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   REVIEW OF LITERATURE

   NEED/IMPORTANCE OF THE STUDY

   STATEMENT OF THE PROBLEM

   OBJECTIVES

   HYPOTHESES

   RESEARCH METHODOLOGY

   RESULTS & DISCUSSION

   FINDINGS

   RECOMMENDATIONS/SUGGESTIONS

   CONCLUSIONS

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   ACKNOWLEDGMENTS

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   APPENDIX/ANNEXURE

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CONTRIBUTIONS TO BOOKS

- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

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INTEGRATION OF INDIAN STOCK MARKET WITH ASIAN AND WESTERN MARKETS

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ABSTRACT

This study investigates the integration in Indian stock market with the Asian and the western markets by using correlation, cointegration and causality techniques during January, 2006 to March, 2012. Mean returns in the Asian markets are higher than the western markets during the study period. However, Asian markets are more volatile than the western markets. Cointegration level is low among the selected markets, there is weak long period relationship among such markets and markets are more affected by their domestic fundamentals. The American and Hong Kong markets have differential risk associated with such markets relative to Indian market. There is strong long period positive relationship between Indian and UK markets. Hong Kong and American markets are competitive for Indian market. Besides, Asian markets bear significant short period relationship with Indian market; however such relationship is insignificant in the case of western markets. Indian Market is relatively closed and more influenced by the fundamentals of the economy itself in general and industrial sector in particular. Only 8 per cent variation is contributed by other markets dominated by the London market. London, US and Hong Kong markets are able to affect the Indian market but immune from the impact of Indian market. Indian and Korean markets bear two ways causation. However, Indian market is effective enough to influence the Chinese market but unaffected from the changes in the Chinese market.

KEYWORDS

Cointegration, Granger Causality, International Portfolio Diversification, Variance Decomposition, Vector Error Correction.

INTRODUCTION

Global financial integration has increased substantially in recent decades, for liberalization and deregulation of financial markets across countries. The nature and extent of financial market integration is important for investors as it influences international asset allocation and portfolio diversification. Berkert and Harvey (1995) pointed out that a market is completely integrated with the world if its assets have the same expected return with the assets with identical risk level listed in major global markets. In an integrated world, cross section reward to risk is not important as it is common to all integrated markets. However, reward to risk is different for segmented markets due to different risk exposures. Hence, investing at the same time in a group of cointegrated markets will not hedge the risk of investing. Moreover, capital markets integration contradicts the market efficiency hypothesis as one market's movement can be used to predict another market's movements. Besides, integrated markets reduce the scope of international portfolio diversification. Financial integration may bring some benefits in the form of development of markets and institutions, effective price discovery and increased level of investments. However, such linkages may pose various risks in the form of contagion and associated economic activities slow down.

Following the global trends financial liberalization has also been started in India since 1992. Such liberalizations are expected to be reflected in the stock market integration across the nations opposed to the stock markets segmentations. Recent surge in the inflow of capital in the Indian market indicates scope of diversification for global players that is Indian market seems to be more segmented. Therefore, it is important to study such cointegration of Indian market with other important markets of the world. The investors are also interested in the short period and the long period integration given the investment horizon of the investors.

LITERATURE REVIEW

The studies of Almon (1972) and Solnik (1974) relied on the correlation and regression to measure the nature and price convergence and international portfolio diversification across markets. These were the crude techniques and the intuitive way of inferring about the integration of the markets. Taylor and Tonks (1989) showed that the cointegration technique is useful from the perspective of the international capital asset price model; Kasa (1992) suggested that the short term return correlation between stock markets is not appropriate from the perspective of long horizons investors driven by common stochastic trends. A cointegration model is useful since it not only distinguishes between the nature of long run and of short term linkages among financial markets but captures the interaction between them as well. The empirical literature on the subject have brought to the fore various useful perspectives relating to price equalization, market equilibrium, market efficiency and portfolio diversification.

