\ln Y_t$ (i.e., $\ln NIFTY_t/\ln K100_t/\ln CSEALL_t/\ln JACO_t/\ln KLCO_t/\ln PSECO_t/\ln ST_t/\ln SET50_t/\ln SHCO_t/\ln SP500_t$ and $\ln NIFTY_t/\ln KOSPI_t/\ln TW_t/\ln N225_t/\ln TASI_t/\ln ADG_t/\ln T50_t/\ln KPI_t/\ln SHCO_t/\ln SP500_t$) and $z_t = [K100_t/CSEALL_t/JACO_t/KLCO_t/PSECO_t/ST_t/SET50_t/SHCO_t/SP500_t]/[NIFTY_t/CSEALL_t/JACO_t/KLCO_t/PSECO_t/ST_t/SET50_t/SHCO_t/SP500_t]/\ldots\ldots\ldots/[NIFTY_t/K100_t/CSEALL_t/JACO_t/KLCO_t/PSECO_t/ST_t/SET50_t/SHCO_t]$ and $z_t = [KOSPI_t/TW_t/N225_t/TASI_t/ADG_t/T50_t/KPI_t/SHCO_t/SP500_t]/[NIFTY_t/TW_t/N225_t/TASI_t/ADG_t/T50_t/KPI_t/SHCO_t/SP500_t]/\ldots\ldots\ldots/[NIFTY_t/KOSPI_t/TW_t/N225_t/TASI_t/ADG_t/T50_t/KPI_t/SHCO_t]$ where $NIFTY_t$, $K100_t$, $CSEALL_t$, $JACO_t$, $KLCO_t$, $PSECO_t$, ST_t, $SET50_t$, $KOSPI_t$, TW_t, $N225_t$, $TASI_t$, ADG_t, $T50_t$, KPI_t, $SHCO_t$ and $SP500_t$ respectively is a vector matrix of forcing I(0) and I(1) regressors with a multivariate identically and independently distributed (i.i.d) zero mean error vector and a non-heteroskedastic process.

Based on the assumption that the natural log returns series of the Asian and US stock markets show unique long-run relationships, the conditional VECM becomes:

$$\Delta y_t = \alpha_{y0} + \beta_t + \delta_{yy} y_{t-1} + \delta_{zz} z_{t-1} + \sum_{i=1}^{p-1} \phi_i \Delta y_{t-i} + \sum_{i=1}^{p-1} \xi_i \Delta z_{t-i} + \varepsilon_{yt}$$

$$t = 1,2........,T \tag{4}$$

So, on the basis of equation (4), I develop the following conditional VECMs under both sets of equations:

$$\begin{aligned}
\Delta \ln NIFTY_t &= \alpha_0 + \delta_1 \ln NIFTY_{t-1} + \delta_3 \ln K100_{t-1} + \delta_4 \ln CSEALL_{t-1} \\
&+ \delta_5 \ln JACO_{t-1} + \delta_6 \ln KLCO_{t-1} + \delta_7 \ln PSECO_{t-1} + \delta_8 \ln ST_{t-1} + \\
&\delta_9 \ln SET50_{t-1} + \delta_{10} \ln SHCO_{t-1} + \delta_{11} \ln SP500_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta \ln NIFTY_{t-i} + \\
&\sum_{d=1}^{q} \vartheta_d \Delta K100_{t-d} + \sum_{f=1}^{q} \varsigma_f \Delta \ln CSEALL_{t-f} + \sum_{g=1}^{q} \Psi_g \Delta \ln JACO_{t-g} \\
&+ \sum_{h=1}^{q} \gamma_h \Delta \ln KLCO_{t-h} + \sum_{i=1}^{p} \eta_j \Delta \ln PSECO_{t-j} + \sum_{k=1}^{q} \iota_k \Delta \ln ST_{t-k} + \\
&\sum_{l=1}^{q} \varphi_l \Delta \ln SET50_{t-l} + \sum_{m=1}^{q} \pi_m \Delta \ln SHCO_{t-m} + \sum_{o=1}^{q} \theta_o \Delta \ln SP500_{t-o} + \varepsilon_t
\end{aligned} \tag{5.1}$$

$$\begin{aligned}
\Delta \ln K100_t &= \alpha_0 + \delta_1 \ln K100_{t-1} + \delta_2 \ln NIFTY_{t-1} + \delta_4 \ln CSEALL_{t-1} \\
&+ \delta_5 \ln JACO_{t-1} + \delta_6 \ln KLCO_{t-1} + \delta_7 \ln PSECO_{t-1} + \delta_8 \ln ST_{t-1} \\
&+ \delta_9 \ln SET50_{t-1} + \delta_{10} \ln SHCO_{t-1} + \delta_{11} \ln SP500_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta \ln K100_{t-i} \\
&+ \sum_{d=1}^{q} \ni_c \Delta NIFTY_{t-c} + \sum_{f=1}^{q} \varsigma_f \Delta \ln CSEALL_{t-f} + \sum_{g=1}^{q} \Psi_g \Delta \ln JACO_{t-g} \\
&+ \sum_{h=1}^{q} \gamma_h \Delta \ln KLCO_{t-h} + \sum_{i=1}^{p} \eta_j \Delta \ln PSECO_{t-j} + \sum_{k=1}^{q} \iota_k \Delta \ln ST_{t-k} \\
&+ \sum_{l=1}^{q} \varphi_l \Delta \ln SET50_{t-l} + \sum_{m=1}^{q} \pi_m \Delta \ln SHCO_{t-m} + \sum_{o=1}^{q} \theta_o \Delta \ln SP500_{t-o} + \varepsilon_t
\end{aligned} \tag{5.2}$$

$$\Delta \ln SP500_t = \alpha_0 + \delta_1 \ln SP500_{t-1} + \delta_2 \ln NIFTY_{t-1} + \delta_3 \ln K100_{t-1} + \delta_4 \ln CSEALL_{t-1} + \delta_5 \ln JACO_{t-1} + \delta_6 \ln KLCO_{t-1} + \delta_7 PSECO_{t-1} + \delta_8 \ln ST_{t-1} + \delta_9 \ln SET50_{t-1} + \delta_{10} \ln SHCO_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta \ln SP500_{t-i} + \sum_{c=1}^{q} \ni_c \Delta NIFTY_{t-c} + \sum_{d=1}^{q} \vartheta_d \Delta \ln K100_{t-d} + \sum_{f=1}^{q} \varsigma_f \ln CSEALL_{t-f} + \sum_{g=1}^{q} \Psi_g \Delta \ln JACO_{t-g} + \sum_{h=1}^{q} \gamma_h \Delta \ln KLCO_{t-h} + \sum_{i=1}^{p} \eta_j \Delta \ln PSECO_{t-j} + \sum_{k=1}^{q} \iota_k \Delta \ln ST_{t-k} + \sum_{l=1}^{q} \varphi_l \Delta \ln SET50_{t-l} + \sum_{m=1}^{q} \pi_m \Delta \ln SHCO_{t-m} + \varepsilon_t \quad (5.10)$$

and

$$\Delta \ln NIFTY_t = \alpha_0 + \delta_{12} \ln NIFTY_{t-1} + \delta_{14} \ln KOSPI_{t-1} + \delta_{15} \ln TW_{t-1} + \delta_{16} \ln N225_{t-1} + \delta_{17} \ln TASI_{t-1} + \delta_{18} \ln ADG_{t-1} + \delta_{19} \ln T50_{t-1} + \delta_{20} \ln KPI_{t-1} + \delta_{10} \ln SHCO_{t-1} + \delta_{11} \ln SP500_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta \ln NIFTY_{t-i} + \sum_{p=1}^{q} \rho_p \Delta KOSPI_{t-p} + \sum_{r=1}^{q} \sigma_r \Delta \ln TW_{t-r} + \sum_{s=1}^{q} \tau_s \ln N225_{t-s} + \sum_{u=1}^{q} \varpi_u \Delta \ln TASI_{t-u} + \sum_{v=1}^{q} \omega_v \Delta \ln ADG_{t-v} + \sum_{w=1}^{p} \psi_w \Delta \ln T50_{t-w} + \sum_{y=1}^{q} \partial_y \Delta \ln KPI_{t-y} + \sum_{m=1}^{q} \pi_m \Delta \ln SHCO_{t-m} + \sum_{o=1}^{q} \theta_o \Delta \ln SP500_{t-0} + \varepsilon_t \quad (5.11)$$

$$\Delta \ln KOSPI_t = \alpha_0 + \delta_{12} \ln KOSPI_{t-1} + \delta_{13} \ln NIFTY_{t-1} + \delta_{15} \ln TW_{t-1} + \delta_{16} \ln N225_{t-1} + \delta_{17} \ln TASI_{t-1} + \delta_{18} \ln ADG_{t-1} + \delta_{19} \ln T50_{t-1} + \delta_{20} \ln KPI_{t-1} + \delta_{10} \ln SHCO_{t-1} + \delta_{11} \ln SP500_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta \ln KOSPI_{t-i} + \sum_{c=1}^{q} \ni_c \Delta NIFTY_{t-c} + \sum_{r=1}^{q} \sigma_r \Delta \ln TW_{t-r} + \sum_{s=1}^{q} \tau_s \ln N225_{t-s} + \sum_{u=1}^{q} \varpi_u \Delta \ln TASI_{t-u} + \sum_{v=1}^{q} \omega_v \Delta \ln ADG_{t-v} + \sum_{w=1}^{p} \psi_w \Delta \ln T50_{t-w} + \sum_{y=1}^{q} \partial_y \Delta \ln KPI_{t-y} + \sum_{m=1}^{q} \pi_m \Delta \ln SHCO_{t-m} + \sum_{o=1}^{q} \theta_o \Delta \ln SP500_{t-0} + \varepsilon_t \quad (5.12)$$

$$\Delta \ln SP500_t = \alpha_0 + \delta_{12} \ln SP500_{t-1} + \delta_{13} \ln NIFTY_{t-1} + \delta_{14} \ln KOSPI_{t-1} + \delta_{15} \ln TW_{t-1} + \delta_{16} \ln N225_{t-1} + \delta_{17} \ln TASI_{t-1} + \delta_{18} \ln ADG_{t-1} + \delta_{19} \ln T50_{t-1} + \delta_{20} \ln KPI_{t-1} + \delta_{10} \ln SHCO_{t-1} + \delta_{11} \ln SP500_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta \ln SP500_{t-i} + \sum_{c=1}^{q} \ni_c \Delta NIFTY_{t-c} + \sum_{p=1}^{q} \rho_p \Delta \ln KOSPI_{t-p} + \sum_{r=1}^{q} \sigma_r \Delta \ln TW_{t-r} + \sum_{s=1}^{q} \tau_s \ln N225_{t-s} + \sum_{u=1}^{q} \varpi_u \Delta \ln TASI_{t-u} + \sum_{v=1}^{q} \omega_v \Delta \ln ADG_{t-v} + \sum_{w=1}^{p} \psi_w \Delta \ln T50_{t-w} + \sum_{y=1}^{q} \partial_y \Delta \ln KPI_{t-y} + \sum_{m=1}^{q} \pi_m \Delta \ln SHCO_{t-m} + \varepsilon_t \quad (5.20)$$

Where, δ_i are the long-run multipliers, α_0 is the drift and ε_t are white noise errors or disturbances.

I undertake the bounds testing procedure in three steps.

In the first step, I estimate equations (5.1-5.20) by OLS in order to investigate the existence of long-run relationships in between the Asian and US stock markets returns. This is conducted with the help of F-test for the joint significance of the coefficients of the lagged levels of the variables, i.e., H_N: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = \delta_8 = \delta_9 = \delta_{10} = \delta_{11} = 0$ and $\delta_1 = \delta_{12} = \delta_{13} = \delta_{14} = \delta_{15} = \delta_{16} = \delta_{17} = \delta_{18} = \delta_{19} = \delta_{10} = \delta_{11} = 0$ (under both sets of equations), as against the alternative hypothesis of H_A: $\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq \delta_7 \neq \delta_8 \neq \delta_9 \neq \delta_{10} \neq \delta_{11} \neq 0$ and $\delta_{12} \neq \delta_{13} \neq \delta_{14} \neq \delta_{15} \neq \delta_{16} \neq \delta_{17} \neq \delta_{18} \neq \delta_{19} \neq \delta_{20} \neq \delta_{10} \neq \delta_{11} \neq 0$ (also, as required under each equation of both sets).

