International Portfolio Diversification Opportunities for the Indian Investors in and Around U.S. 2007-09 Financial Crisis : An ARDL Application for Future Reference

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Abstract

This study primarily aimed at finding the portfolio diversification and arbitrage opportunities for the Indian and international investors by investigating the short- and long-run associations and co-integrations in between the Indian and 40 international stock markets amidst the recent U.S. financial crisis overall and under selected structural breaks. To fulfill its objectives, this study used the most advanced autoregressive distributed lag on transformed natural log returns of these countries' benchmark indices monthly closing values. This was conducted by estimating regression equations by ordinary least squares and subsequent *F* or Wald test, then after establishing co-integrations, it estimated conditional ARDL, and lastly obtained the short-run dynamic adjustments by estimating an error correction model. Long-run co-integration results showed that there were enough portfolio diversification opportunities for the Indian investors in Asian and Latin American markets in the overall study period. However, during the crisis period, both Indian and international investors had less number of profitable diversification opportunities as most of these international stock markets were co-integrated. In the short-run, these markets showed dynamic adjustments, especially in the post-crisis period, generally within one month, which neutralized the arbitrage opportunities. These findings will 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. The data provided in the paper will be indispensable for international managers to mitigate international risks in terms of transactions and translations. Implications of the U.S. crisis on co-integrating relationships and efficiency of these markets will also be helpful to policymakers and other stakeholders in this area.

Key words : co-integrations, Indian investors, international markets, autoregressive distributed lag, portfolio diversification, market efficiency

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Portfolio diversification strategies of international investors in light of long-run co-integration and short-run dynamic linkages of international stock markets has been well-researched in empirical literature. As the financial markets are becoming increasingly interconnected, it is indispensable for them to understand these relationships in order to gain most from their effective diversification strategies by adjusting their portfolios with changing times and situations, including financial turbulences and crises.

Akdogan (1992) observed that a complete integration of stock markets implied absence of arbitrage opportunities. In this regard, Dwyer and Wallace (1992) defined market efficiency as lack of arbitrage opportunities. So, efficient markets are generally co-integrated. Hooy and Lim (2009) also suggested a positive association between market integration and informational efficiency.

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Yusof and Majid (2006) observed that stock market integration was defined by many studies either based on asset pricing or from a statistical perspective. It was characterized by the law of one price [LOOP] (Cournot, 1927 ; Marshall, 1930) and portfolio diversification with risky assets (Markowitz, 1952) from the viewpoint of asset pricing. So, this study has followed Kearney and Lucey's (2004) idea of equalization of the rates of returns to define it as it is a direct approach based upon the law of one price, which implies that stock market indices having same risk characteristics would command similar market returns under the condition of unrestricted international capital flows.

The Reserve Bank of India [RBI] (2007) also observed that the unification of various stock markets leads to the convergence of risk-adjusted returns. Thus, in case of co-integrated and/or interlinked stock markets with high correlations, portfolio diversification benefits are wiped off. So, international investors should invest in markets which are not integrated in the short- and long-run to reap maximum profits. Markowitz (1952) also pointed out that diversification profit would be maximum in case of perfect negative correlation in between asset prices or international markets.

From the statistical viewpoint, stock markets are integrated when they share long-run equilibrium relationships (Bachman, Choi, Jeon, & Kopecky, 1996 ; Yusof & Majid, 2006). This implies that international stock prices have the tendency to move in tandem, especially in the long-run due to arbitrage activities mostly (Narayan, Smyth, & Nandha, 2004) and other common factors, including international trades (Bachman et al., 1996). So, this study has also applied this statistical aspect of co-integration in Indian and 40 international stock markets. It is also noteworthy that the degree of stock market co-integration also impacts financial stability of a country (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 portfolio diversification. However, 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 U.S. stock market was more volatile. The emerging stock markets have also been found to be more closely integrated with other developing and developed markets than ever before during recent times. Mukhopadhyay (2009) found that market integration is more prominent among markets which are at a comparable development stage.

Wang, Chen, and Huang (2011) consistently found the Chinese market to have the highest levels of dependence, as well as the greatest variability in dependence, with markets in Japan and the Pacific.

Karim and Karim (2012) re-examined the integration among five selected ASEAN emerging stock markets (Malaysia, Thailand, Indonesia, the Philippines, and Singapore) based on autoregressive distributed lag (ARDL) bound testing approach proposed by Pesaran, Shin, and Smith (2001). They found that the stock markets in the ASEAN region were integrated during the pre-, post-1997, and post U.S. financial crisis. In line with many studies on international interdependences of stock markets, their study also found that the ASEAN stock markets were moving towards more integration among themselves, especially following the global financial crisis. This implies that the long-run diversification benefits that can be earned by investors across the ASEAN markets tend to diminish.

Dasgupta (2013) aimed at investigating the relative integration and dynamic linkages of the emerging economies all over the world and the U.S. with India to find the most attractive international portfolio diversification opportunities between 2003-12 for the overall study period and for pre-, during-, and post-U.S. financial crisis periods. The results showed many unidirectional but no bidirectional causal relationships and some long-run integration in between these markets. He concluded that these emerging economies' stock markets were the most favorable investment destinations for the U.S. and global investors, especially China, Brazil, and India.

Khan and Aslam (2014) revealed that there was no co-integration of Pakistan's stock market (KSE100 index) with China and Japan's stock markets. However, there was co-integration of Pakistan's stock market (KSE 100 index) with the stock market of India, Indonesia, Malaysia, and Singapore.

Kapingura, Misi, and Khumalo (2014) investigated the extent to which the South African stock market was integrated to other African stock markets as well as the developed markets as represented by the U.S., Japan, and German by employing the ARDL approach to co-integration. The results suggested that the South African stock market was fully integrated to the developed markets, but not so to other African stock markets. This suggested that investors could diversify their portfolios by investing in other African stock markets.

Singh and Kaur (2015) attempted to model the dynamic volatility spillover from the U.S. market to the BRIC countries' stock markets during the subprime crisis by employing the ARMA E-GARCH (1,1) model. The results from the E-GARCH (1,1) model supported the spillover of the U.S. volatility to the Brazilian market only. The study revealed that the volatility in the U.S. market did not have a direct impact on the Russian, Indian, and Chinese stock markets.

Bhattacharjee and Swaminathan (2016) conducted an analysis of the stock market integration of India and a few selected countries of the globe in three different phases by using the Engle-Granger bivariate co-integration test for ascertaining the long-run equilibrium relation among the countries. It was observed that co-integration of India with other stock markets was increasingly improving over the years with financial liberalization. More specifically, the study found that the Indian stock market was more responsive to the other Asian stock markets during the recession phase than in any other sub-sample periods.

Dasgupta (2016) tested the short-run dynamic linkages and long-run integration of 27 countries all over the world under trade-agreement or economic-status based selected panels (regional mostly) and in three-phased crisis periods to find out the most attractive international portfolio diversification opportunities in between January 2005 - June 2012. Long-run co-integration results showed all round integration among the paneled stock markets which nullified the portfolio diversification opportunities for the international investors within such panels. Sub-periods results also showed that these markets were mostly integrated, especially during and post-crisis periods.

However, Awokuse, Chopra, and Bessler (2009) pointed out that although empirical evidence from most previous studies, using conventional linear co-integration models, showed stock market integration in some regions, the existing empirical evidence remains inconclusive and there are conflicting results regarding the nature of dynamic interdependence between developed and/or emerging markets.

So, it is conclusive that empirical literature on stock market integration is though abundant in numbers, but their results vary according to variable specifications, research methodology adopted, participating countries, 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.) provided only general conclusions or overall trends rather than results for each country.

Thus, the present study attempts to partially fill the research gaps in the existing relevant literature and attempts to provide most recent empirical evidence on short- and long-run associations and co-integrations in between the Indian and these most important 40 international stock markets.

More specifically, this study contributes to the existing literature in several ways. First, its data is comprehensive in its time and period-coverage. It covers a lengthy time-period of seven and half years and covers pre-, during-, and post- U.S. subprime crisis periods and different short- and long-run associations in between these stock markets in all these periods. Also, it has undertaken less noisy monthly log returns data. Secondly, unlike previous studies, it revisits the issue of Indian and these international stock markets' co-integration and associations with the more advanced and robust autoregressive distributed lag (ARDL) techniques as developed by Pearson et al.

(2001). Thirdly, the findings of this study will provide useful information for the Indian and international investors in formulating their international portfolio diversification strategies in future under different similar periods. This will 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 and financial stability judgment for the interested parties. Fourthly, portfolio diversification opportunities of the Indian investors are chosen primarily as the focal point which is also a departure from most of the previous empirical studies that tend to focus on investors from more developed countries like the U.S., etc. Lastly, this study examines the impact of the recent U.S. subprime financial crisis on the short- and long-run associations of these 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 this crisis that started in the developed U.S. market on the developed and most emerging markets from around the different continents under one study.

Data Descriptions and Research Methodology

(1) Data Descriptions : Theoretically, in this kind of co-integration and linkages studies, the data would preferably be in a longer time-interval and over a long period of time (Hooker, 1993 ; Lahiri & Mamingi, 1995). Bekaert, Harvey, and Lumsdaine (2002) ; Karolyi and Stultz (1996) ; Lin, Engle, and Ito (1994) ; Longin and Solnik (1995, 2001), etc. also observed that integration of international stock markets is a time-varying concept. So, longitudinal studies should be undertaken to get authentic results. So, this study has used the monthly stock indices closing values to compute natural log returns spanning from January 2005 - June 2012. Monthly data is undertaken here instead of daily and weekly data to avoid problems of too much noise and non-synchronous infrequent trading (see Ibrahim, 2005). The reason for taking the data from January 2005 - June 2012 in this study is to examine the sub-periods, i.e., pre-, during- and post-crisis for similar time-periods, that is, 30 months each.

However, whenever this kind of multi-country co-integration study is undertaken, it is imperative to consider the financial situations as prevalent in the international stock markets' arena during the study period. This is because the existing literature is 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 ; Yang, Kolari, & Min, 2002). However, in comparison to the pre-crisis period, post-crisis co-integration is more

Table 1. Countries' Panel

Panel A. American (with India)		Panel B. European 1 (with India)		Panel C. European 2 (with India)		Panel D. Asian 1 (with India)		Panel E. Asian 2 (with India)	
Country	**Index Abbreviation**	**Country**	**Index Abbreviation**	**Country**	**Index Abbreviation**	**Country**	**Index Abbreviation**	**Country**	**Index Abbreviation**
Argentina	MERVAL	Austria	ATX	Russia	RTSI	Australia	ALLORD	Pakistan	K100
Brazil	BOVESPA	Belgium	BEL20	Spain	IBEX35	China	SHCO	Philippines	PSECO
Canada	TSXCO	Denmark	KFXCO	Sweden	STOALL	Hong Kong	HS	Saudi Arabia	TASI
Chili	IPSA	Finland	HELGEN	Switzerland	ZSM	Indonesia	JACO	Singapore	ST
Mexico	IPCALL	France	CAC40	Turkey	ISE100	Iran	T50	Sri Lanka	CSEALL
Peru	LIMAGEN	Germany	DAX30	UK	FTSE100	Japan	N225	Taiwan	TW
USA	SP500	Greece	GRECO	India	SENSEX	Rep. of Korea	KOSPI	Thailand	SET50
Venezuela	IBC	Netherlands	AEXGEN			Kuwait	KPI	UAE	ADG
India	SENSEX	Norway	OSEALL			Malaysia	KLCO	India	SENSEX
		India	SENSEX			India	SENSEX		

prominent in empirical studies.