Kasa (1992) used the cointegration to estimate the number of common stochastic trends in five stock markets of: Canada, Germany, Japan, United Kingdom and USA. The study presented the evidence that a single common stochastic trend governed by long run co-movement between these stock markets during the period from 1974 to 1990, indicated that a high degree of integration existed at that time between these stock markets. Arshanapali and Doukas (1993) revealed that degree of international co-movements in stock price indices changes after the crises periods. Specifically, they find that France, Germany and UK stock markets are not related to the US stock market in the pre-October 1987-crash period, but reported strong interdependence between the three major European and the US stock markets in a post-crash period. Kotumos (1996) found evidence that the stock markets of France, Germany, Italy and the UK are integrated because they are affected not only by local news but also by international news, especially unfavorable, stemming from the other markets.

Lamba (2002) examined the influence of developed equity markets on Indian markets and what influence can the Indian equity market exert on the others. To examine these dynamic relationships, a multivariate co-integration framework is used with error correction models estimated to analyse the casual influence of the major developed markets on south Asian markets. This method allows separation of any long run equilibrium relationships between the markets from the short run casual effects. It finds that Indian stock market is not at all integrated with the world markets. Of course, the study finds that baring Japan there is a unidirectional causality from the developed market. Hence we may conclude that Indian stock market is not influenced by other markets. Of course, some short-term sentiments in the world market do have impact but this is short-lived. That means the pre-requisites, which are required for long-run relationship has not been achieved by India so far.

Miloudi (2003) by using the modern cointegration techniques analyzed the integration between sixteen European stock indices, before and after the launch of Euro and observed that a strong degree of cointegration existed between the stock markets of the countries which founded the European Union.

Nath and Verma (2003) examined the interdependence of the three major stock markets in South Asia. Using daily stock market data from January 1994 to November 2002, they examine the stock market indices of India (NSE-Nifty), Singapore (STI) and Taiwan (Taiex). On employing bivariate and multivariate co-integration analysis to model the linkages among the stock markets, no co-integration was found for the entire period. Hence, they conclude that there is no long run equilibrium.

Ahmad et.al (2005) revealed that there is no long-term relationship of the Indian equity market with that of the US and Japanese equity markets. Further, NASDAQ and Nikkei have stronger causal relationship in 1999–2001 which becomes either very weak or disappears in 2002–2004. There seems to be a disassociation in the movements of the NASDAQ and Nikkei with that of the Sensex and Nifty. When the stock markets have no tendency to move together in the long-term and causal effects become weak in the short-term then the markets are segmented and provide ample room for diversification of investments. The recent surge of FII investments to the Indian equity market is primarily a reflection of this trend.

Ortiz (2006) found time varying integration among NAFTA capital markets and mild segmentation along with a time varying integration between these markets and the world capital market. It has also been established that larger markets of the EU are more integrated and the smaller markets are relatively more independent implying that larger benefits from short run diversification by extending stock investment into smaller countries.
Chaudhary et.al. (2007) studied the long run relationship between eight Far East countries around the Asian financial crisis of 1997 and also checked the effect of US and Japan. Cointegration results showed stationary long run relationships between the stock markets of the Far East countries before, during and after the crisis. The highest of significant vectors was found during the crisis period. Both the causality test and band spectrum regression results indicate that the US and Japan influence the Far East markets with the US having a stronger relationship and increasing its influence and role during and after crisis.
Raj & Dhal (2008) revealed that there is integration of Indian stock market in terms of stock prices measured in US dollar denominated stock prices. At the same time, it was found that India's stock market provides opportunities for higher returns than other regional and global markets.
Erdinc and Milla (2009) studied the cointegration in the capital markets of France, Germany and United Kingdom between 1991 and 2006 and observed strong long term relationship among the sampled capital markets.
Yeoh et.al. (2010) revealed varying degree of market integration for Malaysia and Singapore. The level of market integration is found to coincide with certain economic events that have taken placed. The varying degree of market integration in favour of Malaysia shows the inappropriate use of OLS in estimating the level of market integration.
Tripathi & Sethi (2010) examines the integration of the Indian stock market with the stock market of Japan, UK, US and China over the period 1998 to 2008 using Engle - Granger cointegration test and Granger's causality Test. The results showed that the Indian stock market was not integrated with any of these markets except US. However, unidirectional causality was found in most cases. The findings have important implications for investment and speculative decisions.
The literature surveyed above showed mixed results depending on the development level of the nations and the maturity of their capital markets.