Thus, I denote the tests which normalize on dependent variable (respectively) by:

F_{NIFTY} [*NIFTY|K100, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO, SP500*] (6.1)

F_{K100} [*K100|NIFTY, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO, SP500*] (6.2)

F_{SP500} [*SP500|NIFTY, K100, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO*] (6.10)

and

F_{NIFTY} [*NIFTY|KOSPI, TW, N225, TASI, ADG, T50, KPI, SHCO, SP500*] (6.11)

F_{KOSPI} [*KOSPI|NIFTY, TW, N225, TASI, ADG, T50, KPI, SHCO, SP500*] (6.12)

F_{SP500} [*SP500|NIFTY, KOSPI, TW, N225, TASI, ADG, T50, KPI, SHCO*] (6.20)

Here, two asymptotic critical values bounds provide a test for co-integration, when the independent variables are I(d) (where $0 \leq d \leq 1$). The null hypothesis of no co-integration or long-run relationship is rejected if the computed F-statistic is above the upper bound critical value. On the other hand, if the computed test statistic falls below the lower bound critical value, the alternative hypothesis implying co-integration is not accepted. However, if the computed F-statistic is in between the lower and upper bound critical values, the result is inconclusive. I obtain the approximate critical values for the bounds under F-test from Pearson et al. (2001).

In the second step, I estimate the conditional ARDL (p, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, q_{10} and p, q_{11}, q_{12}, q_{13}, q_{14}, q_{15}, q_{16}, q_{17}, q_{18}, q_9, q_{10}) (as required under each equation of both sets) long-run models for Y_t after establishing co-integration as:

$$\ln NIFTY_t = \alpha_0 + \sum_{i=1}^{p}\delta_1 \ln NIFTY_{t-i} + \sum_{i=0}^{q_2}\delta_3 \ln K100_{t-i} + \sum_{i=0}^{q_3}\delta_4 \ln CSEALL_{t-i} + \sum_{i=0}^{q_4}\delta_5 \ln JACO_{t-i} + \sum_{i=0}^{q_5}\delta_6 \ln KLCO_{t-i} + \sum_{i=0}^{q_6}\delta_7 \ln PSECO_{t-i} + \sum_{i=0}^{q_7}\delta_8 \ln ST_{t-i} + \sum_{i=0}^{q_8}\delta_9 \ln SET50_{t-i} + \sum_{i=0}^{q_9}\delta_{10} \ln SHCO_{t-i} + \sum_{i=0}^{q_{10}}\delta_{11} \ln SP500_{t-i} + \varepsilon_t \quad (7.1)$$

$$\ln K100_t = \alpha_0 + \sum_{i=1}^{p}\delta_1 \ln K100_{t-i} + \sum_{i=0}^{q_1}\delta_2 \ln NIFTY_{t-i} + \sum_{i=0}^{q_3}\delta_4 \ln CSEALL_{t-i} + \sum_{i=0}^{q_4}\delta_5 \ln JACO_{t-i} + \sum_{i=0}^{q_5}\delta_6 \ln KLCO_{t-i} + \sum_{i=0}^{q_6}\delta_7 \ln PSECO_{t-i} + \sum_{i=0}^{q_7}\delta_8 \ln ST_{t-i} + \sum_{i=0}^{q_8}\delta_9 \ln SET50_{t-i} + \sum_{i=0}^{q_9}\delta_{10} \ln SHCO_{t-i} + \sum_{i=0}^{q_{10}}\delta_{11} \ln SP500_{t-i} + \varepsilon_t \quad (7.2)$$

$$\ln SP500_t = \alpha_0 + \sum_{i=1}^{p}\delta_1 \ln SP500_{t-i} + \sum_{i=0}^{q_1}\delta_2 \ln NIFTY_{t-i} + \sum_{i=0}^{q_2}\delta_3 \ln K100_{t-i} + \sum_{i=0}^{q_3}\delta_4 \ln CSEALL_{t-i} + \sum_{i=0}^{q_4}\delta_5 \ln JACO_{t-i} + \sum_{i=0}^{q_5}\delta_6 \ln KLCO_{t-i} + \sum_{i=0}^{q_6}\delta_7 \ln PSECO_{t-i} + \sum_{i=0}^{q_7}\delta_8 \ln ST_{t-i} + \sum_{i=0}^{q_8}\delta_9 \ln SET50_{t-i} + \sum_{i=0}^{q_9}\delta_{10} \ln SHCO_{t-i} + \varepsilon_t \quad (7.10)$$

and

$$\ln NIFTY_t = \alpha_0 + \sum_{i=1}^{p}\delta_1 \ln NIFTY_{t-i} + \sum_{i=0}^{q_{12}}\delta_{13} \ln KOSPI_{t-i} + \sum_{i=0}^{q_{13}}\delta_{14} \ln TW_{t-i} + \sum_{i=0}^{q_{14}}\delta_{15} \ln N225_{t-i} + \sum_{i=0}^{q_{15}}\delta_{16} \ln TASI_{t-i} + \sum_{i=0}^{q_{16}}\delta_{17} \ln ADG_{t-i} + \sum_{i=0}^{q_{17}}\delta_{18} \ln T50_{t-i} + \sum_{i=0}^{q_{18}}\delta_{19}\Delta \ln KPI_{t-i} + \sum_{i=0}^{q_9}\delta_{10} \ln SHCO_{t-i} + \sum_{i=0}^{q_{10}}\delta_{11} \ln SP500_{t-i} + \varepsilon_t \quad (7.11)$$

$$\ln KOSPI_t = \alpha_0 + \sum_{i=1}^{p}\delta_1 \ln KOSPI_{t-i} + \sum_{i=0}^{q_{11}}\delta_{12} \ln NIFTY_{t-i} + \sum_{i=0}^{q_{13}}\delta_{14} \ln TW_{t-i} + \sum_{i=0}^{q_{14}}\delta_{15} \ln N225_{t-i} + \sum_{i=0}^{q_{15}}\delta_{16} \ln TASI_{t-i} + \sum_{i=0}^{q_{16}}\delta_{17} \ln ADG_{t-i} + \sum_{i=0}^{q_{17}}\delta_{18} \ln T50_{t-i} + \sum_{i=0}^{q_{18}}\delta_{19} \ln KPI_{t-i} + \sum_{i=0}^{q_9}\delta_{10} \ln SHCO_{t-i} + \sum_{i=0}^{q_{10}}\delta_{11} \ln SP500_{t-i} + \varepsilon_t \quad (7.12)$$

$$\ln SP500_t = \alpha_0 + \sum_{i=1}^{p}\delta_1 \ln SP500_{t-i} + \sum_{i=0}^{q_{11}}\delta_{12} \ln NIFTY_{t-i} + \sum_{i=0}^{q_{12}}\delta_{13} \ln KOSPI_{t-i} + \sum_{i=0}^{q_{13}}\delta_{14} \ln TW_{t-i} + \sum_{i=0}^{q_{14}}\delta_{15} \ln N225_{t-i} + \sum_{i=0}^{q_{15}}\delta_{16} \ln TASI_{t-i} + \sum_{i=0}^{q_{16}}\delta_{17} \ln ADG_{t-i} + \sum_{i=0}^{q_{17}}\delta_{18} \ln T50_{t-i} + \sum_{i=0}^{q_{18}}\delta_{19} \ln KPI_{t-i} + \sum_{i=0}^{q_9}\delta_{10} \ln SHCO_{t-i} + \varepsilon_t \quad (7.20)$$

Here, it is extremely critical to select the most appropriate distributed lag orders (i.e., p, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, q_{10} and p, q_{11}, q_{12}, q_{13}, q_{14}, q_{15}, q_{16}, q_{17}, q_{18}, q_9, q_{10}) of the respective ARDL model. The lag orders of the dependent variable (respectively) and the regressors is generally selected using either akaike information criterion (AIC) or the Schwartz Bayesian criterion (SBC). However, I use the SBC here in line with Pearson and Shin (1995) and many others who suggest that SBC is preferable over AIC as it is a parsimonious model that selects the smallest possible lag length.

In the third and final step, I obtain the short-run dynamic adjustments by estimating an ECM in association with the long-run estimates. I undertake the following equations under both sets:

$$\Delta LNIFTY_t = \mu + \sum_{i=1}^{p}\lambda_i \Delta \ln NIFTY_{t-i} + \sum_{d=1}^{q}\vartheta_d \Delta \ln K100_{t-d} + \sum_{f=1}^{q}\varsigma_f \Delta \ln CSEALL_{t-f} + \sum_{g=1}^{q}\Psi_g \Delta \ln JACO_{t-g} + \sum_{h=1}^{q}\gamma_h \Delta \ln KLCO_{t-h} + \sum_{j=1}^{q}\eta_i \Delta \ln PSECO_{t-j} + \sum_{k=1}^{q}\iota_k \Delta \ln ST_{t-k} + \sum_{l=1}^{q}\varphi_l \Delta \ln SET50_{t-l} + \sum_{m=1}^{q}\pi_m \Delta \ln SHCO_{t-m} + \sum_{o=1}^{q}\theta_o \Delta \ln SP500_{t-o} + \upsilon ecm_{t-1} + \varepsilon_t \quad (8.1)$$

$$\Delta \ln K100_t = \mu + \sum_{i=1}^{p}\lambda_i \Delta \ln K100_{t-i} + \sum_{c=1}^{q}\ni_c \Delta \ln NIFTY_{t-c} + \sum_{f=1}^{q}\varsigma_f \Delta \ln CSEALL_{t-f} + \sum_{g=1}^{q}\Psi_g \Delta \ln JACO_{t-g} + \sum_{h=1}^{q}\gamma_h \Delta \ln KLCO_{t-h} + \sum_{j=1}^{q}\eta_i \Delta \ln PSECO_{t-j} + \sum_{k=1}^{q}\iota_k \Delta \ln ST_{t-k} + \sum_{l=1}^{q}\varphi_l \Delta \ln SET50_{t-l} + \sum_{m=1}^{q}\pi_m \Delta \ln SHCO_{t-m} + \sum_{o=1}^{q}\theta_o \Delta \ln SP500_{t-o} + \upsilon ecm_{t-1} + \varepsilon_t \quad (8.2)$$

$$\Delta \ln SP500_t = \mu + \sum_{i=1}^{p}\lambda_i \Delta \ln SP500_{t-i} + \sum_{c=1}^{q}\ni_c \Delta \ln NIFTY_{t-c} + \sum_{d=1}^{q}\vartheta_d \Delta \ln K100_{t-d} + \sum_{f=1}^{q}\varsigma_f \Delta \ln CSEALL_{t-f} + \sum_{g=1}^{q}\Psi_g \Delta \ln JACO_{t-g} + \sum_{h=1}^{q}\gamma_h \Delta \ln KLCO_{t-h} + \sum_{j=1}^{q}\eta_i \Delta \ln PSECO_{t-j} + \sum_{k=1}^{q}\iota_k \Delta \ln ST_{t-k} + \sum_{l=1}^{q}\varphi_l \Delta \ln SET50_{t-l} + \sum_{m=1}^{q}\pi_m \Delta \ln SHCO_{t-m} + \upsilon ecm_{t-1} + \varepsilon_t \quad (8.10)$$

and

$$\Delta \ln NIFTY_t = \mu + \sum_{i=1}^{p} \lambda_i \Delta \ln NIFTY_{t-i} + \sum_{p=1}^{q} \rho_p \Delta \ln KOSPI_{t-p} + \sum_{r=1}^{q} \sigma_r \Delta \ln TW_{t-r} + \sum_{s=1}^{q} \tau_s \Delta \ln N225_{t-s} + \sum_{u=1}^{q} \varpi_u \Delta \ln TASI_{t-u} + \sum_{v=1}^{q} \omega_v \Delta \ln ADG_{t-v} + \sum_{w=1}^{q} \psi_w \Delta \ln T50_{t-w} + \sum_{y=1}^{q} \partial_y \Delta \ln KPI_{t-y} + \sum_{m=1}^{q} \pi_m \Delta \ln SHCO_{t-m} + \sum_{o=1}^{q} \theta_o \Delta \ln SP500_{t-o} + \upsilon ecm_{t-1} + \varepsilon_t \quad (8.11)$$