Thus, it is necessary to examine the truth behind this finding in relation to the selected Indian and 40 international markets, and the corresponding Indian investors' portfolio diversification opportunities in different study-periods. So, this study has divided the overall study period (January 2005 - June 2012) into three sub-periods - pre-crisis (January 2005 - June 2007), during-the-crisis (July 2007 - December 2009), and post-crisis (January 2010 - June 2012). This is well supported by the existing literature of Dasgupta (2013), Gokay (2009), and International Monetary Fund (2009).

Thus, this study has also taken a balanced perspective in regard to monthly returns (i.e., 30 months each under different sub-periods)It has collected data mainly from www.econstat.com and also respective stock exchanges. The Indian and 40 international stock markets are represented by the American, European (1 and 2), and Asian (1 and 2) panels with India respectively (see Table 1). All these are the benchmark indices of respective countries.

(2) Log Transformation : Here, monthly returns are calculated as the difference in the natural logarithm of the closing indices values for two consecutive trading months. Thus, it is presented as :

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

where, R_t is the 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.

(3) Autoregressive Distributed Lag (ARDL) Model Specification : This study has applied the ARDL or bounds testing procedure [for its numerous benefits (see e.g., Marashdeh, 2005)] by following Pearson et al. (2001) as summarized in Choong, Zulkornain, and Venus (2005) by modeling the long-run equation (2) as a general vector autoregressive (VAR) model of order p, in x_t :

$$x_t = a_0 + \beta_t + \sum_{i=1}^{p} \lambda_t x_{t-i} + \varepsilon_t, \qquad t = 1,2,3,\ldots..,T \qquad (2)$$

with a_0 representing a $(k+1)$ vector of intercepts/drift and denotes a $(k+1)$ vector of trend coefficients.

Then it derives the following vector error correction model (VECM) corresponding to equation (2) in line with Pearson et al. (2001) :

$$\Delta x_t = a_0 + \beta_t + \Pi x_{t-1} + \sum_{i=1}^{p} \Delta\Gamma_i \, \Delta x_{t-i} + \varepsilon_t, \qquad t = 1,2,3,\ldots..,T \qquad (3)$$

where the $(k+1) \times (k+1)$ matrices, that is,

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

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 and z_t 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 Indian and selected international stock markets show unique long-run relationships, the conditional VECM becomes :

$$\Delta y_t = a_{y0} + \beta_t + \delta_{yy} y_{t-1} + \delta_{zz} z_{t-1} + \sum_{i=1}^{p-1} \phi_i \Delta y_{t-i} + \sum_{i=0}^{p-1} \xi_i \Delta z_{t-i} + \varepsilon_{yt}, \qquad t = 1,2,\ldots..,T \qquad (4)$$

where δ_{yy} and δ_{zz} are the long-run multipliers, a_{y0} is the drift, and ε_{yt} are white noise errors or disturbances.

(4) Bounds Testing Procedure : This study has conducted the bounds testing procedure in three steps.

In the first step, it has estimated conditional VECMs from equation (4) by the OLS in order to investigate the existence of long-run relationships in between the Indian and international stock markets log returns. This is undertaken with the help of F-test for the joint significance of the coefficients of the lagged levels of the variables, that is, $H_N : \delta_{yy} = \delta_{zz} = 0$, as against the alternative hypothesis of $H_A : \delta_{yy} \neq \delta_{zz} \neq 0$.

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

In the second step, the conditional ARDL long-run model for Y_t is estimated after establishing co-integration as:

$$\ln Y_t = a_0 + \sum_{i=1}^{p} \delta_i \ln Y_{t-i} + \varepsilon_t \tag{5}$$

It is indispensable here to select the appropriate distributed lag orders of the respective ARDL model. This study has used the Schwartz Bayesian Criterion (SBC) in line with Pearson and Shin (1995) and many others who suggest that SBC is preferable over Akaike information criteria (AIC) as it is a parsimonious model that selects the smallest possible lag length.

In the third and final step, it has obtained the short-run dynamic adjustments by estimating an ECM in association with the long- run estimates. It has undertaken the following equation :

$$\Delta \ln Y_t = \mu + \sum_{i=1}^{p} \lambda_i \Delta \ln Y_{t-i} + \upsilon ecm_{t-1} + \varepsilon_t \tag{6}$$

where, λ_i are the short-run dynamic coefficients of the models' convergence to long-run equilibrium and υ is the speed of such adjustment.

(5) Granger Causality Tests : Leong and Felmingham (2001) found that correlation test results do not provide a reliable basis for empirical studies investigating integration as correlation coefficients are known to be upward-biased if the stock indices have heteroskedastic elements. So, investigation should be extended by employing Granger's (1969) pair wise causality tests.

Granger (1969) observed that a time series X_t Granger-causes another time series Y_t if the latter can be predicted with better accuracy by using past values of X_t rather than by not doing so, other information being identical. Thus, testing causal relations between two stationary series ΔX_t and ΔY_t is based on the following two equations:

$$\Delta Y_t = \alpha_0 + \sum_{k=1}^{p} \alpha_k \Delta Y_{t-k} + \sum_{k=1}^{p} \beta_k \Delta X_{t-k} + \mu_t \tag{7}$$

$$\Delta X_t = \varphi_0 + \sum_{k=1}^{p} \varphi_k \Delta X_{t-k} + \sum_{k=1}^{p} \Phi \Delta Y_{t-k} + \upsilon_t \tag{8}$$

where, Δ is the difference operator, Y_{t-k} and X_{t-k} represent the lagged value of Y_t and X_t , μ_t and υ_t are disturbance terms assumed to be white noise. The lag length ($k = 1, 2, ..., p$) is chosen by using the Akaike information criterion

(AIC) and/or Schwarz information criteria (SIC). The null hypothesis that X_t does not Granger cause Y_t is not accepted if the β_k's ($k > 0$) are significantly different from zero using standard F test (the statistic is for the joint hypothesis $\beta_1 = \beta_2 = ... = \beta_k = 0$). Similarly, Y_t Granger-causes X_t if the Φ_k's, $k > 0$, are jointly different from zero.

Results and Discussion

(1) Graphical and Descriptive Statistics Results: Figures provide the graphical results of the Indian and 40 international stock markets indices' log returns here in the overall study period (see Figures 1- 3) and during-the-crisis period (see Appendix 5), respectively. It is evident that all these markets were more volatile in during-the-crisis period due to mostly negative and uncertain investors' sentiment, news flows, and portfolio investments amidst the influence of the U.S. crisis. It is also found that the Asian markets had shown less volatility for the overall study period in comparison to other continental markets.

In terms of actual returns (see Appendix 1), this study has found that in the overall study period, the Indian

Figure 1. Indian Market with Latin American Markets (Overall Study Period [January 2005 – June 2012])

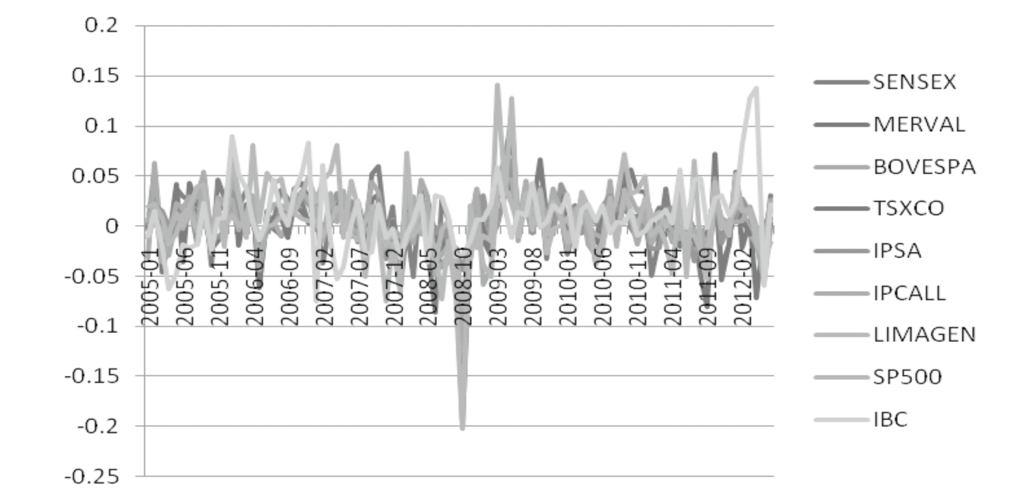


Figure 2. Indian Market with European Markets (Overall Study Period [January 2005 – June 2012])

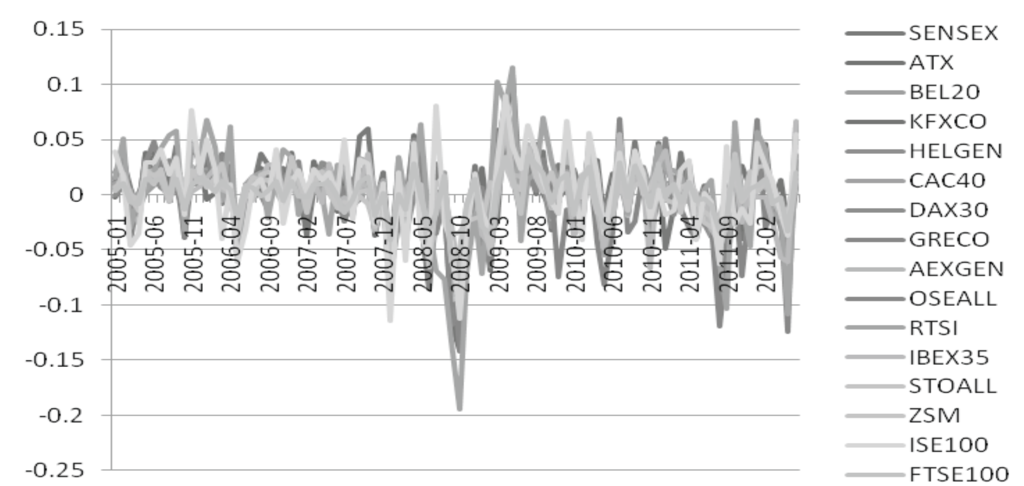
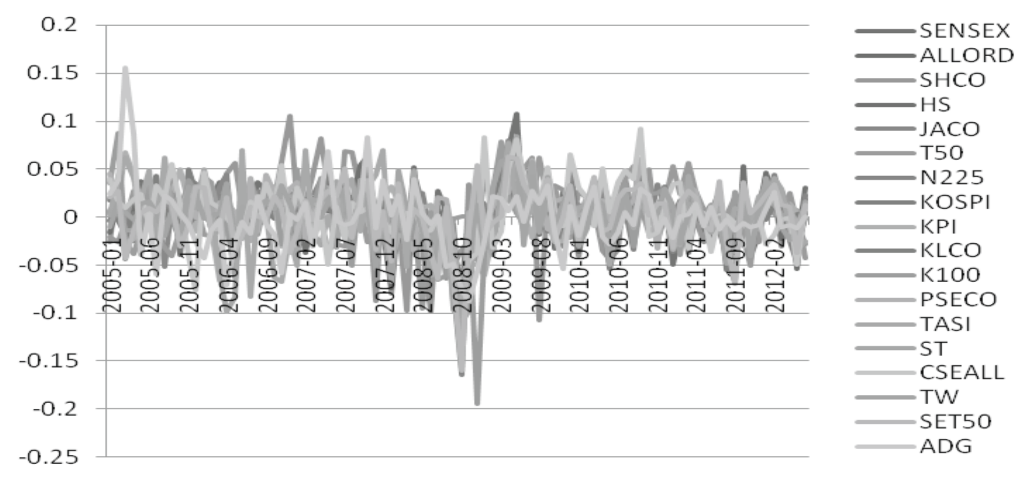