NEED FOR THE STUDY
In the globalised era, Indian markets are more exposed to the international markets than before, especially the financial markets. Indian stock markets are seemed to driven by the inflow of foreign capital. The level and nature of stock markets integration influence the investment decisions of investors. Therefore, both domestic and foreign investors are more interested to understand the nature of Indian stock market integration with the other leading markets of the world to decide their investment plans. Moreover, investors are concerned to find whether the relationship of Indian market with other markets is for long period or due to short period impulses. There is dearth of such studies in the Indian context so; there is a dire need for such study in Indian stock market scenario. Hence, an attempt has been made in the present study.

STATEMENT OF THE PROBLEM
Since the capital movement across the nations has increased considerably in recent years especially from the developed to the developing countries. Therefore, it is expected to have more integration among the stock markets of such nations. The knowledge of such integration is important for the investors in terms of diversification of their international portfolio. Moreover, the investors have long and short period horizons hence, the knowledge of the nature of integration among markets help them to design their investment plans. In this background, the present study has been carried out to study the nature of integration of Indian market with the following objectives:

OBJECTIVES
1. To investigate the cointegration of the Indian stock market vis-à-vis Asian and western markets.
2. To examine the extent of movement in one market can be attributed to innovations in the others.
3. To discover the direction of integration between the markets.

HYPOTHESES
1. Indian stock market bears long period relationship with other Asian and western markets.
2. Indian stock market is being affected by the Asian and the western stock market performance.
3. There is two ways causation between the Indian and the other markets under study.

RESEARCH METHODOLOGY AND DATA BASE
DATA BASE
This Study covers the period of January 1, 2006 to March 31, 2012. This period encompasses the period of boom, recession and recovery in the world economy to large extent. Six major stock indices are purposively selected for the analysis namely, Bombay Stock Exchange Sensex (BSE), London Stock Exchange (FTSE100), US stock Exchange (S & P 500), Hong Kong Stock Exchange (Hang Seng), Korea Stock Exchange (Kospi composite Index) and Chinese stock exchange (SSE). The weekly data on these stock indices has been downloaded from ***in.finance.yahoo.com.*** FTSE100 and S&P 500 are used to represent the western markets and Hang Seng, Kospi and SSE represent the Asian Markets. The logarithm of the indices is used to analyse the data. And the data on the returns has been obtained by using the following formula:
$R_t = (P_t - P_{t-1}) / P_{t-1}$ --------- (1)
Where R_t is the weekly return in period't'. P_t and P_{t-1} are weekly levels of stock index in period t and t-1 respectively.
METHODOLOGY
The degree of price co-movement model has widely been used in recent studies as a way of estimating long-term linkages between markets. In this study the model will be examined through the utilization of non-asset pricing models such as correlation, cointegration and Granger Causality. The cointegration makes it possible to examine different levels of data to find comparable long-term properties and has been used in many equity market integration studies. Granger Causality helps to determine the direction of interaction between markets.
Correlation
There are many possible measures of co-movement, and correlation is a standardized measure of closeness of linear relationship between two variables. The Karl-Pearson's correlation coefficient has been used in this study to determine the inkling of size and the direction of the pair wise relationship between series of market indices and market returns. In terms of portfolio theory, the concept of correlation is useful that the returns on the negatively correlated assets tend to be offsetting which stabilizes portfolio returns.
Normality Test
The Jarque-Bera (JB) test has been used to test whether the weekly value of stock indices follow the normal probability distribution. The JB test of normality is an asymptotic or large sample test. This test computes the skewness and kurtosis measures and uses the following test statistic:
$JB = n [S^2/6 + (K-3)^2/24]$ ------------ (2)
Where n is the size of the sample, S is Skewness coefficient, and K is Kurtosis coefficient. For a normally distributed variable, S=0 and K=3. Therefore, the JB test of normality is a test of the joint hypothesis that S and K are 0 and 3 respectively.
Tests of Stationary
Non-stationarity is a commonly observed problem in the analysis of time series. It seems from the fact that time series are not independent of time. When a variable is not stationary, its means and variance are not consistent overtime, and an observation is correlated with its more recent lags. Thus, a non-stationary series will exhibit a time varying mean and this is impossible to use the term 'mean' properly without referring to some particular time period.