$$\Delta \ln KOSPI_t = \mu + \sum_{i=1}^{p} \lambda_i \Delta \ln KOSPI_{t-i} + \sum_{c=1}^{q} \ni_c \Delta \ln NIFTY_{t-c} + \sum_{r=1}^{q} \sigma_r \Delta \ln TW_{t-r} + \sum_{s=1}^{q} \tau_s \Delta \ln N225_{t-s} + \sum_{u=1}^{q} \varpi_u \Delta \ln TASI_{t-u} + \sum_{v=1}^{q} \omega_v \Delta \ln ADG_{t-v} + \sum_{w=1}^{q} \psi_w \Delta \ln T50_{t-w} + \sum_{y=1}^{q} \partial_y \Delta \ln KPI_{t-y} + \sum_{m=1}^{q} \pi_m \Delta \ln SHCO_{t-m} + \sum_{o=1}^{q} \theta_o \Delta \ln SP500_{t-o} + \upsilon ecm_{t-1} + \varepsilon_t \quad (8.12)$$

$$\Delta \ln SP500_t = \mu + \sum_{i=1}^{p} \lambda_i \Delta \ln SP500_{t-i} + \sum_{c=1}^{q} \ni_c \Delta \ln NIFTY_{t-c} + \sum_{p=1}^{q} \rho_p \Delta \ln KOSPI_{t-p} + \sum_{r=1}^{q} \sigma_r \Delta \ln TW_{t-r} + \sum_{s=1}^{q} \tau_s \Delta \ln N225_{t-s} + \sum_{u=1}^{q} \varpi_u \Delta \ln TASI_{t-u} + \sum_{v=1}^{q} \omega_v \Delta \ln ADG_{t-v} + \sum_{w=1}^{q} \psi_w \Delta \ln TP50_{t-w} + \sum_{y=1}^{q} \partial_y \Delta \ln KPI_{t-y} + \sum_{m=1}^{q} \pi_m \Delta \ln SHCO_{t-m} + \upsilon ecm_{t-1} + \varepsilon_t \quad (8.20)$$

Where λ, ϶, ϑ, ς, Ψ, γ, η, ι, φ, π, θ, ρ, σ, τ, ϖ, ω, ψ and ∂ (under both sets of equations) are the short-run dynamic coefficients of my models' convergence to long-run equilibrium and υ is the speed of such adjustment.

3. RESULTS AND DISCUSSIONS

Figures 1-4 provide the graphical results of Asian and US markets indices returns here. It is evident that for the overall study period the Thailand, Sri Lankan and Chinese markets were most volatile. The Indian and US market were showing stability in most years. However, in during-the-crisis period in line with most Asian markets the Indian and Chinese markets were extremely volatile especially in the year 2009. However, the US market returns was stable in this period. It is also interesting to note that these markets were showing more suspicion from the investors in terms of volatility in the post-US crisis period ever than before.

From Table 1, it is found that the Indian stock market was the third strongest market after Sri Lanka and Philippines to attract foreign investors for the overall study period with an average

Figure 1: Asian and United States of America indices returns (for the overall study period [January 2005-June, 2012])

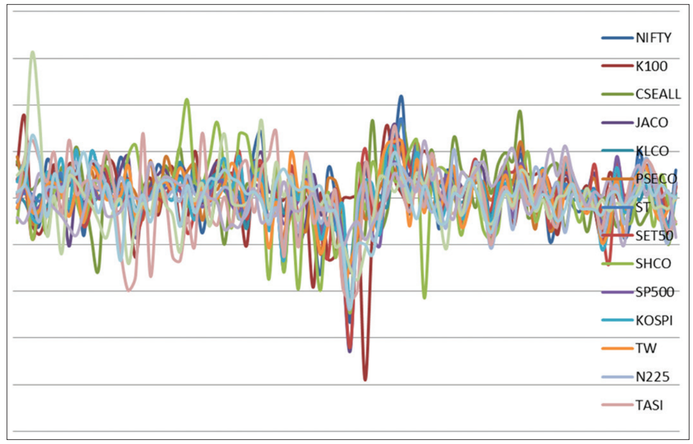


Figure 2: Asian and United States of America indices returns (for the pre-crisis period [January 2005-June, 2007])

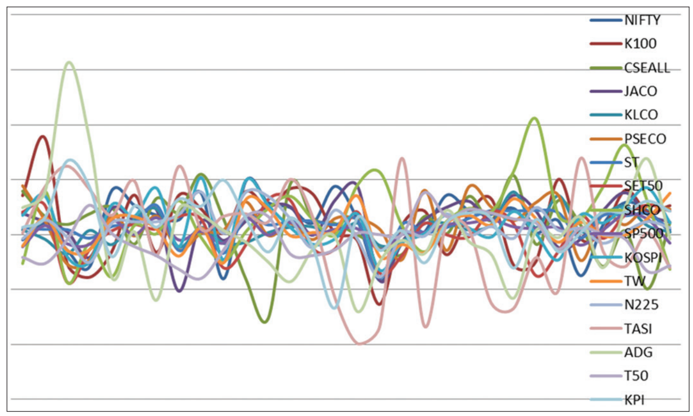
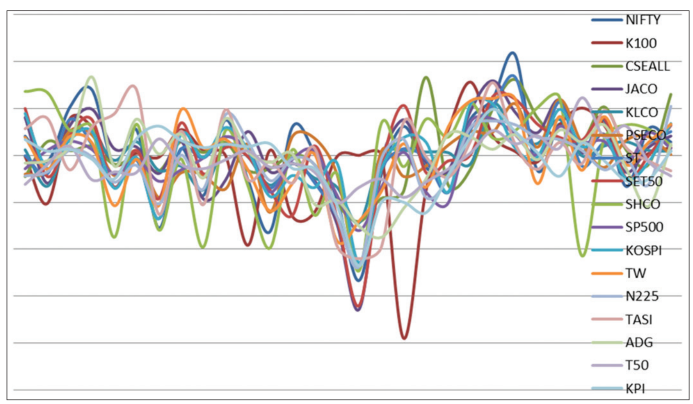
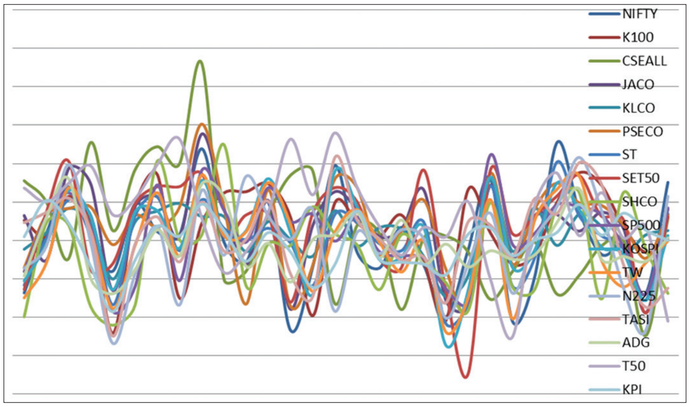


Figure 3: Asian and United States of America indices returns (for the during-the-crisis period [July 2007-December 2009])



return of 0.45% (approximately). The volatility of such returns (standard deviation [SD] = 3.47% approximately] was also higher in relative terms to above markets, but Indian was superior to its immediate competitor China (0.27% mean returns with a SD of 4.15%). The Indian market also outperformed its Chinese peer in most parts of the studied period except in the pre-crisis period. However, the risk-adjusted return results for the overall study period show that the Indian market was outperforming its Asian peers after Indonesia, Philippines, Si Lanka and Malaysia

Figure 4: Asian and United States of America indices returns (for the post-crisis period [January 2010-June 2012])



only in that order. Especially, in during-the-crisis period, it was the second strongest Asian market after Sri Lanka when most of other studied markets including the US were giving negative average returns. The risk-adjusted returns results also point out that only Sri Lankan, Indian and Indonesian market were giving positive returns in during-the-crisis period. So, it supports that India is one of the strongest portfolio diversification opportunity for the international investors among its Asian peers. However, in the post-crisis period interestingly its ASEAN peers (except Singapore) were offering much higher returns with less risk. This is supported by risk-adjusted returns of these markets. Also, though the US market was outperforming the Indian market, but its strongest emerging peer China was underperforming the NIFTY. Thus, there is clear evidence of shifting portfolio diversification flows in between these markets in different periods.

Results in Table 1 has also pointed out that all these log returns series have had higher kurtosis (i.e., value is >3 [leptokurtic]) (except Iran) for the overall study period and in during-the-crisis (except Sri Lanka, China and Taiwan) periods. It implies that they had a thicker tail and a higher peak than a normal distribution, i.e., they were non-normal. The skewness values (mostly negative) in both these periods also imply a deviation from normal distribution (i.e., asymmetric) and volatility in these returns series. However, in other periods they were not so non-normal in this study. The Jarque-Bera test results significantly validate all these findings mostly for the overall study period and during-the-crisis period, and less significantly in other periods. These results clearly indicate lack of co-integration and opportunities for portfolio diversification for the international investors in Asian and US markets.

The correlation coefficients point out the short-run relationships in between these markets. It is interesting to note that in during-the- and post-crisis periods most of these markets were inter-related in the short-run. For the overall study period, the Indian stock market returns were closely associated with all its ASEAN peers, the US, the Republic of Korean, "Taiwan Province of China", Japan and Islamic Republic of Iran market's returns. This is due to its associations with these markets in all except the pre-crisis period. The US market also has shown quite similar associations with most of these Asian markets in the studied markets. However, it is found that the Chinese market was not showing much short-run associations with its Asian peers in most periods except during-the-crisis period. These results however contradict with earlier descriptive statistics results in implying that the Chinese market is the most attractive investment destination in the short-run for the international investors. Some other Asian developing markets like Pakistan and Sri Lanka also in this regard can become probable future portfolio diversification opportunities.

Table 1 provides the summary statistics of selected Asian and US stock markets natural log returns.

Before I proceed with the ARDL bounds test, I test the stationarity issue of all the variables to determine their respective orders of integration. This is conducted to ensure that they are not I(2) stationary so as to avoid spurious results.

Here, I have applied the more efficient univariate DF generalized least squares (DF-GLS) test for autoregressive unit root in line with Elliot et al. (1996). This test has the best overall performance in terms of sample size and power in comparison to augmented DF tests.

Table 2 provides the DF-GLS test results for autoregressive unit root for both a constant and trend for the log-levels and a constant with no trend for the first difference of the variables.

The DF-GLS unit root test results for the variables in Table 2 indicate that all variables in the overall study period and in all sub-periods are I(0)/I(1).

Before estimating the short and long-run relationships among the selected stock markets natural log returns series, I have decided the lag-length on the first difference variables by using SBC.