Figure 3. Indian Market with Asian Markets (Overall Study Period [January 2005 – June 2012])



investors could go to Mexico, Peru, Venezuela, Indonesia, Philippines, and Sri Lankan markets for earning higher returns. Similarly, during-the-crisis period, they could look at Brazil, Peru, Venezuela, and Sri Lankan markets. However, when risk adjusted returns are considered, their portfolio diversification choices are wider as shown by the results, especially in the overall study period. This implies higher riskiness of the Indian stock market in relation to monthly logarithmic returns. In this regard, results show that the Indian investors could invest in Chili, Mexico, Peru, Venezuela, Indonesia, Malaysia, Philippines, and Sri Lankan markets in the overall period to maximize returns at given level of market risks. Results also point out that the Indian investors had most profitable diversification opportunities in both pre- and post-crisis periods with limited risks. In a broad context, the Latin American stock markets would be the most favourable portfolio diversification destinations for them. Among their Asian and European counterparts, some of the ASEAN [Association of South East Asian Nations] markets in most of these periods, and Denmark, Germany, Norway, Sweden, and the UK in pre- and post-crisis periods could be attractive to the Indian investors. As per the risk adjusted returns, they should never look at some of the European markets like Greece, Belgium, France, etc., and Japan, Saudi Arabia, and UAE markets in Asia.

The Indian market as a probable destination of foreign investors from these countries ranks ninth for the overall study period and in the pre-crisis period ; fifth in during-the-crisis period ; and 22nd in the post-crisis period in terms of risk adjusted returns. This is validated by the actual returns from the Indian BSE Sensex during all these periods. However, results also show that except for few of its ASEAN peers and Sri Lanka, it is still one of the strongest emerging markets in Asia in attracting foreign investors, especially in the crisis period.

Descriptive results (see Appendix 2) also point out that all these log returns series mostly have higher kurtosis (i.e., value is greater than 3 [leptokurtic]) (except Iran) for the overall study period and in during-the-crisis (except for Venezuela, France, Germany, Switzerland, Turkey, the UK, Australia, China, Sri Lanka, and Taiwan) periods. It implies that they have a thicker tail and a higher peak than a normal distribution, that is, they are non-normal. The skewness values are mostly negative in both these periods (except for Venezuela, Iran, Sri Lanka, and UAE for the overall study period and Chili, Venezuela, Finland, Iran, and Sri Lanka in during-the-crisis period), which also implies a deviation from normal distribution (i.e., asymmetric) and volatility in these returns series. However, in other periods, they are 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, including Indian investors, in these markets.

(2) Correlation Results : The correlation coefficients (see Appendix 3) in combination with coefficients of determination have pointed out the existing short-run relationships in between these markets. It is proved that the Indian stock market was interlinked with only Hong Kong and Singapore stock markets in the overall study period. However, during-the-crisis period, it had short-run relationships with the Brazilian, U.S., Austrian, Belgium, France, Germany, Greece, the Netherlands, Spanish, Turkish, Hong Kong, Indonesian, Malaysian, Singapore, and Thailand stock markets. This implies lack of portfolio diversification opportunities for international and Indian investors in mutual markets for reaping maximum gains. In pre- and post-crisis periods, such profitable opportunities were evident as results show many negative correlationships (in line with Markowitz (1952)) in between the Indian and Iranian, Kuwait, Saudi Arabian, Sri Lankan, UAE, and Venezuelan markets and otherwise non-significant short-run relations, especially in the post-crisis period.

(3) Unit Root Tests Results : Before this study proceeds with the ARDL bounds test, it has tested 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.

This study has applied the more efficient univariate Dickey-Fuller generalized least squares [DF-GLS] test for autoregressive unit root. This test has the best overall performance in terms of sample size and power in comparison to Augmented Dickey-Fuller [ADF] tests. The test regression under the DF-GLS test includes both a constant and trend for the log-levels and a constant with no trend for the first differences of the variables.

The DF-GLS unit root test results (see Appendix 4) for the variables indicate that all variables in the overall study period and in all sub-periods are $I(0)/I(1)$.

(4) Granger Causality Tests Results : The results under Table 2 show that the Indian stock market was significantly Granger caused by the Iranian stock market in the overall study period and Russian stock market had unidirectional Granger causality with it in the post-crisis period. Thus, there was an overwhelming presence of portfolio diversification opportunities for the Indian investors in all other international stock markets in the short-run. This is equally applicable for these countries' investors for the Indian market.

Table 2. Granger Causality Tests Results (in Relation to SENSEX)

Overall study period [January 2005 – June 2012]		Pre-crisis period (January 2005 – June 2007)		During-the-crisis period [July 2007 – December 2009]		Post-crisis period (January 2010 – June 2012)	
Causal Effect	*F* - Stat (Probability)	Causal Effect	*F* -Stat (Probability)	Causal Effect	*F* - Stat (Probability)	Causal Effect	*F* -Stat (Probability)
T50→SENSEX	8.22232 (0.0052)	None		None		**RTSI→SENSEX**	8.78821 (0.0064)

(5) Bounds Tests Co-integration Results : Before estimating the short and long-run relationships among the selected stock markets' log returns series, this study has decided the lag-length on the first difference variables by using SBC.

The Table 3 reports the results of the calculated F-statistics when the Indian benchmark index Sensex is considered as a dependent variable (normalized) in the ARDL-OLS regressions (see equation 4). It presents the F-stat results for examining long-run co-integration in between the selected international and Indian stock markets for the overall study period and during sub-periods. It is found that for the overall study period under Panel B and C, that is, India with the European markets, the computed F-statistics exceeds the upper bound critical value at 1% significance level. This implies the rejection of null hypothesis of no co-integration in between these markets. So, it is evident that there were long-run co-integrating relationships in between these markets. But,

Table 3. *F*-Statistics Results for Examining Long - Run Cointegration (SENSEX is the Dependent Variable)

Period	Equation	Computed *F*-statistic	Outcome
	Panel A.		
Overall	*FSENSEX[SENSEX/MERVAL,BOVESPA,TSXCO,IPSA,IPCALL,LIMAGEN,SP500,IBC]*	2.462737	No Co-integration
Pre-crisis	*FSENSEX [SENSEX/MERVAL,BOVESPA,TSXCO,IPSA,IPCALL,LIMAGEN,SP500,IBC]*	1.383624	No Co-integration
During-the-crisis	*FSENSEX [SENSEX/MERVAL,BOVESPA,TSXCO,IPSA,IPCALL,LIMAGEN,SP500,IBC]*	1.617600	No Co-integration
Post-crisis period	*FSENSEX [SENSEX/MERVAL,BOVESPA,TSXCO,IPSA,IPCALL,LIMAGEN,SP500,IBC]*	1.097987	No Co-integration
	Panel B.		
Overall	*FSENSEX [SENSEX/ATX,BEL20,KFXCO,HELGEN,CAC40,DAX30,GRECO,AEXGEN,OSEAL]*	4.988116	**Co-integration*** **
Pre-crisis	*FSENSEX [SENSEX/ATX,BEL20,KFXCO,HELGEN,CAC40,DAX30,GRECO,AEXGEN,OSEAL]*	3.556962	**Co-integration** **
During-the-crisis	*FSENSEX [SENSEX/ATX,BEL20,KFXCO,HELGEN,CAC40,DAX30,GRECO,AEXGEN,OSEAL]*	1.213705	No Co-integration
Post-crisis period	*FSENSEX [SENSEX/ATX,BEL20,KFXCO,HELGEN,CAC40,DAX30,GRECO,AEXGEN,OSEAL]*	3.897567	**Co-integration** **
	Panel C.		
Overall	*FSENSEX [SENSEX/RTSI,IBEX35,STOALL,ZSM,ISE100,FTSE100]*	5.168650	**Co-integration*** **
Pre-crisis	*FSENSEX [SENSEX/RTSI,IBEX35,STOALL,ZSM,ISE100,FTSE100]*	2.942466	No Co-integration
During-the-crisis	*FSENSEX [SENSEX/RTSI,IBEX35,STOALL,ZSM,ISE100,FTSE100]*	1.407020	No Co-integration
Post-crisis period	*FSENSEX [SENSEX/RTSI,IBEX35,STOALL,ZSM,ISE100,FTSE100]*	7.129598	**Co-integration*** **
	Panel D.		
Overall	*FSENSEX[SENSEX/ALLORD,SHCO,HS,JACO,T50,N225,KOSPI,KPI,KLCO]*	2.689814	Inconclusive
Pre-crisis	*FSENSEX[SENSEX/ALLORD,SHCO,HS,JACO,T50,N225,KOSPI,KPI,KLCO]*	1.583953	No Co-integration
During-the-crisis	*FSENSEX[SENSEX/ALLORD,SHCO,HS,JACO,T50,N225,KOSPI,KPI,KLCO]*	3.014899	**Co-integration* **
Post-crisis period	*FSENSEX[SENSEX/ALLORD,SHCO,HS,JACO,T50,N225,KOSPI,KPI,KLCO]*	7.274501	**Co-integration*** **
	Panel E.		
Overall	*FSENSEX[SENSEX/K100,PSECO,TASI,ST,CSEALL,TW,SET50,ADG]*	2.444603	No Co-integration
Pre-crisis	*FSENSEX[SENSEX/K100,PSECO,TASI,ST,CSEALL,TW,SET50,ADG]*	1.019995	No Co-integration
During-the-crisis	*FSENSEX[SENSEX/K100,PSECO,TASI,ST,CSEALL,TW,SET50,ADG]*	2.344155	No Co-integration
Post-crisis period	*FSENSEX[SENSEX/K100,PSECO,TASI,ST,CSEALL,TW,SET50,ADG]*	5.719218	**Co-integration*** **