In order to determine the cointegration between two or more series, two tests must be performed. First, it is necessary to test data series for non-stationarity, that is, to determine the order of integration. Secondly, data is examined for the evidence of a long run relationship between the variables in question.

Unit Roots

Currently, the most widely used test for stationarity is a unit root in series is an indicator of stationarity. For this purpose, the Augmented Dickey-Fuller test has been used in the following format.

$\Delta y_t = \psi y_{t-1} + \Sigma \alpha_i \Delta y_{t-1} + \mu_t$ (i = 1, 2, 3, ----, p) -------------- (3)

If the ψ turned out to be insignificant then the unit root exists in the series hence, the series is termed as non-stationarity. The lagged values of y_t are added on the right hand side of the model to make the residual values pure white noise. The number of lagged values to be added in the model is determined by Akaike Information Criterion (AIC).

Cointegration

Behind the concept of cointegration is the idea that variables hypothesized to be linked by some theoretical economic relationship should not diverge from each other in the long-run. Such variables may drift apart in the short-run but for an equilibrium relationship among such variables to exist the variables must not diverge without bound. Thus, 'Cointegration' is a statistical expression describing the nature of an equilibrium relationship where the divergence from a stable equilibrium is stochastically bounded and, when it does occur, it is diminishing overtime. Cointegration allows us to describe the existence of equilibrium, or stationary relationship among two or more time series, each of which is individually non- stationary, some linear combination of these series, which define the equilibrium relationship, has linear properties independent of time.

The Engle-Granger (EG) approach of cointegration:

Consider the following regression equation of two time series Y_t and X_t

$Y_t = \beta_0 + \beta_1 x_t + u_t$ ------------ (4)

In the EG procedure, first the non-stationarity is tested, if the variables are non stationary at levels and stationary at first difference the time series are termed as I(1). Run the regression of the equation and save the residuals. Test whether the residuals are stationary, if so then the linear combination of two variables is stationary, it can be concluded that variables are cointegrated of order one and there is a long term, or equilibrium relationship exists between the two. Of course, in the short run there may be disequilibrium. If two variables are cointegrated, then the relationship between the two can be expressed as ECM (Error Correction Mechanism) in the following manner

$\Delta Y_t = \alpha_0 + \alpha_1 \Delta x_t + \alpha_2 u_{t-1} + \varepsilon_t$ ---------------------- (5)

Where Δ is the first difference operator, ε_t is a random error term, and u_{t-1} is the one period lagged value of error term from the previous regression estimation. ECM states that ΔY_t depends on Δx_t and also on the equilibrium error term. If the latter is non zero, then the model is out of equilibrium otherwise it is in equilibrium. This EG model can be extended to more than two variables also.

Johansen Cointegration

The Johansen procedure is based on the maximum likelihood estimation in a VAR (Vector Auto Regressive) model. If we have a set of k variables (k ≥ 2) which are integrated of first order I (1) and thought to be cointegrated, a VAR model with k lags containing these variables can be set up:

$y_t = \beta_1 y_{t-1} + \beta_2 y_{t-2} + \text{-------} + \beta_k y_{t-k} + \mu_t$ -----------------(6)

For Johansen test to be used, the above VAR needs to be transformed into a vector error correction model (VECM) of the following form:

$\Delta y_t = \Pi y_{t-1} + \Sigma \Gamma_i \Delta y_{t-l} + \mu_t$ (i = 1, 2 ,3, ----, k)

Where $\Pi = (\Sigma \beta_i) - I_k$ and $\Gamma_i = - \Sigma \beta_j$ (j = i+1, i+2, --------, k)

This VAR model contains k variables in the first difference form on the LHS and k-1 lags of the dependent variables (differences) on the RHS, with Γ coefficient matrix. As this test can be affected by the lag length used in the VECM, it is important to select the optimal lag length (AIC criterion).