For the overall study period, it is found from Tables 3 and 4 that except when the Indian NIFTY Index and JACO Index of Indonesia are the dependent variables, in all other cases under set 1, the computed F-statistics exceeds the upper bound critical value at 1% mostly and 5% significance level. This implies the rejection of null hypothesis of no co-integration under first set of equations (i.e., 6.2, 6.3, 6.5-6.10). Thus, there were long-run co-integrating relationships in between these markets in all such cases. However, under set two equations (i.e., 6.11-6.20), my results show that there were long-run co-integrating relationships at 1% or 5% significance level in between set two markets returns when the Indian, Pakistan, "Taiwan Province of China," Japanese, Chinese and the US markets are the dependent variables respectively. However, in other cases except TASI (result is inconclusive), no long-run equilibrium relationship is found. These results imply fewer chances of portfolio diversification opportunities for the international investors of these countries in Asia and the US. It is interesting to find here that during-the-crisis results are somewhat similar for the first set of countries, i.e. significant co-integration is observed when NIFTY, K100, CSEALL, KLCO and PSECO are dependent variables. But, in other cases, the results are either contradictory (no co-integration) or inconclusive or no co-integration is found. However, for the second set of Asian countries in relation to the US, India and China especially, mostly there were

Table 1: Descriptive statistics results

Variables	NIFTY	K100	CSEALL	JACO	KLCO	PSECO	ST	SET50	SHCO	SP500
Overall study period (January, 2005-June, 2012)										
Mean	0.004493	0.003847	0.005755	0.006635	−0.002734	0.005101	0.001600	0.002666	0.002720	0.000564
Median	0.005622	0.006397	0.005054	0.012613	0.004472	0.011585	0.006240	0.009891	0.008081	0.004002
Maximum	0.107434	0.087847	0.092262	0.079657	0.055169	0.060582	0.083820	0.062681	0.105328	0.044431
Minimum	−0.133183	−0.194910	−0.076501	−0.163815	−0.071720	−0.119597	−0.118841	−0.159838	−0.122810	−0.080017
SD	0.034690	0.036988	0.032254	0.031977	0.017859	0.026842	0.026865	0.032654	0.041505	0.020698
Skewness	−0.655019	−1.942397	0.135792	−1.812338	−0.687516	−1.177251	−1.040138	−1.556922	−0.648865	−0.893677
Kurtosis	5.329004	11.31107	3.307678	10.74089	6.086337	7.002946	7.463675	8.468256	3.883699	4.798346
Jarque-Bera	26.77672***	315.6206***	0.631588	273.9739***	42.81071***	80.87722***	90.94480***	148.4920***	9.243843***	24.10756***
Risk-adjusted return (mean/SD [in%])	12.95	10.40	17.84	20.75	15.31	19.00	5.96	8.16	6.55	2.72
	KOSPI	TW	N225	TASI	ADG	T50	KPI			
Mean	0.003509	0.000833	−0.001175	−0.001062	−0.001095	0.001404	2.80E-05			
Median	0.005463	0.003021	0.000889	0.004332	−0.003402	0.001215	0.004272			
Maximum	0.055077	0.060705	0.052499	0.077718	0.155944	0.061554	0.067175			
Minimum	−0.114268	−0.090608	−0.118200	−0.109962	−0.087232	−0.050422	−0.117790			
SD	0.028291	0.028531	0.027121	0.040564	0.034621	0.024505	0.026535			
Skewness	−0.864575	−0.451206	−1.027242	−0.569624	0.927030	0.121458	−1.147497			
Kurtosis	5.232237	3.516009	5.731225	3.256845	7.326735	2.656217	6.753123			
Jarque-Bera	29.89816***	4.052296	43.80185***	5.114455	83.09316***	0.664481	72.57349***			
Risk-adjusted return (mean/SD [in%])	12.40	2.92	−4.33	−2.62	−3.16	5.73	0.11			
Pre-crisis period (January, 2005-June, 2007)										
	NIFTY	K100	CSEALL	JACO	KLCO	PSECO	ST	SET50	SHCO	SP500
Mean	0.010571	0.011511	0.007741	0.011006	0.005798	0.010112	0.007828	0.002316	0.015985	0.003119
Median	0.013323	0.019620	0.011820	0.013475	0.005236	0.012720	0.009098	0.007082	0.014221	0.004553
Maximum	0.048692	0.087847	0.054964	0.044113	0.038800	0.044511	0.026626	0.031861	0.105328	0.018405
Minimum	−0.041922	−0.063441	−0.076501	−0.051501	−0.017597	−0.026983	−0.039476	−0.043470	−0.043605	−0.013639
SD	0.024355	0.031678	0.029588	0.021769	0.013059	0.020339	0.013446	0.021242	0.034094	0.008949
Skewness	−0.720021	−0.150651	−0.853219	−1.182472	0.704494	−0.198691	−1.650132	−0.568884	0.460329	−0.215969
Kurtosis	2.862401	3.059587	3.872198	4.324299	3.453570	2.233501	6.508184	2.329587	3.269423	1.984659
Jarque–Bera	2.615817	0.117917	4.590824	9.183414***	2.738717	0.931792	28.99887***	2.179964	1.150248	1.521859
Risk-adjusted return (mean/SD [in%])	43.40	36.34	26.16	50.56	44.40	49.72	58.22	10.90	46.89	34.85
	KOSPI	TW	N225	TASI	ADG	T50	KPI			
Mean	0.009639	0.005347	0.006611	−0.002302	0.002077	−0.003578	0.009160			
Median	0.010711	0.005466	0.005906	0.004715	−0.003402	−0.002079	0.014747			
Maximum	0.051958	0.037682	0.038820	0.069494	0.155944	0.038256	0.067175			
Minimum	−0.032389	−0.025906	−0.038631	−0.099248	−0.070186	−0.039949	−0.066825			
SD	0.022785	0.017233	0.016736	0.048491	0.045142	0.019730	0.026369			
Skewness	0.018266	0.099647	−0.274652	−0.321517	1.354962	0.104518	−0.540784			
Kurtosis	2.224718	2.229358	3.820878	2.151941	5.998789	2.219073	4.084391			
Jarque-Bera	0.752997	0.792010	1.219470	1.415871	20.42053***	0.816929	2.932116			
Risk-adjusted return (mean/SD [in%])	42.30	31.03	39.50	−4.75	4.60	−18.13	34.74			
During-the-crisis period (July, 2007-December, 2009)										
	NIFTY	K100	CSEALL	JACO	KLCO	PSECO	ST	SET50	SHCO	SP500
Mean	0.002693	−0.005550	0.003977	0.002453	−0.000900	−0.002647	−0.002932	−0.000793	−0.002222	−0.004325

(*Contd...*)

Table 1: (*Continued*)

Variables	NIFTY	K100	CSEALL	JACO	KLCO	PSECO	ST	SET50	SHCO	SP500
Median	0.004959	0.001212	0.002168	0.008023	0.003421	0.004864	−0.001355	0.003256	0.019175	0.001735
Maximum	0.107434	0.078376	0.083402	0.079657	0.055169	0.059867	0.083820	0.062681	0.068265	0.038988
Minimum	−0.133183	−0.194910	−0.070436	−0.163815	−0.071720	−0.119597	−0.118841	−0.159838	−0.122810	−0.080017
SD	0.048914	0.050423	0.036759	0.045927	0.024799	0.034828	0.039442	0.045938	0.056865	0.027626
Skewness	−0.572187	−1.891660	0.410353	−1.506841	−0.513719	−1.136998	−0.577740	−1.343316	−0.825524	−0.729942
Kurtosis	3.797974	8.007720	2.978812	6.964337	4.115285	5.652153	4.435434	5.898024	2.388339	3.248550
Jarque-Bera	2.432942	49.23846***	0.842510	30.99781***	2.874361	15.25622***	4.244507	19.52067***	3.875111	2.741294
Risk-adjusted return (mean/SD [in%])	5.51	−11.01	10.82	5.34	−3.63	−7.60	−7.43	−1.73	−3.91	−15.66
	KOSPI	TW	N225	TASI	ADG	T50	KPI			
Mean	−0.000514	−0.001180	−0.007850	−0.001940	−0.003708	−0.005909	−0.007873			
Median	0.002228	0.004768	−0.003813	0.003285	0.001823	−0.009473	0.003893			
Maximum	0.055077	0.060705	0.052499	0.077718	0.083814	0.061554	0.049342			
Minimum	−0.114268	−0.090608	−0.118200	−0.109962	−0.087232	−0.050422	−0.117790			
SD	0.037223	0.040561	0.035150	0.046931	0.037145	0.024176	0.033681			
Skewness	−0.901312	−0.309329	−0.874321	−0.647403	−0.311292	0.589319	−1.230853			
Kurtosis	4.258919	2.297094	4.590387	3.027661	3.162983	3.455848	5.028956			
Jarque-Bera	6.042910**	1.096019	6.983846**	2.096607	0.517718	1.996233	12.72083***			
Risk-adjusted return (mean/SD [in%])	−1.38	−2.91	−22.33	−4.13	−9.98	−24.44	−23.38			
Post-crisis period (January, 2010-June, 2012)										
	NIFTY	K100	CSEALL	JACO	KLCO	PSECO	ST	SET50	SHCO	SP500
Mean	0.000215	0.005580	0.005545	0.006445	0.003305	0.007839	−9.62E-05	0.006475	−0.005603	0.002897
Median	−0.002394	0.009708	0.001691	0.012613	0.005401	0.013094	0.001622	0.013074	−0.002584	0.005027
Maximum	0.050895	0.035215	0.092262	0.055414	0.031620	0.060582	0.040751	0.041262	0.049873	0.044431
Minimum	−0.046951	−0.048490	−0.049795	−0.037734	−0.029449	−0.036317	−0.043505	−0.069699	−0.044314	−0.037146
SD	0.025434	0.022303	0.030962	0.022740	0.013022	0.022105	0.020350	0.026140	0.024737	0.020842
Skewness	0.177952	−0.956012	0.623002	−0.416236	−0.425695	−0.218219	−0.364241	−0.995832	0.334967	−0.142992
Kurtosis	2.479775	3.209274	3.401364	2.791115	3.221288	3.001545	2.531196	3.645986	2.317483	2.310830
Jarque-Bera	0.496627	4.624543	2.142021	0.920803	0.967292	0.238100	0.938080	5.480030	1.143302	0.695928
Risk-adjusted return (mean/SD [in%])	0.85	25.02	17.91	28.34	25.38	35.46	−0.47	24.77	−22.65	13.90
	KOSPI	TW	N225	TASI	ADG	T50	KPI			
Mean	0.001403	−0.001670	−0.002284	0.001057	−0.001653	0.013698	−0.001203			
Median	0.002411	−0.000367	0.000566	0.002506	−0.006574	0.016471	0.002007			
Maximum	0.035958	0.034067	0.043204	0.043187	0.032061	0.056014	0.020740			
Minimum	−0.054850	−0.047907	−0.053816	−0.050040	−0.027925	−0.050390	−0.037232			
SD	0.022168	0.022897	0.025131	0.022108	0.015592	0.025134	0.013368			
Skewness	−0.386020	−0.204447	−0.244324	−0.258723	0.632366	−0.613177	−0.518077			
Kurtosis	2.772278	2.173263	2.409447	2.722300	2.618810	3.423457	3.195904			
Jarque-Bera	0.809879	1.063360	0.734413	0.431085	2.181068	2.104076	1.389994			
Risk-adjusted return (mean/SD [in%])	6.33	−7.29	−9.09	4.78	−10.60	54.50	−9.00			

*** and **denote significance at 1% and 5% levels respectively. SD: Standard deviation

Table 2: DF-GLS unit root tests results

Log level (χ_t)			First difference ($\Delta\chi_t$)			I (d)
Variables	SBC lag	DF-GLS statistics	Variables	SBC lag	DF-GLS statistics	
Overall study period (January, 2005-June, 2012) (maxlag=12)						
NIFTY	0	−8.598328***	NIFTY	0	−13.65094	I (0)
K100	0	−7.621255***	K100	6	−0.641969	I (0)
CSEALL	0	−7.048843***	CSEALL	0	−13.24758	I (0)
JACO	0	−7.309445***	JACO	1	−11.62837	I (0)
KLCO	0	−7.584664***	KLCO	0	−14.65802	I (0)
PSECO	0	−7.348201***	PSECO	5	−1.312211	I (0)
ST	0	−7.388075***	ST	2	−8.691770	I (0)
SET50	0	−7.705750***	SET50	1	−12.55580	I (0)
SHCO	1	−4.620578***	SHCO	4	−0.841914	I (0)
SP500	0	−7.216337***	SP500	4	−1.349212	I (0)
KOSPI	0	−9.256966***	KOSPI	4	−1.910201	I (0)
TW	0	−7.807299***	TW	4	−1.801695	I (0)
N225	0	−7.770454***	N225	4	−1.983676	I (0)
TASI	0	−7.985584***	TASI	9	−0.464707	I (0)
ADG	0	−6.313573***	ADG	0	−12.61531	I (0)
T50	0	−4.998420***	T50	0	−10.69433	I (0)
KPI	0	−5.619277***	KPI	0	−11.84396	I (0)
Pre-crisis period (January, 2005-June, 2007) (maxlag=4)						
NIFTY	0	−5.430406***	NIFTY	0	−8.444036	I (0)
K100	0	−4.974379***	K100	2	−2.996037	I (0)
CSEALL	0	−5.162044***	CSEALL	0	−8.589970	I (0)
JACO	0	−5.557929***	JACO	0	−7.996799	I (0)
KLCO	0	−5.913069***	KLCO	0	−9.682394	I (0)
PSECO	0	−6.217344***	PSECO	0	−8.319655	I (0)
ST	0	−5.829731***	ST	0	−10.37565	I (0)
SET50	0	−5.829731***	SET50	0	−10.37565	I (0)
SHCO	1	−4.501032***	SHCO	3	−1.477562	I (0)
SP500	0	−6.074357***	SP500	0	−7.899322	I (0)
KOSPI	0	−6.199902***	KOSPI	0	−10.62961	I (0)
TW	0	−5.356506***	TW	0	−6.785833	I (0)
N225	0	−4.613567***	N225	0	−7.909065	I (0)
TASI	0	−5.454456***	TASI	0	−8.829050	I (0)
ADG	0	−3.825206***	ADG	0	−6.858702	I (0)
T50	0	−2.653410	T50	0	−5.402315***	I (1)
KPI	0	−4.629282***	KPI	0	8.685111	I (0)
During-the-crisis period (July, 2007-December, 2009) (maxlag=4)						
NIFTY	0	−4.721230***	NIFTY	0	−8.404769	I (0)
K100	0	−4.423083***	K100	0	−6.952493	I (0)
CSEALL	0	−4.008534***	CSEALL	0	−5.821331	I (0)
JACO	0	−3.607540**	JACO	0	−5.705868	I (0)
KLCO	0	−4.270772***	KLCO	0	−6.953356	I (0)
PSECO	0	−5.020567***	PSECO	0	−9.239352	I (0)
ST	0	−3.929500***	ST	0	−8.010963	I (0)
SET50	0	−4.216811***	SET50	0	−6.313121	I (0)
SHCO	1	−2.643099	SHCO	0	−12.38232***	I (1)
SP500	4	−2.603392	SP500	3	−1.789184*	I (1)
KOSPI	0	−4.932060***	KOSPI	0	−7.732941	I (0)
TW	0	−4.345442***	TW	0	−9.047443	I (0)
N225	0	−4.130907***	N225	0	−6.424525	I (0)
TASI	0	−4.376869***	TASI	2	−5.935665	I (0)
ADG	0	−3.352822**	ADG	0	−8.240715	I (0)
T50	0	−2.977296*	T50	0	−7.024517	I (0)
KPI	0	−2.455640	KPI	0	−5.227353***	I (1)