Notes: 1) The relevant critical value bounds are taken from Pearson et al. (2001), where the critical values in case of:
a) Eight regressors are - 2.79 - 4.10 at the 1% significance level (***), 2.22 - 3.39 at the 5% significance level (**) and 1.95-3.06 at the 10% significance level (*) [for Panel A and E].
b) 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 Panel B and D].
c) Six regressors are - 3.15 - 4.43 at the 1% significance level (***), 2.45 - 3.61 at the 5% significance level (**) and 2.12 - 3.23 at the 10% significance level (*) [for Panel C].
2) For example, * denotes that the computed *F*-statistics is above the 90% upper bound and ** denotes it is above the 95% upper bound.
3) Results obtained from Eviews 7.

under other panels, the results are either contradictory (no co-integration) or inconclusive. Thus, there were enough portfolio diversification opportunities for the Indian investors in Asian and Latin American markets. However, in during-the-crisis period, results show that there was no co-integration in between the Indian with the Latin American and European markets. But, the computed *F*-statistics exceeds the upper bound critical value at 10% significance level under panel D. This indicates co-integration in between the Indian with the Australian,

Table 4. Estimated Long- and Short-run Coefficients (SENSEX is the Dependent Variable)

Long-run		Short-run		Diagnostic Tests	
Regressors	Coefficients	Regressors	Coefficients		
Panel A. MERVAL, BOVESPA, TSXCO, IPSA, IPCALL, LIMAGEN, SP500, IBC, and SENSEX					
Overall Study Period [January 2005 – June 2012] [ARDL 0,0,0,0,0,0,0,0,0]					
BOVESPA	.43009***	ΔBOVESPA	.43009***	R^2	.62773
	(2.7481)		(2.7481)	$\bar{R}^2$	.59051
SP500	.37882*	ΔSP500	.37882*	DW	1.8965
	(1.7542)		(1.7542)	$\chi^2 Auto$	23.9107 [0.021]
		ECT(-1)	-1.0000	$\chi^2 Norm$	.13010 [0.937]
			(None)	$\chi^2 Reset$	.029353 [0.864]
Pre-Crisis Period [January 2005 – June 2007] [ARDL 0,0,0,1,0,1,1,0,0]					
MERVAL	-.35217**	ΔMERVAL	-.35217**	R^2	.81481
	(-2.0978)		(-2.0978)	$\bar{R}^2$	.69499
TSXCO	1.1815**	ΔSP500	2.1501***	DW	2.1854
	(2.3600)		(3.1950)	$\chi^2 Auto$	22.9758 [0.028]
SP500	2.1501***	ECT(-1)	-1.0000	$\chi^2 Norm$	1.2959 [0.523]
	(3.1950)		(None)	$\chi^2 Reset$	7.9728 [0.005]
During-the-Crisis Period [July 2007 – December 2009] [ARDL 0,0,0,1,0,0,0,0,0]					
TSXCO	-.83401*	ΔIPSA	.54201*	R^2	.83461
	(-1.7018)		(1.8587)	$\bar{R}^2$	.75626
IPSA	.54201*	ΔIPCALL	(.65849*)	DW	1.4965
	(1.8587)		(-1.9230)	$\chi^2 Auto$	23.0958 [0.027]
IPCALL	-.65849*	ΔSP500	1.5931***	$\chi^2 Norm$	1.4556 [0.483]
	(-1.9230)		(3.3072)	$\chi^2 Reset$	1.2402 [0.265]
SP500	1.5931***	ECT(-1)	-1.0000		
	(3.3072)		(None)		
Post-Crisis Period [January 2010 – June 2012] [ARDL 1,0,0,0,0,0,0,0,0]					
IPSA	.39696**	ΔIPSA	.52795*	R^2	.6334
	(2.0145)		(1.9020)	$\bar{R}^2$	.45975
		ECT(-1)	-1.3300***	DW	2.2312
			(-8.0150)	$\chi^2 Auto$	18.9533 [0.090]
				$\chi^2 Norm$	1.6478 [0.439]
				$\chi^2 Reset$	2.1270 [0.145]
Panel B. ATX, BEL20, KFXCO, HELGEN, CAC40, DAX30, GRECO, AEXGEN, OSEALL, and SENSEX					
Overall Study Period [January 2005 – June 2012] [ARDL 0,0,0,0,0,1,0,0,0,0]					
BEL20	.49089*	ΔBEL20	.49089*	R^2	.66441
	(1.8635)		(1.8635)	$\bar{R}^2$	.62139
CAC40	-.93849***	ΔCAC40	-.70597**	DW	2.1488
	(-2.4367)		(-1.9486)	$\chi^2 Auto$	18.3319 [0.106]
DAX30	.58136***	ΔDAX30	.58136***	$\chi^2 Norm$	8.1731 [0.017]

	(2.5268)		(2.5268)	χ^2*Reset*	.22853 [0.633]
OSEALL	.34332*	ΔOSEALL	.34332*		
	(1.8856)		(1.8856)		
		ECT(-1)	-1.0000		
			(None)		
Pre-Crisis Period [January 2005 – June 2007] [ARDL 0,0,0,0,0,0,0,0,0,0,0]					
		ECT(-1)	-1.0000	R^2	.72326
			(None)	$\bar{R}^2$	.59217
				DW	1.9140
				χ^2*Auto*	12.5137 [0.405]
				χ^2*Norm*	1.3005 [0.522]
				χ^2*Reset*	5.8790 [0.015]
During-the-Crisis Period [July 2007 – December 2009] [ARDL 0,0,0,0,1,1,1,0,0,0]					
KFXCO	-.61553*	ΔKFXCO	-.61553*	R^2	.87246
	(-1.8853)		(-1.8853)	$\bar{R}^2$	.77680
CAC40	-1.6160*	ΔOSEALL	.65803**	*DW*	2.6324
	(-1.7443)		(2.1078)	χ^2*Auto*	21.7235 [0.041]
DAX30	1.7257*			χ^2*Norm*	2.0340 [0.362]
	(1.9957)			χ^2*Reset*	.81812 [0.366]
OSEALL	.65803**				
	(2.1078)				
Post-Crisis Period [January 2010 – June 2012] [ARDL 0,0,1,0,1,0,1,0,0,0]					
ATX	.52917**	ΔATX	.52917**	R^2	.85474
	(2.0634)		(2.0634)	$\bar{R}^2$	.74579
BEL20	1.1836**	ΔHELGEN	.51883**	*DW*	2.6472
	(2.5227)		(2.3795)	χ^2*Auto*	22.1840 [0.036]
GRECO	-.26198**	ΔDAX30	.35703*	χ^2*Norm*	.91831 [0.632]
	(-2.5521)		(1.7702)	χ^2*Reset*	.29489 [0.587]
		ΔGRECO	-.26198**		
			(-2.5521)		
		ECT(-1)	-1.0000		
			(None)		
Panel C. RTSI, IBEX35, STOALL, ZSM, ISE100, FTSE100 and SENSEX					
Overall Study Period [January 2005 – June 2012] [ARDL 0,0,0,0,0,0,0,0]					
RTSI	.11903*	ΔRTSI	.11903*	R^2	.67653
	(1.8314)		(1.8314)	$\bar{R}^2$	.65286
ISE100	.37346***	ΔISE100	.37346***	*DW*	2.1175
	(4.5019)		(4.5019)	χ^2*Auto*	14.7078 [0.258]
FTSE100	.45424*	ΔFTSE100	.45424*	χ^2*Norm*	1.4711 [0.479]
	(1.7890)		(1.7890)	χ^2*Reset*	.21206 [0.645]
		ECT(-1)	-1.0000		
			(None)		

Pre-Crisis Period [January 2005 – June 2007] [ARDL 0,0,0,0,0,0,0]					
RTSI	.20650*	ΔRTSI	.20650*	R^2	.71898
	(1.7988)		(1.7988)	$\bar{R}^2$	.64234
		ECT(-1)	-1.0000	*DW*	2.2535
			(None)	χ^2*Auto*	14.0940 [0.295]
				χ^2*Norm*	.63156 [0.729]
				χ^2*Reset*	2.1788 [0.140]
During-the-Crisis Period [July 2007 – December 2009] [ARDL 0,0,0,0,1,1,0]					
RTSI	.14311*	ΔRTSI	.14311*	R^2	.87537
	(1.6872)		(1.6872)	$\bar{R}^2$	.82552
STOALL	-.50393**	ΔSTOALL	-.50393**	*DW*	2.5084
	(-2.0402)		(-2.0402)	χ^2*Auto*	22.0974 [0.036]
ZSM	-1.8232***	ΔZSM	-1.1204***	χ^2*Norm*	.16662 [0.920]
	(-3.3227)		(-2.7329)	χ^2*Reset*	.40336 [0.525]
ISE100	1.2045***	ΔISE100	.78562***		
	(4.7549)		(4.6418)		
FTSE100	.89766**	ΔFTSE100	.89766**		
	(2.4974)		(2.4974)		
		ECT(-1)	-1.0000		
			(None)		
Post-Crisis Period [January 2010 – June 2012] [ARDL 1,0,1,0,0,1,0]					
IBEX35	-.23179**	ΔSTOALL	.49043*	R^2	.84839
	(-2.1318)		(1.9593)	$\bar{R}^2$	.77658
STOALL	.31090*	ΔISE100	.50435***	*DW*	2.3467
	(1.9183)		(4.5621)	χ^2*Auto*	15.3983 [0.220]
ISE100	.54842***	ECT(-1)	-1.5775***	χ^2*Norm*	1.4390 [0.487]
	(5.1552)		(-12.1816)	χ^2*Reset*	1.5023 [0.220]
Panel D. ALLORD, SHCO, HS, JACO, T50, N225, KOSPI, KPI, KLCO and SENSEX					
Overall Study Period [January 2005 – June 2012] [ARDL 0,0,0,0,0,0,0,0,0,0]					
ALLORD	.38544**	ΔALLORD	.38544**	R^2	.72956
	(1.9203)		(1.9203)	$\bar{R}^2$	.69875
HS	.41839***	ΔHS	.41839***	*DW*	2.0999
	(3.2974)		(3.2974)	χ^2*Auto*	18.5935 [0.099]
JACO	.25699**	ΔJACO	.25699**	χ^2*Norm*	7.2984 [0.026]
	(2.1955)		(2.1955)	χ^2*Reset*	1.2072 [0.272]
		ECT(-1)	-1.0000		
			(None)		
Pre-Crisis Period [January 2005 – June 2007] [ARDL 0,1,0,1,0,0,0,0,0,1]					
HS	1.1402***	ΔALLORD	.95670**	R^2	.88414
	(3.0553)		(2.1837)	$\bar{R}^2$	.79724
KLCO	-.70302*	ΔHS	.42772*	*DW*	2.3599
	(-1.9338)		(1.9600)	χ^2*Auto*	20.4434 [0.059]