Johansen test centers on an examination of the Π matrix. In equilibrium, all the Δy_{t-l} will be zero and assuming error terms μ_t to be at its expected value of zero, then $\Gamma_i \Delta y_{t-l}$ will be equal to zero. From this follows interpretation of Π as a long-run coefficient matrix. The test of cointegration between the **ys** is calculated by looking at the rank of the Π matrix through its Eigen values. The number of Eigen values that are different from zero determines the rank of a matrix. There are two test statistics for cointegration under Johansen methodology: Trace (λ_{trace}) Statistic and Max-Eigenvalue Statistic (λ_{max}). The test statistics are formulated in the following way:

$\lambda_{trace}(r) = -T \Sigma \ln(1+\hat{\lambda}_i)$ (i = r+1, r+2,---------, k)

$\lambda_{max}(r, r+1) = -T \ln(1+\hat{\lambda}_{r+1})$

Where r is the number of cointegrating vectors under the null hypothesis (r=0, 1, k-1), k represents number of variables in the system, T is number of observations and $\hat{\lambda}_i$ is the estimated value for i^{th} ordered Eigen value obtained from the estimated Π matrix.

λ_{trace} is a joint test where the null hypothesis is that the number of cointegrating vectors is less than or equal to r against the alternative hypothesis that there are more than r.

λ_{max} conducts separate tests on every Eigen value and the null hypothesis that number of cointegrating vectors is r against the alternative hypothesis r +1.

Variance Decomposition Analysis

Variance decomposition or forecast error variance decomposition indicates the amount of information each variable contributes to the other variables in a vector auto regression (VAR) model. Variance decomposition determines how much of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables. Variance decomposition decomposes variation in endogenous variable into component shocks to the endogenous variables in the VAR. VECM of stock prices is useful for identifying the relative importance of each stock price to others, based on the dynamic interaction among markets through impulse response function and forecast error variance decomposition. The latter is useful for gauging the importance of innovations in one market to the others and the nature of volatility transformation across markets.

Granger Causality

In order to test for Granger causality between stock market indices X_t and Y_t, following equations are estimated;

$Y_t = \alpha_0 + \sum \alpha_i X_{t-i} + \sum \beta_j Y_{t-j} + \mu_{1t}$ ------------------- (7)

$X_t = \lambda_0 + \sum \lambda_i Y_{t-i} + \sum \delta_j X_{t-j} + \mu_{2t}$ -------------------- (8)

And perform F test for the joint insignificance of the coefficients. The null hypothesis claimed that Y_t does not cause X_t or vice versa. Therefore, the rejection of null hypothesis indicates the presence of Granger causality. For each pair of stock market indices two causality tests are performed so that it can be determined whether X_t causes Y_t or Y_t causes X_t, or both or none.

E-Views Econometric Package has been used to analyse the data.

EMPIRICAL FINDINGS AND DISCUSSION

DESCRIPTIVE STATISTICS AND CORRELATION ANALYSIS

Descriptive statistics for the weekly returns are presented in the Table-1. The mean of returns during the study period is higher in the Asian markets as compared to western markets. As the table highlights that SEE depicted the highest return (0.27) followed by the BSE (0.25), Kospi (0.17) and Hang Seng (0.16). However, average weekly returns of western stock markets are far less during the study period. For instance, FTSE 100 and S&P 500 have recorded 0.05 percent and 0.07 respectively. But the Asian markets are more volatile than the western markets as revealed by the value of standard deviation. The order of returns did not change after making risk adjustments. American Market was most stable followed by the England market whereas the Chinese market is most volatile. Stock returns are negatively skewed except the Chinese market. The returns distribution is highly leptokurtic. Obviously, the Jarque-Bera Statistic, defined over Skewness and kurtosis measures is very high and significant for all the six markets under consideration, implying that stock returns differ significantly from the normal distribution. Alternatively, this implies that in each stock market there exist opportunities for investors to benefit from abnormal returns.

The correlation analysis among the selected markets provides the inklings of the co-movements of the stock prices. All the pair wise correlation coefficients have recorded the positive values implying that the selected markets have movement in the same direction (Table-2). The correlation coefficient of Indian market is highest with the Kospi (0.90) followed by Hong Kong (0.88), SSE (0.64). However, such relation of Indian market is relatively weak with FTSE100 (0.44) and S&P500 (0.39). At this stage it is not possible to comment on causal relationship but it is clear that co-movement in stock indices is unidirectional.