(*Contd...*)

Table 2: (*Continued*)

Log level (χ_t)			First difference ($\Delta\chi_t$)			I (d)
Variables	**SBC lag**	**DF-GLS statistics**	**Variables**	**SBC lag**	**DF-GLS statistics**	
Post-crisis period (January, 2010-June, 2012) (maxlag=4)						
NIFTY	2	−2.449658	NIFTY	2	−1.898775*	I (1)
K100	1	−5.436422***	K100	1	−7.975089	I (0)
CSEALL	0	−5.774971***	CSEALL	1	−6.801768	I (0)
JACO	0	−6.582617***	JACO	1	−8.583776	I (0)
KLCO	0	−5.432146***	KLCO	0	−8.266782	I (0)
PSECO	0	−5.654623***	PSECO	0	−7.166694	I (0)
ST	0	−5.580975***	ST	2	−1.983817	I (0)
SET50	0	−5.299348***	SET50	0	−5.927836	I (0)
SHCO	0	−5.600636***	SHCO	0	−6.825828	I (0)
SP500	0	−5.436634***	SP500	0	−6.685610	I (0)
KOSPI	2	−2.134505	KOSPI	2	−2.420581**	I (1)
TW	0	−4.973828***	TW	0	−7.108703	I (0)
N225	0	−5.234598***	N225	0	−6.830476	I (0)
TASI	0	−4.382427***	TASI	1	−6.077855	I (0)
ADG	0	−4.821275***	ADG	0	−5.587857	I (0)
T50	0	−3.936158***	T50	0	−5.780648	I (0)
KPI	0	−3.855950***	KPI	0	−5.429991	I (0)

The DF-GLS statistic are compared to the critical values from the simulated MacKinnon Table in ERS (1996, Table 1, P 825). ***.** and * denotes the rejection of the null at 1%, 5% and 10% significance level. Results obtained from Eviews 7. DF-GLS: Dickey-Fuller generalized least squares, SBC: Schwartz Bayesian Criterion

Table 3: F-statistics results for examining long-run co-integration (India, Pakistan, Sri Lanka, Indonesia, Malaysia, Philippines, Singapore, Thailand, China and the USA)

Period	Equation	Computed F-statistic	Outcome
Overall study period (January, 2005-June, 2012)	F_{NIFTY} [*NIFTY|K100, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO, SP500*]	2.542738	No Co-integration
	F_{K100} [*K100|NIFTY, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO, SP500*]	3.741712	Co-integration**
	F_{CSEALL} [*CSEALL|NIFTY, K100, JACO, KLCO, PSECO, ST, SET50, SHCO, SP500*]	4.937133	Co-integration***
	F_{JACO} [*JACO|NIFTY, K100, CSEALL, KLCO, PSECO, ST, SET50, SHCO, SP500*]	2.249642	No Co-integration
	F_{KLCO} [*KLCO|NIFTY, K100, CSEALL, JACO, PSECO, ST, SET50, SHCO, SP500*]	5.636599	Co-integration***
	F_{PSECO} [*PSECO|NIFTY, K100, CSEALL, JACO, KLCO, ST, SET50, SHCO, SP500*]	5.838676	Co-integration***
	F_{ST} [*ST|NIFTY, K100, CSEALL, JACO, KLCO, PSECO, SET50, SHCO, SP500*]	3.165462	Co-integration*
	F_{SET50} [*SET50|NIFTY, K100, CSEALL, JACO, KLCO, PSECO, ST, SHCO, SP500*]	4.314295	Co-integration***
	F_{SHCO} [*SHCO|NIFTY, K100, CSEALL, JACO, KLCO, PSECO, ST, SET50, SP500*]	4.774155	Co-integration***
	F_{SP500} [*SP500|NIFTY, K100, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO*]	3.912669	Co-integration**
Pre-crisis period (January, 2005-June, 2007)	F_{NIFTY} [*NIFTY|K100, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO, SP500*]	1.982053	No Co-integration
	F_{K100} [*K100|NIFTY, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO, SP500*]	0.751328	No Co-integration
	F_{CSEALL} [*CSEALL|NIFTY, K100, JACO, KLCO, PSECO, ST, SET50, SHCO, SP500*]	0.855244	No Co-integration
	F_{JACO} [*JACO|NIFTY, K100, CSEALL, KLCO, PSECO, ST, SET50, SHCO, SP500*]	3.526333	Co-integration**
	F_{KLCO} [*KLCO|NIFTY, K100, CSEALL, JACO, PSECO, ST, SET50, SHCO, SP500*]	1.925652	No Co-integration
	F_{PSECO} [*PSECO|NIFTY, K100, CSEALL, JACO, KLCO, ST, SET50, SHCO, SP500*]	2.212084	No Co-integration

(*Contd...*)

Table 3: (*Continued*)

Period	Equation	Computed F-statistic	Outcome
	$F_{ST}\,[ST \mid NIFTY, K100, CSEALL, JACO, KLCO, PSECO, SET50, SHCO, SP500]$	0.544458	No Co-integration
	$F_{SET50}\,[SET50 \mid NIFTY, K100, CSEALL, JACO, KLCO, PSECO, ST, SHCO, SP500]$	1.836805	No Co-integration
	$F_{SHCO}\,[SHCO \mid NIFTY, K100, CSEALL, JACO, KLCO, PSECO, ST, SET50, SP500]$	1.104213	No Co-integration
	$F_{SP500}\,[SP500 \mid NIFTY, K100, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO]$	4.893655	Co-integration***
During-the-crisis period (July, 2007-December, 2009)	$F_{NIFTY}\,[NIFTY \mid K100, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO, SP500]$	6.409653	Co-integration***
	$F_{K100}\,[K100 \mid NIFTY, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO, SP500]$	4.587589	Co-integration***
	$F_{CSEALL}\,[CSEALL \mid NIFTY, K100, JACO, KLCO, PSECO, ST, SET50, SHCO, SP500]$	10.98273	Co-integration***
	$F_{JACO}\,[JACO \mid NIFTY, K100, CSEALL, KLCO, PSECO, ST, SET50, SHCO, SP500]$	1.610591	No Co-integration
	$F_{KLCO}\,[KLCO \mid NIFTY, K100, CSEALL, JACO, PSECO, ST, SET50, SHCO, SP500]$	4.577212	Co-integration***
	$F_{PSECO}\,[PSECO \mid NIFTY, K100, CSEALL, JACO, KLCO, ST, SET50, SHCO, SP500]$	8.002944	Co-integration***
	$F_{ST}\,[ST \mid NIFTY, K100, CSEALL, JACO, KLCO, PSECO, SET50, SHCO, SP500]$	1.883647	No Co-integration
	$F_{SET50}\,[SET50 \mid NIFTY, K100, CSEALL, JACO, KLCO, PSECO, ST, SHCO, SP500]$	2.041457	No Co-integration
	$F_{SHCO}\,[SHCO \mid NIFTY, K100, CSEALL, JACO, KLCO, PSECO, ST, SET50, SP500]$	2.199211	No Co-integration
	$F_{SP500}\,[SP500 \mid NIFTY, K100, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO]$	2.831856	Inconclusive
Post-crisis period (January, 2010-June, 2012)	$F_{NIFTY}\,[NIFTY \mid K100, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO, SP500]$	5.016047	Co-integration***
	$F_{K100}\,[K100 \mid NIFTY, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO, SP500]$	1.891075	No Co-integration
	$F_{CSEALL}\,[CSEALL \mid NIFTY, K100, JACO, KLCO, PSECO, ST, SET50, SHCO, SP500]$	0.406888	No Co-integration
	$F_{JACO}\,[JACO \mid NIFTY, K100, CSEALL, KLCO, PSECO, ST, SET50, SHCO, SP500]$	0.898048	No Co-integration
	$F_{KLCO}\,[KLCO \mid NIFTY, K100, CSEALL, JACO, PSECO, ST, SET50, SHCO, SP500]$	2.152291	No Co-integration
	$F_{PSECO}\,[PSECO \mid NIFTY, K100, CSEALL, JACO, KLCO, ST, SET50, SHCO, SP500]$	5.079057	Co-integration***
	$F_{ST}\,[ST \mid NIFTY, K100, CSEALL, JACO, KLCO, PSECO, SET50, SHCO, SP500]$	3.594037	Co-integration**
	$F_{SET50}\,[SET50 \mid NIFTY, K100, CSEALL, JACO, KLCO, PSECO, ST, SHCO, SP500]$	0.823784	No Co-integration
	$F_{SHCO}\,[SHCO \mid NIFTY, K100, CSEALL, JACO, KLCO, PSECO, ST, SET50, SP500]$	1.444186	No Co-integration
	$F_{SP500}\,[SP500 \mid NIFTY, K100, CSEALL, JACO, KLCO, PSECO, ST, SET50, SHCO]$	1.262844	No Co-integration

The relevant critical value bounds are taken from Pearson et al. (2001), where the critical values in case of nine regressors are – 2.65-3.97 at the 1% significance level (***), 2.14-3.30 at the 5% significance level (**) and 1.88-2.99 at the 10% significance level (*). For example, *denotes that the computed F-statistics is above the 90% upper bound and ** denotes it is above the 95% upper bound. Results obtained from Eviews 7

no long-run co-integrating relationships. In the pre-crisis period also, except when JACO and SP500 (under set 1) are the dependent variables, no long-run co-integration are found in between the Asian and US markets. All these results indicate that there were portfolio diversification opportunities in above periods in selected Asian markets. However, in the post-crisis period under set two countries significant co-integration were found except when NIFTY, T50 (inconclusive), SHCO and SP500 are the dependent variables. In the first set countries also, no co-integration were found when the Chinese and the US market indices were dependent variables. This implies that the Chinese and the US markets were the most profitable investment destinations for the Asian including Indian investors post-US crisis.

Once I established existence of long-run co-integrating relationships in between these stock markets log returns, equation (7) was estimated using the respective ARDL specifications for the overall study period and all sub-periods.