		ECT(-1)	-1.0000	χ^2*Norm*	4.3101 [0.116]
			(None)	χ^2*Reset*	5.8692 [0.015]
During-the-Crisis Period [July 2007 – December 2009] [ARDL 0,0,0,0,0,0,0,0,0,0,0]					
ALLORD	.65864*	ΔALLORD	.65864*	R^2	.84192
	(1.7049)		(1.7049)	$\bar{R}^2$	.76705
HS	.63543***	ΔHS	.63543***	*DW*	2.2704
	(2.6530)		(2.6530)	χ^2*Auto*	25.3549 [0.013]
		ECT(-1)	-1.0000	χ^2*Norm*	1.0924 [0.579]
			(None)	χ^2*Reset*	.10066 [0.751]
Post-Crisis Period [January 2010 – June 2012] [ARDL 0,0,0,1,0,1,0,1,0,0]					
HS	.74837***	ΔKOSPI	.35159*	R^2	.91454
	(2.6660)		(1.9692)	$\bar{R}^2$	.85045
T50	.21521**	ECT(-1)	-1.0000	*DW*	2.2535
	(2.1200)		(None)	χ^2*Auto*	24.7170 [0.016]
KOSPI	-.59729**			χ^2*Norm*	.90356 [0.636]
	(-2.2714)			χ^2*Reset*	1.0087 [0.315]
Panel E. K100, PSECO, TASI, ST, CSEALL, TW, SET50, ADG and SENSEX					
Overall Study Period [January 2005 – June 2012] [ARDL 0,0,0,0,0,0,0,0,0,0]					
PSECO	.24620**	ΔPSECO	.24620**	R^2	.71227
	(2.0939)		(2.0939)	$\bar{R}^2$	.68349
TASI	.11933*	ΔTASI	.11933*	*DW*	1.9882
	(1.7731)		(1.7731)	χ^2*Auto*	13.9437 [0.304]
ST	.62222***	ΔST	.62222***	χ^2*Norm*	1.0752 [0.584]
	(3.9062)		(3.9062)	χ^2*Reset*	2.8320 [0.092]
		ECT(-1)	-1.0000		
			(None)		
Pre-Crisis Period [January 2005 – June 2007] [ARDL 0,0,1,0,0,0,0,0,1]					
PSECO	-.95426**	ΔST	.79794**	R^2	.69719
	(-2.0495)		(2.5605)	$\bar{R}^2$	.52897
ST	.79794**	ΔTW	.70650**	*DW*	1.9608
	(2.5605)		(2.2457)	χ^2*Auto*	11.1901 [0.513]
TW	.70650**	ECT(-1)	-1.0000	χ^2*Norm*	3.7530 [0.153]
	(2.2457)		(None)	χ^2*Reset*	.43679 [0.509]
During-the-Crisis Period [July 2007 – December 2009] [ARDL 0,0,1,0,0,0,0,1,0]					
PSECO	.73610***	ΔPSECO	.35223*	R^2	.86648
	(2.6878)		(1.7482)	$\bar{R}^2$	.79230
ST	.70720**	ΔST	.70720**	*DW*	1.8265
	(2.4052)		(2.4052)	χ^2*Auto*	18.5651 [0.100]
SET50	-.62937*	ECT(-1)	-1.0000	χ^2*Norm*	2.3962 [0.302]
	(-1.9476)		(None)	χ^2*Reset*	2.9180 [0.088]
Post-Crisis Period [January 2010 – June 2012] [ARDL 1,1,0,0,1,0,0,1,0]					
PSECO	.46729***	ΔK100	.42873*	R^2	.88225

	(3.8945)		(1.7983)	$\bar{R}^2$	.79394
ST	.90651***	ΔPSECO	.71388***	*DW*	1.7277
	(3.2258)		(3.7122)	χ^2*Auto*	20.8759 [0.052]
SET50	-.31299*	ΔST	.59430*	χ^2*Norm*	.0097353 [0.995]
	(-1.7522)		(1.9906)	χ^2*Reset*	.80668 [0.369]
		ECT(-1)	-1.5277***		
			(-8.7588)		

Notes: 1) *Auto* is the Breusch-Godfrey Lagrange Multiplier (LM) test for auto or serial correlation. Norm is the Jarque-Bera normality test. *RESET* is the Ramsey Test for functional form.

2) ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

3) Figures in parentheses and square brackets represent *t*- statistics and *p*- value, respectively.

Chinese, Hong Kong, Indonesian, Iranian, Japanese, Rep. of Korean, Kuwait, and Malaysian stock markets during this period. So, all other markets were available for portfolio diversification purpose for the Indian investors. It is also interesting to note here that in post-crisis period, the Indian market was significantly co-integrated with all other international stock markets except the Latin American markets. So, portfolio diversification opportunities were limited for the Indian and international investors. However, in the pre-crisis period, such opportunities were plenty more for them in all Asian and Latin American markets.

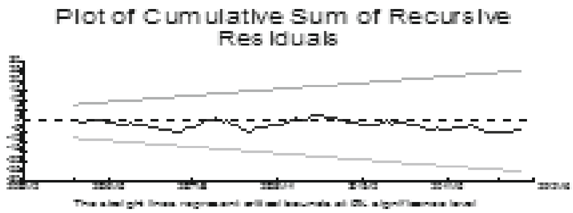
Once I established existence of long-run co-integrating relationships in between these stock markets log returns, equation (5) is estimated using the respective ARDL specifications for the overall study period and all sub-periods. Also, the results of the short-run dynamic coefficients associated with the long-run co-integrating relationships are obtained from the ECM equation (6). Both types of results are shown in the Table 4 with dependent variable of SENSEX under both sets of equations with 40 international stock markets.

It is found from the Table 4 that estimated coefficients of the long-run relationships show that the Brazilian, France, German, Turkish, Hong Kong, and Singapore 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 Brazilian, German, Turkish, Hong Kong, and Singapore stock markets' returns caused a 0.43%, 0.58%, 0.37%, 0.42% (appx.) and 0.62% increase in SENSEX's returns respectively. Also, a 1% increase in CAC 40 caused - 0.94% (appx.) decrease in SENSEX's returns. The U.S., Belgium, Norway, Russian, UK, Australian, Indonesian, and Philippines stock markets were also co-integrated with the Indian market in the long-run (see Table 4). So, these coefficients results more specifically have pointed out that the Indian investors could look into the other international markets for possible profitable portfolio diversification opportunities. International investors from other countries also could get in the Indian market during this study period. In during-the-crisis period, it is found that the U.S., Switzerland, Turkey, Hong Kong, and Philippines [at 1% significance level] ; Norway, Sweden, the UK, and Singapore [at 5% significance level] ; and Canada, Chili, Mexico, Denmark, France, Germany, Russian, Australian, and Thailand [at 10% significance level] stock markets had long-run associations with the Indian stock market. So, the Indian investors could look into 22 other markets for strategizing their portfolio diversification process. The short-run coefficients results are also quite similar in most cases under both periods, which imply that all these markets were equally profitable in the short-run for diversification purposes for the Indian investors. There were also arbitrage opportunities available in these non-integrated markets during the study period.

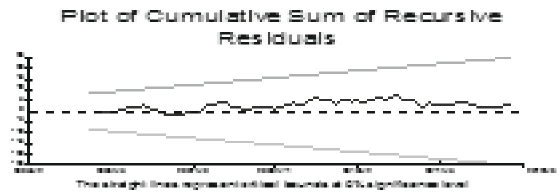
It is also found from the Table 4 that estimated coefficients of the long-run relationships show that the Argentinean, the U.S., Hong Kong, Singapore, and Taiwan market returns had a very high significant impact on the Indian stock market returns in the pre - crisis period. It is observed that a 1% increase in the SP 500, HS, ST, and TW returns caused a 2.15%, 1.14%, 0.80% (appx.), and 0.71% (appx.) increase in SENSEX's returns,

Figure 4. Cumulative Sum [CUSUM] Plots (Overall Study Period [January 2005 – June 2012])

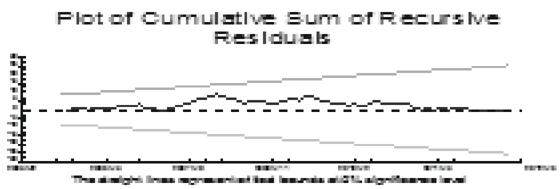
Dependent Variable: SENSEX (with Latin American Markets)



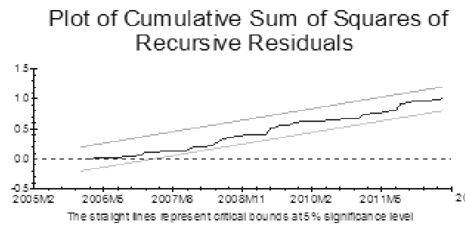
Dependent Variable: SENSEX (with European 1 Markets)



Dependent Variable: SENSEX (with European 2 Markets)



Dependent Variable: SENSEX (with Asian 1 Markets)



Dependent Variable: SENSEX (with Asian 2 Markets)

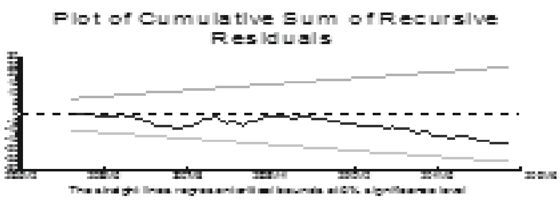
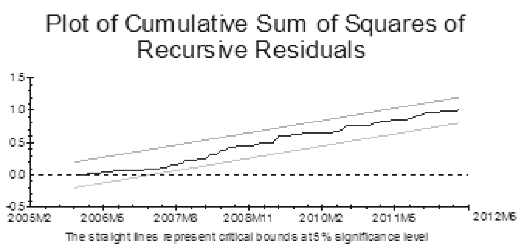
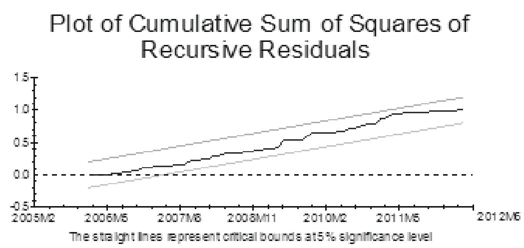


Figure 5. Cumulative Sum of Squares [CUSUMQ] Plots [Overall Study Period [January 2005 – June 2012])

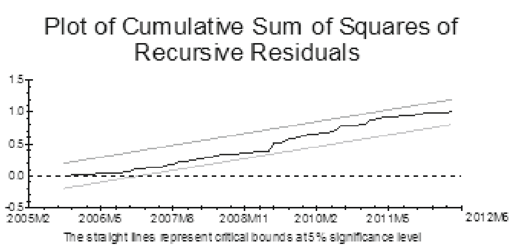
Dependent Variable: SENSEX (with Latin American Markets)



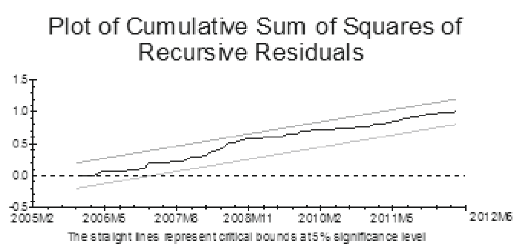
Dependent Variable: SENSEX (with European 1 Markets)



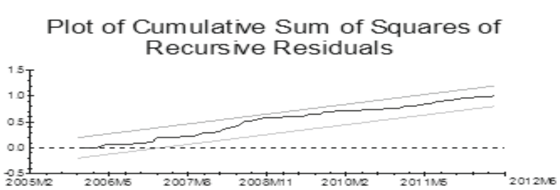
Dependent Variable: SENSEX (with European 2 Markets)



Dependent Variable: SENSEX (with Asian 1 Markets)



Dependent Variable: SENSEX (with Asian 2 Markets)



respectively. Also, a 1% increase in MERVAL and PSECO caused a - 0.35% and - 0.95% decrease in SENSEX's returns, respectively. The Malaysian and Russian stock markets were also co-integrated with the Indian market in the long-run during the pre-crisis period (see Table 4). In the post-crisis period, the Chilean, Austrian, Belgian, Greece, Spanish, Swedish, Turkish, Hong Kong, Iranian, Rep. of Korean, Philippine, Singapore, and Thailand stock markets were associated with the Indian market in the long-run. Thus, it is evident that the Indian investors had less portfolio diversification opportunities in the long-run in the post-crisis period than in the pre-U.S. crisis period. The short-run coefficients results also mostly support this fact for the short-run associations of the Indian stock market with these international markets.