TABLE-1: STATISTICAL MOMENTS OF STOCK RETURNS (January 1, 2006 to March 31 2012, Weekly Data)

Statistic	Sensex	FTSE100	S&P500	Hang Sang	Kospi	SSE
Mean	0.25	0.05	0.07	0.16	0.17	0.27
Std. Deviation	3.88	3.00	2.97	3.64	3.44	3.98
Skewness	-0.05	-0.87	-0.53	-0.08	-0.58	0.15
Kurtosis	5.30	12.29	8.52	5.05	9.57	4.27
Jarque-Bera(Probability)	71.74 (0.00)	1212.16 (0.00)	428.53 (0.00)	57.63 (0.00)	602.85 (0.00)	22.93 (0.00)
Risk Adjusted Returns (%)	6.44	1.67	2.35	4.39	4.94	.78

TABLE-2: CORRELATION OF STOCK PRICE INDICES (January 1, 2006 to March 31 2012, Weekly Data)

Index	Sensex	FTSE100	S&P500	Hang Sang	Kospi	SSE
Sensex	1.00	0.44	0.39	0.88	0.90	0.64
FTSE100	0.44	1.00	0.97	0.64	0.55	0.30
S&P500	0.39	0.97	1.00	0.53	0.53	0.31
Hang Sang	0.88	0.64	0.62	1.00	0.84	0.78
Kospi	0.90	0.55	0.53	0.84	1.00	0.56
SSE	0.64	0.30	0.31	0.78	0.56	1.00

Table-3 presents pair wise correlation coefficients of weekly stock returns. Again the relationship is positive, that is, co-movement of Indian market with other major markets is one directional. However, this relationship is weakest with the Chinese market and strongest with the Hong Kong market. Moreover, such relationship of Indian market is stronger with the western markets.

TABLE-3: CORRELATION OF WEEKLY STOCK RETURNS (January 1, 2006 to March 31 2012)

Index	Sensex	FTSE100	S&P500	Hang Sang	Kospi	SSE
Sensex	1.00	0.54	0.50	0.61	0.53	0.19
FTSE100	0.54	1.00	0.88	0.68	0.63	0.09
S&P500	0.50	0.88	1.00	0.65	0.61	0.10
Hang Sang	0.61	0.68	0.65	1.00	0.75	0.35
Kospi	0.53	0.63	0.61	0.73	1.00	0.26
SSE	0.19	0.09	0.10	0.35	0.26	1.00

EMPIRICAL COINTEGRATION ANALYSIS

The finding that many macro-economic time series may contain a unit root has spurred the development of the theory of non stationary time series analysis (Engle and Granger, 1987) pointed out that a linear combination of two or more non-stationary series may be stationary. If such a stationary linear combination exists, the non- stationary time series are said to be cointegrated. The stationary linear combination is called the cointegrating equation and may be interpreted as a long-run equilibrium relationship between the variables.

In order to perform a cointegration test, the non-stationarity of the data series has to be established. Here, each market is tested for unit roots using the Augmented Dickey-Fuller Test (ADF). Assuming the series have non-zero mean, a constant is included in the regression. Table-4 summarizes the results of the ADF test. The critical values of the tests MacKinnon (1991) are used. Lag lengths were chosen according to Akaike Information Criterion (AIC).

Table-4 reveals that all unit root tests for the stock markets under the study have shown that test statistics are less negative than the critical values and hence all the representative stock price indices in their logarithm level are non- stationary.

However, for the first difference series the null hypothesis of a unit root is rejected for all the market indices at both 1 percent and 5 percent levels of significance. In table-4, rejection of the null hypothesis indicates that the data series are stationary in the first difference and all markets are individually integrated of order one I (1).