Table 4: F-statistics results for examining long-run co-integration (India, South Korea, Taiwan, Japan, Saudi Arabia, UAE, Iran, Kuwait, China and the USA)

Period	Equation	Computed F-statistic	Outcome
Overall study period (January, 2005-June, 2012)	F_{NIFTY} [NIFTY|KOSPI, TW, N225, TASI, ADG, T50, KPI, SHCO, SP500]	3.803187	Co-integration**
	F_{KOSPI} [KOSPI|NIFTY, TW, N225, TASI, ADG, T50, KPI, SHCO, SP500]	4.474550	Co-integration***
	F_{TW} [TW|NIFTY, KOSPI, N225, TASI, ADG, T50, KPI, SHCO, SP500]	5.443806	Co-integration***
	F_{N225} [N225|NIFTY, KOSPI, TW, TASI, ADG, T50, KPI, SHCO, SP500]	4.593034	Co-integration***
	F_{TASI} [TASI|NIFTY, KOSPI, TW, N225, ADG, T50, KPI, SHCO, SP500]	2.969864	Inconclusive
	F_{ADG} [ADG|NIFTY, KOSPI, TW, N225, TASI, T50, KPI, SHCO, SP500]	1.285908	No co-integration
	F_{T50} [T50|NIFTY, KOSPI, TW, N225, TASI, ADG, KPI, SHCO, SP500]	0.870285	No co-integration
	F_{KPI} [KPI|NIFTY, KOSPI, TW, N225, TASI, ADG, T50, SHCO, SP500]	1.862425	No co-integration
	F_{SHCO} [SHCO|NIFTY, KOSPI, TW, N225, TASI, ADG, T50, KPI, SP500]	3.784230	Co-integration**
	F_{SP500} [SP500|NIFTY, KOSPI, TW, N225, TASI, ADG, T50, KPI, SHCO]	4.528689	Co-integration***
Pre-crisis period (January, 2005-June, 2007)	F_{NIFTY} [NIFTY|KOSPI, TW, N225, TASI, ADG, T50, KPI, SHCO, SP500]	2.077869	No co-integration
	F_{KOSPI} [KOSPI|NIFTY, TW, N225, TASI, ADG, T50, KPI, SHCO, SP500]	0.732295	No co-integration
	F_{TW} [TW|NIFTY, KOSPI, N225, TASI, ADG, T50, KPI, SHCO, SP500]	1.419462	No co-integration
	F_{N225} [N225|NIFTY, KOSPI, TW, TASI, ADG, T50, KPI, SHCO, SP500]	1.146697	No co-integration
	F_{TASI} [TASI|NIFTY, KOSPI, TW, N225, ADG, T50, KPI, SHCO, SP500]	0.823265	No co-integration
	F_{ADG} [ADG|NIFTY, KOSPI, TW, N225, TASI, T50, KPI, SHCO, SP500]	1.420010	No co-integration
	F_{T50} [T50|NIFTY, KOSPI, TW, N225, TASI, ADG, KPI, SHCO, SP500]	1.441615	No co-integration
	F_{KPI} [KPI|NIFTY, KOSPI, TW, N225, TASI, ADG, T50, SHCO, SP500]	1.141321	No co-integration
	F_{SHCO} [SHCO|NIFTY, KOSPI, TW, N225, TASI, ADG, T50, KPI, SP500]	1.150635	No co-integration
	F_{SP500} [SP500|NIFTY, KOSPI, TW, N225, TASI, ADG, T50, KPI, SHCO]	0.618356	No co-integration
During-the-crisis period (July, 2007-December, 2009)	F_{NIFTY} [NIFTY|KOSPI, TW, N225, TASI, ADG, T50, KPI, SHCO, SP500]	1.448928	No co-integration
	F_{KOSPI} [KOSPI|NIFTY, TW, N225, TASI, ADG, T50, KPI, SHCO, SP500]	2.834800	Inconclusive
	F_{TW} [TW|NIFTY, KOSPI, N225, TASI, ADG, T50, KPI, SHCO, SP500]	2.629543	No co-integration
	F_{N225} [N225|NIFTY, KOSPI, TW, TASI, ADG, T50, KPI, SHCO, SP500]	1.529474	No co-integration
	F_{TASI} [TASI|NIFTY, KOSPI, TW, N225, ADG, T50, KPI, SHCO, SP500]	1.811209	No co-integration
	F_{ADG} [ADG|NIFTY, KOSPI, TW, N225, TASI, T50, KPI, SHCO, SP500]	0.665056	No co-integration
	F_{T50} [T50|NIFTY, KOSPI, TW, N225, TASI, ADG, KPI, SHCO, SP500]	0.941263	No co-integration
	F_{KPI} [KPI|NIFTY, KOSPI, TW, N225, TASI, ADG, T50, SHCO, SP500]	1.279396	No co-integration
	F_{SHCO} [SHCO|NIFTY, KOSPI, TW, N225, TASI, ADG, T50, KPI, SP500]	1.806917	No co-integration
	F_{SP500} [SP500|NIFTY, KOSPI, TW, N225, TASI, ADG, T50, KPI, SHCO]	1.501623	No co-integration
Post-crisis period (January, 2010-June, 2012)	F_{NIFTY} [NIFTY|KOSPI, TW, N225, TASI, ADG, T50, KPI, SHCO, SP500]	2.077869	No co-integration
	F_{KOSPI} [KOSPI|NIFTY, TW, N225, TASI, ADG, T50, KPI, SHCO, SP500]	5.893446	Co-integration***
	F_{TW} [TW|NIFTY, KOSPI, N225, TASI, ADG, T50, KPI, SHCO, SP500]	3.729750	Co-integration**
	F_{N225} [N225|NIFTY, KOSPI, TW, TASI, ADG, T50, KPI, SHCO, SP500]	3.512004	Co-integration**
	F_{TASI} [TASI|NIFTY, KOSPI, TW, N225, ADG, T50, KPI, SHCO, SP500]	3.022003	Co-integration*
	F_{ADG} [ADG|NIFTY, KOSPI, TW, N225, TASI, T50, KPI, SHCO, SP500]	3.703991	Co-integration**
	F_{T50} [T50|NIFTY, KOSPI, TW, N225, TASI, ADG, KPI, SHCO, SP500]	2.688970	Inconclusive
	F_{KPI} [KPI|NIFTY, KOSPI, TW, N225, TASI, ADG, T50, SHCO, SP500]	1.796044	No co-integration
	F_{SHCO} [SHCO|NIFTY, KOSPI, TW, N225, TASI, ADG, T50, KPI, SP500]	1.200554	No co-integration
	F_{SP500} [SP500|NIFTY, KOSPI, TW, N225, TASI, ADG, T50, KPI, SHCO]	4.482741	Co-integration***

The relevant critical value bounds are taken from Pearson et al. (2001), where the critical values in case of four regressors are – 2.86-4.01 at the 5% significance level (**) and 2.45-3.52 at the 10% significance level (*). *Denotes that the computed F-statistics is above the 90% upper bound and **denotes it is above the 95% upper bound, #at the 5% significance level. (3) Results obtained from Eviews 7

Tables 5 and 6 show the results of the short-run dynamic coefficients associated with the long-run co-integrating relationships (only the significant ones) as obtained from the ECM equation (8) with respective dependent variables of NIFTY, SHCO and SP500 under both sets of equations comprising the Asian countries and the US.

It is found from Tables 5 and 6 that estimated coefficients of the long-run relationships show that the Philippines, Thailand, the Republic of Korean, "Taiwan Province of China," Kuwait and the US market returns had a very high significant impact on the Indian stock market returns in the overall study period. For example, a 1% increase in Philippines and Thailand stock market returns had caused 0.23% and 0.22% (approximately) respectively NIFTY returns. Also, a 1% increase (decrease) in KOSPI, TW, (KPI) and SP500 had caused 0.36% (approximately), 0.29% (approximately), -0.24% and 0.43% NIFTY returns. The Singapore market was also co-integrated with the Indian and US markets in the long-run.

But, except the US market (except post-crisis period), no other above markets had significant long-run associations with the Indian market in sub-periods. In during-the-crisis and post-crisis period NIFTY is significantly co-integrated with some of its

Table 5: Estimated long- and short-run coefficients (India, Pakistan, Sri Lanka, Indonesia, Malaysia, Philippines, Singapore, Thailand, China and the USA)

Dependent variable: NIFTY					
Long-run		**Short-run**		**Diagnostic tests**	
Regressors	**Coefficients**	**Regressors**	**Coefficients**		
Overall study period (January, 2005-June, 2012) [ARDL 0,0,0,0,0,0,1,0,0,0]					
PSECO	0.23463** (1.9809)	ΔPSECO	0.23463**	R^2	0.73584
SET50	0.21899** (2.0888)	ΔSET50	(1.9809)	$\bar{R}^2$	0.69810
		ECT(−1)	0.21899**	DW	2.1229
			(2.0888)	χ^2_{Auto}	14.1661
			−1.0000 (None)	χ^2_{Norm}	[0.290]
				χ^2_{Reset}	1.0674
					[0.586]
					1.2293
					[0.268]
Pre-crisis period (January, 2005-June, 2007) [ARDL 1,0,0,1,0,0,0,0,0,1]					
SP500	2.7297***	ΔSP500	1.7508**	R^2	0.79606
	(3.7215)	ECT(−1)	(2.4858)	$\bar{R}^2$	0.61931
			−1.4343***	DW	2.1425
			(−5.4193)	χ^2_{Auto}	17.6952
				χ^2_{Norm}	[0.125]
				χ^2_{Reset}	0.36427
					[0.833]
					1.3584
					[0.244]
During-the-crisis period (July, 2007-December, 2009) [ARDL 1,1,1,1,1,1,0,0,0,1]					
JACO	−0.62541**	ΔK100	−0.23637**	R^2	0.94761
PSECO	(−2.7138)	ΔCSEALL	(−2.4012)	$\bar{R}^2$	0.86663
ST	1.4487***	ΔJACO	0.75358**	DW	1.3961
SP500	(5.0866)	ΔKLCO	(2.6796)	χ^2_{Auto}	4.3350
	0.42547*	ΔPSECO	−0.48872*	χ^2_{Norm}	[0.037]
	(1.8975)	ΔST	(−1.9151)	χ^2_{Reset}	1.4598
	−0.59470*	ECT(−1)	0.69489*		[0.482]
	(−1.8698)		(1.8461)		1.2547
			0.87851***		[0.263]
			(3.7421)		
			0.64005*		
			(2.0762)		
			−1.5043***		
			(−7.9998)		
Post-crisis period (January, 2010-June, 2012) [ARDL 1,1,1,1,0,0,1,1,1,0]					
PSECO	0.66131***	ΔK100	0.31983*	R^2	0.93733
ST	(4.4489)	ΔPSECO	(1.8052)	$\bar{R}^2$	0.84048
SET50	1.1888***	ΔST	0.94721***	DW	2.0403
	(4.4871)	ECT(−1)	(4.5375)	χ^2_{Auto}	0.33729
	−0.38383**		0.90221***	χ^2_{Norm}	[0.561]
	(−2.1078)		(3.5561)	χ^2_{Reset}	0.36435
			−1.4323***		[0.833]
			(−7.8481)		2.1233
					[0.145]
Dependent variable: SHCO					
Overall study period (January, 2005-June, 2012) [ARDL 0,0,0,0,0,0,0,0,0,0]					
KLCO	0.88471***	ΔKLCO	0.88471***	R^2	0.36919
	(2.5711)	ECT(−1)	(2.5711)	$\bar{R}^2$	0.28832
			−1.0000 (None)	DW	2.1086
				χ^2_{Auto}	8.1909
				χ^2_{Norm}	[0.770]
				χ^2_{Reset}	2.8252
					[0.244]
					2.2053
					[0.138]

(*Contd...*)

Table 5: (*Continued*)