There are few cases where the short and long-run coefficient results contradict under this study. For example, the KLCO and PSECO were not related in the short-run with the SENSEX in the pre-crisis period; the Canadian stock market did not have any short-run associations with the Indian stock market in pre- and during-the-crisis period ; the French, German, and Thailand stock markets similarly didn't have any short-run dynamic linkages with the SENSEX in during-the-crisis period ; and Belgian, Spanish, Hong Kong, Iranian, and Thailand markets were not integrated with the Indian stock market in the post-crisis period, although they had co-integrated interrelationships with the Indian stock market in the long-run. On the other hand, ALLORD was not co-integrated with the SENSEX in the long-run in the pre-crisis period ; the Finish, German, and Pakistani stock markets did not have any long-run associations with the SENSEX in the post-crisis period, although they had short-run associations with the SENSEX. Thus, the Indian investors should take into consideration all these information which may create unique portfolio diversification and arbitrage opportunities for them due to inefficiency in these markets in similar future periods.

It is also found that the equilibrium correction mechanism [ECM in equation (6) and represented by ECT(-1) in Microfit 4.1 (see Table 4)] estimated at -1.33 [Panel A, post-crisis period], -1.58 (appx.) [Panel C, post-crisis period], -1.53 [Panel E, post-crisis period] with SENSEX as a dependent variable is highly significant, has the correct sign, and implies a very high speed of adjustment to equilibrium after a shock. In other words, approximately, 133%, 158%, and 153% of disequilibrium from the previous month's shock converges back to the long-run equilibrium in the current month. Thus, it is clearly evident that in the post-crisis period, arbitrage opportunities exist in these international stock markets for international investors, including the Indian investors in the very short-run.

The regression for the undertaken ARDL equations fits very well in most of the cases at R^2(90%) and also passes the diagnostic tests against serial correlation, functional form misspecification, and non-normal errors (see Table 4). Spurious regressions are also mostly non-existent as there are no signs of high R^2, t - values, F-value, and reasonable Durbin-Watson [DW] statistic in most of the cases. The cumulative sum [CUSUM] and cumulative sum of squares [CUSUMQ] plots [see Figures 4 and 5] from a recursive estimation of this model also indicate stability 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 do not also exceed the critical boundaries. This study has applied these diagnostic tests in line with Bahmani - Oskooee and Ng (2002), Pesaran and Pesaran (1997), and Suleiman (2005) to test the stability of the long-run coefficients.

Conclusion and Policy Implications

This study has re-examined the short- and long-run associations and co-integrations among the Indian and selected 40 international markets from three continents in relation to the crisis emerged from the developed U.S. market in overall and pre-, during-, and post-U.S. sub-prime crisis of 2007-09 by using the Pearson et al.'s (2001) bounds testing approach for the first time. The emphasis has been on how the Indian investors would diversify their portfolio most profitably under different time periods by investing in these international markets. Although results have shown extreme volatility, especially during-the-crisis period for most markets, but the Asian markets were less volatile for the overall study period. This study has found that in the overall study period, the Indian investors could go to Mexico, Peru, Venezuela, Indonesia, Philippines, and Sri Lankan markets for earning higher returns. Similarly, during-the-crisis period, they could look at Brazil, Peru, Venezuela, and Sri Lankan markets. However, when risk adjusted returns are considered, their portfolio diversification choices were more, especially in the overall study period. This implies higher riskiness of the Indian stock market in relation to monthly logarithmic returns. However, they should never look at some of the European markets like Greece, Belgium, France, etc., and Japan, Saudi Arabia, and UAE markets in Asia. Results also have shown that except few of its ASEAN peers and Sri Lanka, Indian market is still one of the strongest emerging markets in Asia in attracting foreign investors, especially in crisis periods (these results are in line with Islam, 2014). These results are also in line with Bhattacharjee and Swaminathan (2016) and Dasgupta (2013, 2016). However, few results contradict with the studies of Khan and Aslam (2014) and Singh and Kaur (2015).

The correlation results in combination with R^2 results have also pointed out many profitable portfolio diversification opportunities for both the Indian and international investors. Especially, in pre- and post-crisis periods, such opportunities were evident as results show many negative correlationships (in line with Markowitz [1952]) in between the Indian and Iranian, Kuwait, Saudi Arabian, Sri Lankan, UAE, and Venezuelan markets. The Granger causality tests results also have shown that there was overwhelming presence of portfolio diversification opportunities for the Indian investors in all other international stock markets except Iran in the short-run for the overall study period. On similar grounds, the international investors could also diversify in India provided their domestic market returns are lower.

For the long-run co-integration, it is found that there were enough portfolio diversification opportunities for the Indian investors in Asian and Latin American markets in the overall study period. However, in during-the-crisis period, results have shown that there was no co-integration in between the Indian with the Latin American and European markets. It is also interesting to note that in the post-crisis period, the Indian market was significantly co-integrated with all other international stock markets except the Latin American markets. So, portfolio diversification opportunities were limited for the Indian and international investors. However, in the pre-crisis period, such opportunities were plenty more for them in all Asian and Latin American markets. It is also found that the Brazilian, France, German, Turkish, Hong Kong, and Singapore market returns had a very high significant impact on the Indian stock market returns in the overall study period. The U.S., Belgium, Norway, Russian, UK, Australian, Indonesian, and Philippines stock markets were also co-integrated with the Indian market in the long-run. So, the Indian and international investors could look into the other international markets for possible profitable portfolio diversification opportunities. However, during-the-crisis period, both Indian and international investors had less number of profitable diversification opportunities as most of these international stock markets were co-integrated.

The short-run coefficients' results are also quite similar in most cases in between the Indian with other paneled countries like the long-run results indicated above. It is also evident that the Indian investors had fewer portfolio diversification opportunities in the short-run like in the long-run in post-crisis period than pre-U.S. crisis. These findings imply that all these markets were equally profitable in the short-run for diversification purposes for the Indian investors. From the statistical perspective, it is also evident from the study results that long-run disequilibrium relationships in between the Indian and international markets (as evident in specific cases) stabilized in the very next month in most of the cases under the post-crisis period. This implies that international investors got very little time to earn windfall gains from their arbitrage activities in these markets. However, all these results imply the efficiency of these markets. Also, there are few cases where the short and long-run coefficients' results contradict under this study. Thus, the Indian investors should always be cautious in their international portfolio diversification strategies. The international investors should also take a clue from these results to implement such decisions in relation to India.

The implications of my study are 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, these markets were not perfectly integrated in all times portfolio revision, and short-run arbitrage activities can work wonders for the stakeholders in similar future 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 the Indian and 40 international stock markets, the study's 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 by utilizing another country's stock returns information. This is in line with the findings of Masih and Masih (2002), but in contradiction with Granger (1986), who observed that co-integration between two returns reflected 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 results of this 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, forex transactions, and treasury management activities. All this information will also be indispensable for Indian and 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 markets, etc., which drive stock markets and associations and co-integrations in between these markets to provide more in-depth knowledge to Indian and international investors to undertake successful portfolio diversification strategies with least possible risks.

Limitations of the Study and Scope for Future Research

This study has taken a constrained time period of January 2005 – June 2012 to make the sub-periods balanced. However, it may have reduced some long-run implications of portfolio diversification benefits that future researchers can look into. Also, future researchers can use some advanced econometric modeling techniques like time-varying copula models to capture the effects of interdependence and dynamic linkages in between developed and emerging international stock markets under different combinations. The impact and linkages of foreign institutional investments on these markets under different time-periods can also be an interesting topic for investigation.

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About the Author

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APPENDICES

Appendix 1. Stock Markets Returns Information

Countries	Actual Return (in %) (Based on indices monthly closing values)				Risk Adjusted Return (Mean/SD)(in %) (Based on indices monthly logarithmic returns)			
	Overall (Jan.05-June12)	Pre-crisis (Jan.05-June07)	During-the-crisis (July07-Dec.09)	Post-crisis (Jan.10-June12)	Overall (Jan.05-June12)	Pre-crisis (Jan.05-June07)	During-the-crisis (July07-Dec.09)	Post-crisis (Jan.10-June12)
India	21.86	16.25	2.56	- 0.03	13.65	46.23	5.32	- 0.04
Argentina	9.42	7.91	0.79	**0.15**	6.51	22.73	1.66	**0.43**
Brazil	14.33	14.35	**3.48**	-2.77	11.58	40.59	**8.74**	- 13.93
Canada	3.39	6.72	- 2.07	- 0.17	5.48	45.50	- 8.84	- 1.17
Chili	19.24	12.35	0.43	**3.05**	**21.11**	**61.35**	1.90	**14.59**
Mexico	**28.16**	**18.82**	0.41	**3.35**	**22.40**	**59.57**	1.38	**20.09**
Peru	**59.28**	**67.04**	**4.89**	**5.68**	**17.87**	**89.83**	- 10.62	**15.14**
USA	1.65	3.21	-3.44	**2.95**	2.72	34.86	-15.66	**13.90**
Venezuela	**98.77**	4.34	**5.16**	**47.63**	**28.46**	9.99	**19.91**	**55.86**
Austria	-2.50	13.37	-6.50	-2.78	-2.92	**50.79**	-20.59	-12.00
Belgium	-3.21	7.76	-6.12	-1.51	-5.45	**57.24**	-25.38	-9.52
Denmark	7.41	9.16	-4.05	**4.33**	8.29	**53.01**	-15.05	**17.79**
Finland	-2.47	10.96	-5.75	-2.86	-3.70	**63.10**	-23.68	-13.57
France	-2.18	7.79	-4.67	-2.51	-3.70	**55.57**	-21.45	-12.52
Germany	6.77	11.75	-3.41	**1.03**	7.71	**68.88**	-13.34	**3.99**
Greece	-10.41	9.85	-7.29	-9.62	-17.82	40.89	-24.74	-38.92
Netherlands	-1.56	7.67	-5.18	-1.11	-2.31	**49.52**	-19.34	-6.00
Norway	11.35	**18.27**	-3.79	**1.21**	9.59	**59.38**	-11.38	**5.45**
Russia	15.99	**27.87**	-3.18	-0.87	7.62	**51.52**	-5.86	-2.26
Spain	-2.91	8.53	-2.64	-5.40	-4.34	**52.05**	-10.49	-23.17
Sweden	5.11	10.61	-3.60	**0.73**	6.49	**52.90**	-14.52	**3.63**
Switzerland	0.88	8.23	-3.86	-0.98	1.79	**59.22**	-22.28	-7.85
Turkey	20.06	11.81	1.62	**2.45**	11.45	29.78	3.26	**7.69**
UK	2.10	4.97	-2.41	**0.39**	3.73	**49.97**	-11.51	**2.22**
Australia	0.27	7.43	-3.02	-2.04	0.50	**59.81**	-14.25	-14.33
China	10.10	**26.89**	-1.90	-4.28	6.55	**46.89**	-3.91	-22.65
Hong Kong	4.88	7.07	0.06	-1.48	4.93	42.76	3.50	-6.14
Indonesia	**39.40**	15.18	2.46	**7.48**	**20.75**	50.56	**5.34**	**28.34**
Iran	4.50	2.92	-4.47	**21.01**	5.73	-18.13	-24.44	**54.50**
Japan	-2.88	7.72	-5.58	-1.95	-4.33	39.50	-22.33	-9.09
Rep. of Korea	14.26	12.62	-0.47	**1.36**	12.40	42.30	-1.38	**6.33**
Kuwait	0.08	11.77	-5.59	-1.06	0.11	34.74	-23.38	-9.00
Malaysia	10.16	6.57	-0.80	**3.42**	**15.31**	44.40	-3.63	**25.38**
Pakistan	16.26	16.20	-4.25	**6.27**	10.40	36.34	-11.01	**25.02**
Philippines	**25.04**	13.48	-2.23	**9.58**	**19.00**	**49.72**	-7.60	**35.46**
Saudi Arabia	-2.63	-1.96	-1.67	**1.01**	-2.62	-4.75	-4.13	**4.78**
Singapore	5.24	9.56	-2.44	-0.09	5.96	**58.22**	-7.43	-14.17
Sri Lanka	**30.61**	9.43	**4.22**	**6.22**	**17.84**	26.16	**10.82**	**17.91**
Taiwan	2.51	5.96	-1.04	-1.45	2.92	31.03	-2.91	-7.29
Thailand	9.83	2.31	-0.71	**7.52**	8.16	10.90	-1.73	**24.77**
UAE	-2.71	2.06	-3.01	-1.44	-3.16	4.60	-9.98	-10.60

Appendix 2. Descriptive Statistics Results

Overall Study Period [January 2005 - June 2012]									
	SENSEX	**MERVAL**	**BOVESPA**	**TSXCO**	**IPSA**	**IPCALL**	**LIMAGEN**	**SP500**	**IBC**
Skewness	-0.516869	-1.361327	-0.658611	-1.252543	-0.004827	-0.750506	-0.724591	-0.893689	0.751918
Kurtosis	4.560906	9.148738	5.050006	6.114231	3.070629	4.191993	7.446438	4.798369	4.961046
Jarque-Bera	13.14390***	169.5743***	22.26599***	59.90209***	0.019056	13.77707***	82.01601***	24.10821***	22.90210***
	ATX	**BEL20**	**KFXCO**	**HELGEN**	**CAC40**	**DAX30**	**GRECO**	**AEXGEN**	**OSEALL**
Skewness	-1.273676	-1.415287	-0.918124	-0.398895	-0.592980	-0.948396	-0.748343	-1.242292	-1.377149
Kurtosis	6.015738	6.318215	5.703053	4.240587	3.063193	5.064911	4.236427	5.634107	6.294759
Jarque-Bera	58.43878***	71.33512***	40.04365***	8.158226***	5.289362*	29.48128***	14.13309***	49.16879***	69.15598***
	RTSI	**IBEX35**	**STOALL**	**ZSM**	**ISE100**	**FTSE100**			
Skewness	-1.022818	-0.431004	-0.801741	-0.644592	-0.484810	-0.695102			
Kurtosis	5.262246	3.754352	5.277812	3.311972	3.474762	3.539528			
Jarque-Bera	34.88395***	4.920395*	29.09844***	6.597460**	4.370860	8.339085***			
	ALLORD	**SHCO**	**HS**	**JACO**	**T50**	**N225**	**KOSPI**	**KPI**	**KLCO**
Skewness	-0.977615	-0.648866	-0.732102	-1.812325	0.121462	-1.027247	-0.864574	-1.147490	-0.687509
Kurtosis	3.948820	3.883689	4.596463	10.74080	2.656238	5.731234	5.232255	6.753127	6.086344
Jarque-Bera	17.71194***	9.243800***	17.59721***	273.9679***	0.664442	43.80221***	29.89845***	72.57338***	42.81072***
	K100	**PSECO**	**TASI**	**ST**	**CSEALL**	**TW**	**SET50**	**ADG**	
Skewness	-1.942390	-1.177243	-0.569623	-1.040130	0.135794	-0.451199	-1.556922	0.927025	
Kurtosis	11.31105	7.002891	3.256846	7.463626	3.307681	3.516011	8.468256	7.326703	
Jarque-Bera	315.6188***	80.87529***	5.114439*	90.94290***	0.631603	4.052210	148.4920***	83.09197***	
Pre-Crisis Period [January 2005 - June 2007]									
	SENSEX	**MERVAL**	**BOVESPA**	**TSXCO**	**IPSA**	**IPCALL**	**LIMAGEN**	**SP500**	**IBC**
Skewness	-1.068255	-0.172905	-0.026986	-0.587676	-0.209850	-0.862934	0.012503	-0.215960	0.213348
Kurtosis	3.702843	2.744219	2.635588	2.580052	1.953410	3.609054	2.357854	1.984662	2.611215
Jarque-Bera	6.323333**	0.231261	0.169636	1.947259	1.589373	4.186960	0.516221	1.521832	0.416529
	ATX	**BEL20**	**KFXCO**	**HELGEN**	**CAC40**	**DAX30**	**GRECO**	**AEXGEN**	**OSEALL**
Skewness	-0.698696	-0.877542	-0.484431	-0.716570	-0.665052	-0.505259	-1.036904	-1.006567	-0.694794
Kurtosis	3.628311	3.744563	2.712119	4.036885	2.874220	2.794050	3.760788	3.482456	2.841818
Jarque-Bera	2.934348	4.543370*	1.276960	3.911273	2.231245	1.329453	6.099348**	5.356842*	2.444973
	RTSI	**IBEX35**	**STOALL**	**ZSM**	**ISE100**	**FTSE100**			
Skewness	-0.375813	-0.065476	-0.815571	-0.756751	-0.423059	-1.036870			
Kurtosis	2.382482	2.335386	3.534345	3.350873	2.924122	3.661611			
Jarque-Bera	1.182836	0.573575	3.682686	3.017251	0.902093	5.922663**			
	ALLORD	**SHCO**	**HS**	**JACO**	**T50**	**N225**	**KOSPI**	**KPI**	**KLCO**
Skewness	-1.126598	0.460325	-0.894274	-1.182466	0.104508	-0.274685	0.018281	-0.540770	0.704522
Kurtosis	3.454272	3.269422	3.089505	4.324263	2.219082	3.820906	2.224732	4.084371	3.453606
Jarque-Bera	6.604069**	1.150232	4.008640	9.183217***	0.816900	1.219620	0.752971	2.931987	2.738955
	K100	**PSECO**	**TASI**	**ST**	**CSEALL**	**TW**	**SET50**	**ADG**	
Skewness	-0.150638	-0.198693	-0.321518	-1.650144	-0.853214	0.099636	-0.568884	1.354963	
Kurtosis	3.059606	2.233499	2.151941	6.508230	3.872200	2.229353	2.329587	5.998776	
Jarque-Bera	0.117900	0.931799	1.415873	28.99948***	4.590785*	0.792007	2.179964	20.42044***	

During-the-Crisis Period [July 2007 - December 2009]

	SENSEX	MERVAL	BOVESPA	TSXCO	IPSA	IPCALL	LIMAGEN	SP500	IBC
Skewness	-0.364284	-1.857653	-1.163354	-0.971633	0.539955	-0.554915	-0.337840	-0.729958	0.057057
Kurtosis	3.311903	9.587300	5.111079	4.150726	3.317641	3.163011	5.734677	3.248565	2.450496
Jarque-Bera	0.785120	71.49503***	12.33778***	6.375572**	1.583878	1.572869	9.918753***	2.741425	0.393720
	ATX	**BEL20**	**KFXCO**	**HELGEN**	**CAC40**	**DAX30**	**GRECO**	**AEXGEN**	**OSEALL**
Skewness	-0.920919	-0.856792	-0.369161	0.022669	-0.241447	-0.272407	-0.618068	-0.845918	-1.157267
Kurtosis	3.921721	3.414722	3.843211	3.796808	2.483984	2.847592	3.816654	3.237567	4.119488
Jarque-Bera	5.302422*	3.885452	1.570155	0.796197	0.624325	0.400062	2.743694	3.648437	8.262908***
	RTSI	**IBEX35**	**STOALL**	**ZSM**	**ISE100**	**FTSE100**			
Skewness	-0.729994	-0.466542	-0.491762	-0.198193	-0.450348	-0.467507			
Kurtosis	3.785287	3.570561	4.358170	2.539079	2.809795	2.429024			
Jarque-Bera	3.435301	1.495229	3.514932	0.461963	1.059287	1.500329			
	ALLORD	**SHCO**	**HS**	**JACO**	**T50**	**N225**	**KOSPI**	**KPI**	**KLCO**
Skewness	-0.670082	-0.825522	-0.507777	-1.506830	0.589325	-0.874322	-0.901319	-1.230847	-0.513710
Kurtosis	2.603734	2.388330	3.000225	6.964285	3.455884	4.590387	4.258956	5.028959	4.115272
Jarque-Bera	2.441332	3.875106	1.289186	30.99713***	1.996310	6.983855**	6.043096**	12.72077***	2.874278
	K100	**PSECO**	**TASI**	**ST**	**CSEALL**	**TW**	**SET50**	**ADG**	
Skewness	-1.891654	-1.136990	-0.647400	-0.577734	0.410358	-0.309321	-1.343316	-0.311292	
Kurtosis	8.007689	5.652117	3.027659	4.435408	2.978817	2.297096	5.898024	3.163002	
Jarque-Bera	49.23796***	15.25589***	2.096588	4.244379	0.842530	1.095989	19.52067***	0.517726	

Post-Crisis Period [January 2010 - June 2012]