Dependent variable: NIFTY					
Long-run		**Short-run**		**Diagnostic tests**	
Regressors	**Coefficients**	**Regressors**	**Coefficients**		
Pre-crisis period (January, 2005-June, 2007) [ARDL 0,0,0,0,0,1,0,0,0,0]					
KLCO	2.6046***	ΔKLCO	1.4502**	R^2	0.48200
	(2.5901)	ECT(−1)	(2.0476)	$\bar{R}^2$	0.14682
			−1.0000 (None)	DW	1.8316
				χ^2_{Auto}	12.7946
				χ^2_{Norm}	[0.384]
				χ^2_{Reset}	0.81757
					[0.664]
					0.010020
					[0.920]
During-the-crisis period (July, 2007-December, 2009) [ARDL 0,0,0,0,1,0,0,0,1,1]					
CSEALL	0.69121*	ΔCSEALL	0.69121*	R^2	0.75442
JACO	(1.7847)	ΔJACO	(1.7847)	$\bar{R}^2$	0.54159
KLCO	−1.1469**	ΔKLCO	−0.21076**	DW	1.9911
SET50	(−2.2107)	ECT(−1)	(−2.3553)	χ^2_{Auto}	25.2990
	1.2117*		1.2117*	χ^2_{Norm}	[0.013]
	(1.7571)		(1.7571)	χ^2_{Reset}	1.0057
	1.1356*		−1.0000 (None)		[0.605]
	(1.9867)				0.99912
					[0.318]
Post-crisis period (January, 2010-June, 2012) [ARDL 0,0,0,1,0,0,0,0,0,0]					
CSEALL	0.48969**	ΔSET50	0.40442*	R^2	0.71140
SET50	(2.3689)	ΔSP500	(1.7416)	$\bar{R}^2$	0.52467
SP500	0.40442*	ECT(−1)	0.55788**	DW	2.6532
	(1.7416)		(2.2484)	χ^2_{Auto}	22.7216
	0.55788**		−1.0000 (None)	χ^2_{Norm}	[0.030]
	(2.2484)			χ^2_{Reset}	2.7470
					[0.253]
					0.38098
					[0.537]
Dependent variable: S&P500					
Overall study period (January, 2005-June, 2012) [ARDL 0,0,1,0,0,0,0,0,0,0]					
K100	0.12097***	ΔST	0.42338***	R^2	0.69313
ST	(2.4477)	ECT(−1)	(3.9195)	$\bar{R}^2$	0.64929
	0.42338***		−1.0000 (None)	DW	2.0114
	(3.9195)			χ^2_{Auto}	23.6868
				χ^2_{Norm}	[0.022]
				χ^2_{Reset}	2.3957
					[0.302]
					0.86524
					[0.352]
Pre-crisis period (January, 2005-June, 2007) [ARDL 0,1,1,0,1,1,0,1,1,1]					
JACO	0.31517***	ΔNIFTY	0.13766***	R^2	0.93343
KLCO	(3.1464)	ΔPSECO	(3.1038)	$\bar{R}^2$	0.83055
PSECO	0.49079***	ΔSET50	0.093644*	DW	1.6989
ST	(2.7892)	ECT(−1)	(1.8177)	χ^2_{Auto}	0.40302
	0.093644*		0.11518**	χ^2_{Norm}	[0.526]
	(1.8177)		(2.2561)	χ^2_{Reset}	2.9248
	−0.40242**		−1.0000 (None)		[0.232]
	(−2.2255)				5.4326
					[0.020]

(*Contd...*)

Table 5: (*Continued*)

Dependent variable: NIFTY					
Long-run		Short-run		Diagnostic tests	
Regressors	Coefficients	Regressors	Coefficients		
During-the-crisis period (July, 2007-December, 2009) [ARDL 0,1,1,0,1,0,1,0,0,0]					
CSEALL	0.33935*	ΔK100	−0.15213**	R^2	0.89432
PSECO	(1.7139)	ΔCSEALL	(−2.1344)	$\bar{R}^2$	0.78863
ST	1.1599***	ΔPSECO	0.33935*	DW	1.7540
	(2.9990)	ΔST	(1.7139)	χ^2_{Auto}	27.9118
	0.52529***	ECT(−1)	0.38968**	χ^2_{Norm}	[0.006]
	(2.8531)		(2.0939)	χ^2_{Reset}	1.9822
			0.52529***		[0.371]
			(2.8531)		5.8328
			−1.0000 (None)		[0.016]
Post-crisis period (January, 2010-June, 2012) [ARDL 0,0,0,0,0,0,0,0,0,0]					
SHCO	0.27247** (2.0590)	ΔSHCO	0.27247** (2.0590)		
		ECT(−1)	−1.0000 (None)		

Auto is the Breusch-Godfrey lagrange multiplier test for auto or serial correlation. Norm is the Jarque-Bera normality test. RESET is the Ramsey test for functional form. ***,** and *Indicate significance at the 1%, 5% and 10% levels respectively and figures in parentheses and square brackets represent t-statistics and P value respectively. ARDL: Autoregressive distributed lag

Table 6: Estimated long- and short-run coefficients (India, South Korea, Taiwan, Japan, Saudi Arabia, UAE, Iran, Kuwait, China and the USA)

Dependent variable: NIFTY					
Long-run		Short-run		Diagnostic tests	
Regressors	Coefficients	Regressors	Coefficients		
Overall study period (January, 2005-June, 2012) [ARDL 0,0,0,0,0,0,0,0,0,0]					
KOSPI	0.35099*** (2.5969)	ΔKOSPI	0.35099*** (2.5969)	R^2	0.67472
TW	0.28755** (2.2706)	ΔTW	0.28755** (2.2706)	$\bar{R}^2$	0.63302
KPI	−0.24109** (−2.0356)	ΔKPI	−0.24109** (−2.0356)	DW	1.9098
SP500	0.43129** (2.2724)	ΔSP500	0.43129** (2.2724)	χ^2_{Auto}	22.9438 [0.028]
		ECT(−1)	−1.0000 (None)	χ^2_{Norm}	8.3928 [0.015]
				χ^2_{Reset}	2.4978 [0.114]
Pre-crisis period (January, 2005-June, 2007) [ARDL 0,0,1,0,1,1,1,0,0,0]					
N225	0.49767*** (2.9555)	ΔTW	0.73271*** (3.8551)	R^2	0.92211
SP500	0.75650* (1.8745)	ΔN225	0.49767*** (2.9555)	$\bar{R}^2$	0.84422
		ΔTASI	−0.14332** (−2.3325)	DW	2.1094
		ΔT50	−0.48182*** (−3.3918)	χ^2_{Auto}	28.9485 [0.004]
		ΔSP500	0.75650* (1.8745)	χ^2_{Norm}	1.1679 [0.558]
		ECT(−1)	−1.0000 (None)	χ^2_{Reset}	0.7416E−3 [0.978]
During-the-crisis period (July, 2007-December, 2009) [ARDL 0,0,0,0,0,0,0,0,0,0]					
SP500	0.92103** (2.2012)	ΔSP500	0.92103** (2.2012)	R^2	0.80980
		ECT(−1)	−1.0000 (None)	$\bar{R}^2$	0.70413
				DW	2.0222
				χ^2_{Auto}	23.0461 [0.027]
				χ^2_{Norm}	1.5124 [0.469]
				χ^2_{Reset}	2.0668 [0.151]
Post-crisis period (January, 2010-June, 2012) [ARDL 0,1,1,0,0,0,1,0,0,0]					
TW	0.97017***(2.8740)	ΔKOSPI	0.54188** (2.3590)	R^2	0.93019
ADG	0.56724** (2.6140)	ΔADG	0.56724** (2.6140)	$\bar{R}^2$	0.86969
		ECT(−1)	−1.0000 (None)	DW	1.6069
				χ^2_{Auto}	20.2000 [0.063]
				χ^2_{Norm}	6.8449 [0.033]
				χ^2_{Reset}	0.71328 [0.398]
Dependent variable: SHCO					
Overall study period (January, 2005-June, 2012) [ARDL 0,0,0,0,0,0,1,0,0,0]					
ADG	−0.31982** (−1.9246)	ECT(−1)	−1.0000 (None)	R^2	0.42480
				$\bar{R}^2$	0.34263
				DW	1.9570
				χ^2_{Auto}	16.7799 [0.158]
				χ^2_{Norm}	4.3939 [0.111]
				χ^2_{Reset}	0.64587 [0.422]

(*Contd...*)

Table 6: (*Continued*)

Dependent variable: NIFTY					
Long-run		**Short-run**		**Diagnostic tests**	
Regressors	**Coefficients**	**Regressors**	**Coefficients**		
Pre-crisis period (January, 2005-June, 2007) [ARDL 0,0,0,0,0,0,1,0,0,0]					
ADG	−0.39038** (−2.1323)	ECT(−1)	−1.0000 (None)	R^2	0.56268
				$\bar{R}^2$	0.27971
				DW	2.1110
				χ^2_{Auto}	21.0413 [0.050]
				χ^2_{Norm}	1.5156 [0.469]
				χ^2_{Reset}	13.3334 [0.000]
During-the-crisis period (July, 2007-December, 2009) [ARDL 0,0,1,1,0,1,1,0,0,0]					
KOSPI	−1.5847* (−1.8208)	ΔTASI	0.53536* (1.8035)	R^2	0.72211
TW	1.2824* (1.8077)	ΔKPI	−1.3035** (−2.2734)	$\bar{R}^2$	0.44421
TASI	1.2091*** (2.6866)	ECT(−1)	−1.0000 (None)	DW	2.0296
KPI	−1.3035** (−2.2734)			χ^2_{Auto}	15.7937 [0.201]
				χ^2_{Norm}	0.46543 [0.792]
				χ^2_{Reset}	4.1786 [0.041]
Post-crisis period (January, 2010-June, 2012) [ARDL 0,0,0,0,0,0,0,0,0,0]					
ADG	1.0369***	ΔADG	1.0369*** (2.7503)	R^2	0.63422
SP500	(2.7503)	ΔSP500	0.61198* (1.8789)	$\bar{R}^2$	0.43101
	0.61198*	ECT(−1)	−1.0000 (None)	DW	2.1517
	(1.8789)			χ^2_{Auto}	19.9924 [0.067]
				χ^2_{Norm}	0.64406 [0.725]
				χ^2_{Reset}	0.62461 [0.429]
Dependent variable: S&P500					
Overall study period (January, 2005-June, 2012) [ARDL 0,0,0,0,0,0,0,0,1,0]					
NIFTY	0.13289** (2.1499)	ΔNIFTY	0.13289** (2.1499)	R^2	0.71431
N225	0.26359*** (3.7478)	ΔN225	0.26359*** (3.7478)	$\bar{R}^2$	0.67350
KPI	0.22352*** (2.9685)	ECT(−1)	−1.0000 (None)	DW	2.2101
				χ^2_{Auto}	25.3341 [0.013]
				χ^2_{Norm}	1.3897 [0.499]
				χ^2_{Reset}	0.1197E−5 [1.000]
Pre-crisis period (January, 2005-June, 2007) [ARDL 0,0,0,0,0,0,0,0,0,1]					
NIFTY	0.28869*** (4.4404)	ΔNIFTY	0.28869*** (4.4404)	R^2	0.78691
KOSPI	0.18013** (2.5013)	ΔKOSPI	0.18013** (2.5013)	$\bar{R}^2$	0.64903
T50	0.11759* (1.9150)	ΔT50	0.11759* (1.9150)	DW	2.3615
SHCO	0.10462* (1.9239)	ECT(−1)	−1.0000 (None)	χ^2_{Auto}	15.7904 [0.201]
				χ^2_{Norm}	0.40319 [0.817]
				χ^2_{Reset}	0.47129 [0.492]
During-the-crisis period (July, 2007-December, 2009) [ARDL 0,0,0,0,0,0,0,0,0,0]					
NIFTY	0.23027** (2.2012)	ΔNIFTY	0.23027** (2.2012)	R^2	0.85097
KOSPI	0.26809** (2.0274)	ΔKOSPI	0.26809** (2.0274)	$\bar{R}^2$	0.76817
ADG	−0.20418* (−1.9882)	ΔADG	−0.20418* (−1.9882)	DW	2.0943
T50	0.32931** (2.0447)	ΔT50	0.32931** (2.0447)	χ^2_{Auto}	22.1139 [0.036]
		ECT(−1)	−1.0000 (None)	χ^2_{Norm}	1.2499 [0.535]
				χ^2_{Reset}	0.020909 [0.885]
Post-crisis period (January, 2010-June, 2012) [ARDL 1,1,1,0,0,0,0,0,1,0]					
NIFTY	−0.38151*** (−2.7853)	ΔKOSPI	0.98772*** (3.4012)	R^2	0.90954
KOSPI	1.0157*** (5.4516)	ΔTW	−0.43703* (−1.8575)	$\bar{R}^2$	0.81907
TW	−0.26984* (−2.0380)	ΔSHCO	0.29078*** (2.7523)	DW	1.4758
KPI	0.29137** (2.1491)	ECT(−1)	−1.6196*** (−8.5702)	χ^2_{Auto}	24.6816 [0.016]
SHCO	0.17954*** (2.7250)			χ^2_{Norm}	2.0372 [0.361]
				χ^2_{Reset}	3.2502 [0.071]

Auto is the Breusch-Godfrey lagrange multiplier test for auto or serial correlation. Norm is the Jarque-Bera normality test. RESET is the Ramsey test for functional form. ***,** and * indicate significance at the 1%, 5% and 10% levels respectively and figures in parentheses and square brackets represent t-statistics and P value respectively. ARDL: Autoregressive distributed lag

ASEAN peers, Taiwan (post-crisis only) and the US in the long-run. On the other hand, the Malaysian and UAE market returns are showing significant impact on SHCO returns except post and during-US crisis respectively under two sets. The Chinese market had also shown significant co-integration in the long-run with the Malaysian market. Also, like the Indian market, the Chinese market had close associations with some of its ASEAN peers in during-the-crisis period. But, except pre-crisis period and post-US crisis under two sets, it had shown no long-run co-integration with the US market. This implies its attractiveness to the US and other international investors as a profitable diversification opportunity in most periods. Results show that a 1% increase in SHCO returns had caused 0.27% (under set 1) and 0.18% (approximately) (under set 2) increase in the US market returns in post-US crisis under set 1. However, under different sets of markets under set 2, it is resulted that a 1% increase in SP500 returns had caused 0.62% (approximately) in SHCO returns. Thus, there were arbitrage opportunities available in these markets during the study period. For the overall study period, the US market had significant long-run association with the Japanese market. It is also observed that in pre-crisis period, the US market is significantly co-integrated with some ASEAN markets.

Table 6 also provides that the Indian, Japanese and Kuwait stock markets had significant impact on the US market for the overall study period. For example, a 1% increase in NIFTY, N225 and KPI returns had caused 0.13%, 0.26% and 0.22% increase in US market returns. It is interesting to note that the Indian and Chinese (except during-the-crisis) markets were significantly co-integrated with the US market in most sub-periods (Table 4). The short-run coefficients results are also quite similar in case of the Indian, Chinese and US associations with other paneled Asian countries except that in during-the-crisis period under set 1 more short-run associations were observed with the Indian and US markets.

It is also found that the equilibrium correction mechanism (ecm in equation (8) and represented by ECT(−1) in Microfit 4.1 [Table 5]) estimated at −1.4343, −1.5043 and −1.4323 (0.01) (under pre-, during- and post-crisis periods with NIFTY as dependent variable) are highly significant, has the correct sign and imply a very high speed of adjustment to equilibrium after a shock. In other words, approximately, 143%, 150% and 143% of disequilibrium from the previous month's shock converged back to the long-run equilibrium in the current month.

My results have also shown the other significant short and long-run coefficients of the selected Asian and US markets in the overall study period and during sub-periods. It is observed that the Indian market returns had significant long-run associations with JACO, TW and N225 index returns in the pre-crisis period; NIFTY was co-integrated with Sri Lankan, Philippines, Thailand, Singapore, the Republic of Korean and "Taiwan Province of China" stock markets in during-the-crisis period; and had impacted the Pakistani, Malaysian, Thailand, Singapore, the Republic of Korean and UAE stock markets in post-crisis period. These results imply that the Indian market had been strongly associated with most of these Asian markets at different time-periods with rest of the Asian markets. Thus, the Indian investors should be cautious in their international portfolio diversification strategies always. The international investors should also take a clue from these results to implement such decisions in relation to India. The US market had impacted ST, SET50 and KOSPI index returns in the pre-crisis period; had a significant co-integration with the Sri Lankan, Philippines, Singapore and the Republic of Korean markets in during-the-crisis period; and had long-run associations with the Korean, Taiwan, Japanese and Iranian market returns in the post-crisis period. Thus, there were plenty of opportunities for the US investors to make profitable diversification strategies in Asia in different situations. The Chinese market had significant association in the long-run with Malaysian and Thailand markets in the pre-crisis period; had impacted TASI and KPI index returns in during-the-crisis period; and was co-integrated with the Saudi Arabian and UAE market in the post-crisis period. Thus, it is evident that Chinese investors had have more diversification destination than investors from any other studied countries. On the other hand, as results suggest China is the most attractive investment destination for the international including the US and Indian investors.

It is also found from my study that the ASEAN markets had close associations within themselves in most of the periods in the long-run. Especially, the Indonesian stock market returns had impact on all other regional markets and vice versa in the overall study period. Thus, investors from this region should look into some other Asian and US markets to implement their portfolio diversification strategies. Study results also provide that the "Taiwan Province of China" stock market returns (in all periods) and the Japanese, UAE and Kuwait in some other periods (especially during-the-crisis period) had impacted the Republic of Korean market; the KOSPI was co-integrated with the "Taiwan Province of China" market in all except during-the-crisis period and also the Saudi Arabian and Kuwait in some other periods had impacted KOSPI returns; KOSPI and TASI indices more specifically were co-integrated in the long-run in some periods with the Japanese market; the KPI, ADG and N225 also in some periods had long-run associations with the Saudi Arabian stock market; the UAE market returns were impacted by the Saudi Arabian and Kuwait markets in the overall study period and co-integrated with KOSPI and KPI indices in sub-periods; the Iranian stock market returns were impacted by the Saudi Arabian and UAE stock markets in most periods in the long-run; also TASI and ADG were mostly co-integrated with the Kuwait stock markets in the long-run. All these results indicate respective long-run co-integration situations in the study periods in between other Asian markets except India, China and the US. It also points out the respective diversifications opportunities as was available before the country-specific investors throughout these study periods.

In all the above results, the short-run coefficients results are also quite similar except in few cases they were not significant like their long-run counterparts.

The regression for the undertaken ARDL equations (6.1-6.20) fits very well in most of the cases at $R^2 \leq 90\%$ and also passes the diagnostic tests against serial correlation, functional form misspecification and non-normal errors (Tables 5 and 6). Spurious regressions are also mostly non-existent as there are no signs of high R^2, t-values and F-value but low Durbin–Watson statistic in most of the cases. The cumulative sum (CUSUM) and CUSUM of squares (CUSUMQ) plots from a recursive estimation of this Model also indicate stability (in almost all cases) in the coefficients over the overall study period. This is because as the plots of CUSUM stay within the critical 5% bound for the equations and CUSUMQ statistics does not also exceed the critical boundaries. I have applied these diagnostic tests in line with Mohsen and Ng (2002), Peseran and Peseran (1997) and Suleiman (2005) to test the stability of the long-run coefficients.

4. CONCLUSION AND POLICY IMPLICATIONS

This study re-examines the short- and long-run associations and co-integrations among the selected Asian markets in relation to the developed US market in overall and pre-, during- and post-US sub-prime crisis of 2007-09 by using the Pearson et al.'s (2001) bounds testing approach for the first time. There were long-run co-integrating relationships in between the Indian, Pakistani, Sri Lankan, Indonesian, Malaysian, Philippines, Singapore, Thailand, Chinese and the US stock markets except when the Indian NIFTY Index and JACO Index of Indonesia are the dependent variables for the overall study period. Estimated coefficients of the long-run relationships also show that the Philippines, Thailand, the Republic of Korean, "Taiwan Province of China", Kuwait and the US market returns had a very high significant impact on the Indian stock market returns in the overall study period. The Singapore market was also co-integrated with the Indian and US markets in the long-run. In during-the-crisis and post-crisis period NIFTY is significantly co-integrated with some of its ASEAN peers, "Taiwan Province of China" (post-crisis only) and the US in the long-run.

However, under the second set of markets, my results show that there were long-run co-integrating relationships at 1% or 5% significance level in between these markets when the Indian, Pakistan, "Taiwan Province of China," Japanese, Chinese and the US markets are the dependent variables respectively. However, except during-the-crisis period (in line with Dasgupta, 2013), there were no signs of long-run associations which imply that pre- and post-crisis there were enough portfolio diversification opportunities for the Asian and US international investors in these markets. This implies that international investors who diversified their investments across Asian and US markets could only gain limited benefits during this period. Also, mostly no arbitrage opportunities were available during-the-crisis period before the international investors because of strong market efficiency.

On the other hand, the Malaysian and UAE market returns are showing significant impact on SHCO returns except post and during-US crisis respectively under two sets. The Chinese market had also shown significant co-integration in the long-run with the Malaysian market. Also, like the Indian market, the Chinese market had close associations with some of its ASEAN peers in during-the-crisis period. But, except pre-crisis period and post-US crisis under two sets, it had shown no long-run co-integration with the US market. This implies its attractiveness to the US and other international investors as a profitable diversification opportunity in most periods. Thus, there were arbitrage opportunities available in these markets during the study period. For the overall study period, the US market had significant long-run association with the Japanese market. It is also observed that in pre-crisis period, the US market is significantly co-integrated with some ASEAN markets. It is evident that the Indian, Japanese and Kuwait stock markets had significant impact on the US market for the overall study period. Results also confirm that the Chinese and the US markets were the most profitable investment destinations for the Asian including Indian investors post-US crisis.

It is also found from my study that the ASEAN markets had close associations within themselves in most of the periods in the long-run. Especially, the Indonesian stock market returns had impact on all other regional markets and vice versa in the overall study period. However, this finding contradicts with Lee and Isa (2014) results. Thus, investors from this region should look into some other Asian and US markets to implement their portfolio diversification strategies due to efficient information transmission.

Graphical results point out that during-the-crisis most of these Asian markets were extremely volatile, but US market was giving a steady return. It is found that the Indian stock market was the third strongest market after Sri Lanka and Philippines to attract foreign investors for the overall study period. The Indian market also outperformed its Chinese peer in most parts of the studied period except in the pre-crisis period. However, the risk-adjusted return results for the overall study period show that the Indian market was outperforming its Asian peers after Indonesia, Philippines, Si Lanka and Malaysia only in that order. Especially, in during-the-crisis period, it was the second strongest Asian market after Sri Lanka when most of other studied markets including the US were giving negative average returns. The risk-adjusted returns results also point out that only Sri Lankan, Indian and Indonesian market were giving positive returns in during-the-crisis period. So, it supports that India is one of the strongest portfolio diversification opportunity for the international investors among its Asian peers (in line with Islam, 2014). However, it contradicts with the earlier co-integration results implications. Also, in the post-crisis period interestingly its ASEAN peers (except Singapore) were offering much higher returns with less risk. This is supported by risk-adjusted returns of these markets.

It is also evident from the correlations results that the Chinese market was not showing much short-run associations with its Asian peers in most periods except during-the-crisis period unlike the Indian and US markets. Some other Asian developing markets like Pakistan and Sri Lanka also in this regard can become probable future portfolio diversification opportunities along with the Chinese market.

The short-run coefficients results are also quite similar in case of the Indian, Chinese and US associations with other paneled Asian countries except that in during-the-crisis period under set 1 more short-run associations were observed with the Indian and US markets. From the statistical perspective, it is also evident from the study results that long-run disequilibrium relationships in between these Asian and US markets stabilize in the very next month in most of the cases. This implies that international investors get very little time to earn windfall gains from their arbitrage activities in these markets. But, all these results imply the efficiency of these markets. Study results also imply that the Indian market had been strongly associated with most of these Asian markets at different time-periods with rest of the Asian markets. Thus, the Indian investors should be cautious in their international portfolio diversification strategies always. The international investors should also take a clue from these results to implement such decisions in relation to India. On the other hand, as results suggest China is the most attractive investment destination for the international including the US and Indian investors.

The implications of my study is that although the investors who had allocated their funds across these countries didn't gain maximum gains from their portfolio diversification strategies in the overall study period, but there were enough diversification opportunities in different sub-periods and stock markets (e.g., Indian stock market in during-the-crisis period) available before them. Also, as these markets are not perfectly integrated in all times portfolio revision and short-run arbitrage activities can work wonder for the stakeholders in future similar periods. So, selecting the right market in the right time would be the best investment policy for international investors.

In regard to the informational efficiency in between these Asian and US markets, my findings of co-integration suggest that each of these stock returns series contains information on the common stochastic trends, thereby the predictability of one country's stock returns can be enhanced considerably through utilizing other country's stock returns information. This is in line with Masih and Masih (2002), but in contradiction with Granger (1986) who observed that co-integration between two returns reflects an inefficient market. However, the nature and causes of such information transmission, as well as volatility transmission in between these markets should be a topic for future researchers to work upon.

The findings in my study will also have important implications for the formulation of policies of multinational corporations working in these countries in regard to their capital budgeting decisions, treasury management activities and forex transactions. This information is also indispensable for international managers to mitigate international risks in terms of transaction and translation. However, future studies should also look into to investigate the factors, such as macroeconomic fundamentals, stock market characteristics, international, etc. which drive stock markets and associations and co-integrations in between these markets to provide more in-depth knowledge to international investors to undertake successful portfolio diversification strategies with least possible risks always.

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