	SENSEX	MERVAL	BOVESPA	TSXCO	IPSA	IPCALL	LIMAGEN	SP500	IBC
Skewness	0.144076	-0.175564	0.513102	-0.605617	-0.262323	-0.016224	0.070223	-0.142987	1.288899
Kurtosis	2.419655	2.752229	2.978741	2.816284	2.751918	2.097047	2.203645	2.310810	5.472334
Jarque-Bera	0.524789	0.230851	1.316931	1.876050	0.420998	1.020472	0.817382	0.695956	15.94684***
	ATX	**BEL20**	**KFXCO**	**HELGEN**	**CAC40**	**DAX30**	**GRECO**	**AEXGEN**	**OSEALL**
Skewness	-0.353579	0.019810	-0.872507	0.127237	-0.144903	-1.130016	-0.072697	0.078032	0.078543
Kurtosis	2.849137	1.647368	4.584032	2.065409	1.935261	6.151294	3.179542	2.798916	2.281574
Jarque-Bera	0.653541	2.288979	6.942791**	1.172773	1.522070	18.79800***	0.066718	0.080988	0.676014
	RTSI	**IBEX35**	**STOALL**	**ZSM**	**ISE100**	**FTSE100**			
Skewness	-0.816471	0.205478	-0.251145	-0.343155	-0.029800	-0.021336			
Kurtosis	3.360093	2.792554	2.676047	1.962804	2.080970	2.181673			
Jarque-Bera	3.495212	0.264898	0.446552	1.933498	1.060210	0.839349			
	ALLORD	**SHCO**	**HS**	**JACO**	**T50**	**N225**	**KOSPI**	**KPI**	**KLCO**
Skewness	-0.165599	0.334976	-0.421792	-0.416241	-0.613170	-0.244328	-0.386029	-0.518068	-0.425708
Kurtosis	2.522547	2.317507	2.962639	2.791096	3.423465	2.409459	2.772302	3.195906	3.221223
Jarque-Bera	0.422067	1.143290	0.891287	0.920833	2.104043	0.734405	0.809902	1.389949	0.967309
	K100	**PSECO**	**TASI**	**ST**	**CSEALL**	**TW**	**SET50**	**ADG**	
Skewness	-0.956015	-0.218223	-0.258723	-0.364232	0.622995	-0.204437	-0.995832	0.632367	
Kurtosis	3.209285	3.001547	2.722312	2.531209	3.401359	2.173265	3.645986	2.618801	
Jarque-Bera	4.624571*	0.238108	0.431076	0.938032	2.141978	1.063335	5.480030*	2.181079	

Appendix 3. Correlation Results

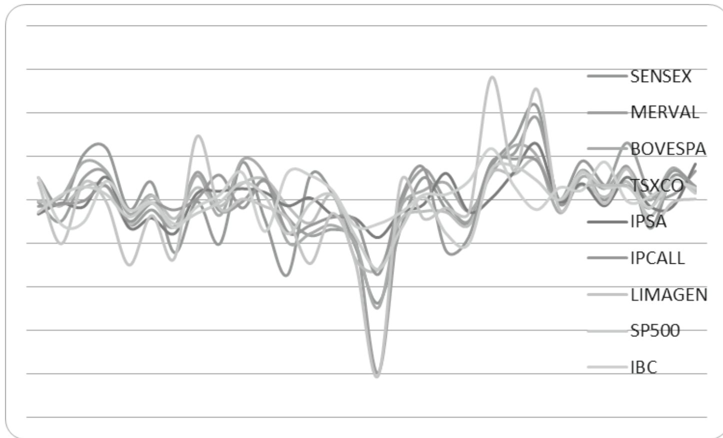
	Overall Study Period [January 2005 - June 2012]	Pre-Crisis Period [January 2005 - June 2007]	During-the-crisis period [July 2007 - December 2009]	Post-crisis period [January 2010 - June 2012]
		Panel A.		
	SENSEX	**SENSEX**	**SENSEX**	**SENSEX**
MERVAL	0.655329	0.486940	0.761841	0.532181
BOVESPA	0.742048	0.573057	**0.824481**	0.670225
TSXCO	0.701726	0.698356	0.771547	0.454834
IPSA	0.559105	0.361479	0.651707	0.511068
IPCALL	0.661437	0.770831	0.650262	0.544145
LIMAGEN	0.548250	0.187604	0.685549	0.344995
SP500	0.700865	0.752153	**0.806675**	0.529403
IBC	0.095002	0.104812	0.316385	**-0.016945**
		Panel B.		
ATX	0.740433	0.716311	**0.797370**	0.591481
BEL20	0.728012	0.714117	**0.812662**	0.489695
KFXCO	0.606380	0.677754	0.673058	0.409940
HELGEN	0.692171	0.684804	0.748543	0.595577
CAC40	0.710295	**0.787103**	**0.793231**	0.540920
DAX30	0.719167	**0.795043**	**0.794823**	0.582592
GRECO	0.660617	0.636201	**0.818121**	0.473103
AEXGEN	0.727444	0.760419	**0.774724**	0.581148
OSEALL	0.718970	0.690295	0.766647	0.571936
		Panel C.		
RTSI	0.653459	0.525462	0.712808	0.550275
IBEX35	0.638653	0.674335	**0.802367**	0.419943
STOALL	0.707161	0.747974	0.704681	0.698227
ZSM	0.605155	0.685854	0.687537	0.276913
ISE100	0.733396	0.577000	**0.826330**	0.603855
FTSE100	0.710535	0.763701	0.773100	0.582293
		Panel D.		
ALLORD	0.745933	**0.806146**	0.773855	0.636116
SHCO	0.470849	0.036590	0.612517	0.348852
HS	**0.787659**	0.581485	**0.884896**	0.651250
JACO	0.737703	0.611459	**0.783195**	0.686157
T50	0.085727	**-0.063201**	0.251212	0.065133
N225	0.650739	0.673570	0.726781	0.445190
KOSPI	0.730192	0.647997	0.745196	0.752196
KPI	0.295394	**-0.248789**	0.486077	0.352766
KLCO	0.647834	0.294506	**0.775959**	0.537452
		Panel E.		
K100	0.215387	0.405173	0.093248	0.405897
PSECO	0.639089	0.269013	0.730177	0.748002
TASI	0.396692	**-0.047666**	0.667343	0.490870
ST	**0.816914**	0.684369	**0.865744**	0.757512
CSEALL	0.308242	**-0.001164**	0.567756	0.040342
TW	0.706665	0.553361	0.759581	0.633330
SET50	0.672329	0.415228	**0.781862**	0.592076
ADG	0.238702	**-0.279995**	0.527061	0.559082

Notes: 1) Results which show more than 0.600 values as per coefficient of determination (R^2) are assumed to be significant under this study based on correlation *(R)* results.

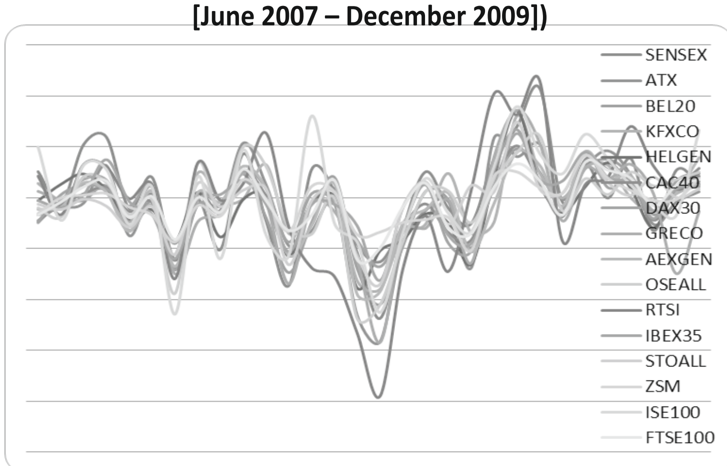
Appendix 4. DF- GLS Unit Root Tests Results

Overall Study Period [January 2005 – June 2012] [maxlag=12]						
	Log Level (x_t)			1st Difference (Δx_t)		*I(d)*
Variable	**SBC Lag**	**DF-GLS Stat**	**Variable**	**SBC Lag**	**DF-GLS Stat**	
MERVAL	0	-8.558043***	MERVAL	4	-1.343031	*I*(0)
BOVESPA	0	-6.841985***	BOVESPA	4	-0.487658	*I*(0)
TSXCO	0	-7.408027***	TSXCO	4	-1.331885	*I*(0)
IPSA	0	-7.741284***	IPSA	4	-1.897210	*I*(0)
IPCALL	0	-8.523218***	IPCALL	4	-1.709765	*I*(0)
LIMAGEN	1	-4.546959***	LIMAGEN	1	-10.88713	*I*(0)
SP500	0	-7.216332***	SP500	4	-1.349229	*I*(0)
IBC	0	-7.900630***	IBC	4	-1.795481	*I*(0)
SENSEX	0	-8.254731***	SENSEX	0	-13.38656	*I*(0)
ATX	0	-6.828958***	ATX	0	-10.89813	*I*(0)
BEL20	3	-2.624737	BEL20	3	-4.444211***	*I*(1)
KFXCO	0	-7.483122***	KFXCO	4	-1.510832	*I*(0)
HELGEN	0	-7.205236***	HELGEN	4	-1.638984	*I*(0)
CAC40	0	-7.527675***	CAC40	2	-9.546662	*I*(0)
		-7.906297***			-10.32770	
DAX30	0	-7.951740***	DAX30	1	-11.60470	*I*(0)
GRECO	0	-7.434393***	GRECO	0	-11.79844	*I*(0)
AEXGEN	0	-7.353401***	AEXGEN	1	-11.13562	*I*(0)
OSEALL	0	-6.724440***	OSEALL	0	-3.761066	*I*(0)
RTSI	0	-7.455113***	RTSI	2	-10.28041	*I*(0)
IBEX35	0	-7.844735***	IBEX35	1	-1.819144	*I*(0)
STOALL	0	-6.897308***	STOALL	4	-12.37447	*I*(0)
ZSM	0	-8.628129***	ZSM	0	-9.984267	*I*(0)
ISE100	0	-8.478551***	ISE100	1	-2.649951	*I*(0)
FTSE100	0	-7.265693***	FTSE100	4	-11.61624	*I*(0)
ALLORD	0	-4.620574***	ALLORD	1	-0.845926	*I*(0)
SHCO	1	-8.031842***	SHCO	4	-1.487855	*I*(0)
HS	0	-7.309440***	HS	4	-11.62836	*I*(0)
JACO	0	-4.998441***	JACO	1	-10.69436	*I*(0)
T50	0	-7.770442***	T50	0	-1.983628	*I*(0)
N225	0	-9.256975***	N225	4	-1.910194	*I*(0)
KOSPI	0	-5.619260***	KOSPI	4	-11.84383	*I*(0)
KPI	0	-7.584679***	KPI	0	-14.65788	*I*(0)
KLCO	0	-7.621245***	KLCO	0	-0.641965	*I*(0)
K100	0	-7.348230***	K100	6	-1.312244	*I*(0)
PSECO	0	-7.985576***	PSECO	5	-0.464700	*I*(0)
TASI	0	-7.388070***	TASI	9	-8.691682	*I*(0)
ST	0	-7.048855***	ST	2	-13.24762	*I*(0)
CSEALL	0	-7.807296***	CSEALL	0	-1.801666	*I*(0)
TW	0	-7.705750***	TW	4	-12.55580	*I*(0)
SET50	0	-6.313571***	SET50	1	-12.61529	*I*(0)
ADG	0		ADG	0		*I*(0)

Appendix 5. Indian Market with Latin American Markets (During-the-Crisis Period [June 2007 – December 2009])



Indian Market with European Markets (During-the-Crisis Period [June 2007 – December 2009])



Indian Market with Asian Markets (During-the-Crisis Period [June 2007 – December 2009])