TABLE-4: AUGMENTED DICKEY-FULLER (ADF) UNIT ROOT TEST OF STOCK PRICE INDICES

Index	In Level Form (Random Walk with Drift)				In First Difference Form (Random Walk with Drift)			
	ADF Test Statistic	MacKinnon Test Statistic		lags	ADF Test Statistic	MacKinnon Test Statistic		lags
		1%	5%			1%	5%	
Sensex	-2.33	-3.45	-3.87	2	-10.76	-3.45	-2.87	1
FTSE100	-1.80	-3.45	-2.87	1	-12.47	-3.45	-2.87	1
S&P500	-1.54	-3.45	-2.87	2	-12.18	-3.45	-2.87	1
Hang Sang	-2.05	-3.45	-2.87	1	-11.82	-3.45	-2.87	1
Kospi	-1.78	-3.45	-2.87	2	-12.24	-3.45	-2.87	1
SSE	-2.28	-3.45	-2.87	3	-8.45	-3.45	-2.87	2

Engle-Granger Cointegration

Since, stock index series in analysis are of the same order of integration; the next step is to estimate the long-run equilibrium relationship among different markets. Cointegration is evaluated using the Engle-Granger cointegration technique according to which the residuals of a regression of one market index on the others are examined. The ADF test is performed on residuals in order to ensure that they are I (0).

If the cointegration relationship exists between the variables this implies that long-run relationship exists between the variables. Again the lag length has been selected by using the Akaike Information Criterion (AIC).

TABLE-5: PERFORMING THE ADF TEST ON THE RESIDUAL SERIES OF THE PAIR-WISE REGRESSION ANALYSIS (ENGLE-GRANGER COINTEGRATION TECHNIQUE)

Pair Cointegration	ADF Test Statistics	MacKinnon Test Statistic		Lags	Result
		1%	5%		
Sensex & FTSE100	**-2.25**	**-3.45**	**-2.87**	**2**	**Non-Stationary**
Sensex & S&P500	**-2.32**	**-3.45**	**-2.87**	**2**	**Non-Stationary**
Sensex & Hang Sang	**-2.21**	**-3.45**	**-2.87**	**2**	**Non-Stationary**
Sensex & Kospi	**-3.50**	**-3.45**	**-2.87**	**2**	**Stationary**
Sensex & SSE	**-1.93**	**-3.45**	**-2.87**	**2**	**Non-Stationary**

Table-5 shows results of ADF tests on the residuals of the pair-wise evaluations for all the combinations of Indian market with other markets. Residuals are not stationary except Indian market with Korean Market.

Consequently, the following error correction model has been estimated.

$\Delta Sensex = \alpha_0 + \alpha_1 \Delta Kospi + \alpha_2 \mu_{t-1} + \varepsilon_t$

The estimated values of this model are presented below:

$\Delta Sensex = 0.005 + 0.632 \Delta Kospi - 0.067 \mu_{t-1}$

(t=0.61) (t=12.06) (t=3.62)

$R^2 = 0.32$ D.W. = 2.29

The estimation of error correction model reveals that equilibrium error term is negative but significant; hence, it has the tendency to be in equilibrium after some weeks. And the

Short-term relationship between Korean market and Indian market is interpreted as short run change in the Korean market has positive impact on the short run changes in the Indian market.

Johansen Cointegration

Since in this study the unit root tests have determined the data series to be cointegrated of the same order I(1), Johansen's cointegration test can be applied. The determination of cointegration r is concluded by using two statistics, the Trace Statistic (λ_{trace}) and Max-Eigen Value Statistic (λ_{max}). A Vector Error Correction (VEC) model is a restricted VAR that has cointegration restrictions. The VEC specification restricts the long run behaviour of the endogenous variables to converge to their cointegrating relationships while allowing a wide range of short term dynamics. The cointegration term is known as the error correction term.

The empirical results of the cointegration rank test derived from Johansen multivariate VECM involving the six stock prices chosen in the study are summarized in Table-6 & 7. Table-6 shows that the Trace statistics reveal that likelihood ratio statistic 114.081 for no cointegrating vector is larger than the critical values (both at 1% and 5%) leading to conclude that null hypothesis of no cointegrating vector is rejected. Testing the hypothesis of at most one cointegrating vectors, the test statistic is lower than the reported critical values, thus suggesting that null hypothesis should not be rejected.

TABLE-6: JOHANSEN COINTEGRATION TEST (TRACE TEST) (January 1, 2006 to March 31 2012) (Weekly Data)

Eigen Value	Likelihood Ratio (Trace)	5% Critical Value	1% Critical Value	Hypothesized No. of CE(s)
0.1478	114.081	102.14	111.01	None**
0.0915	63.044	76.07	84.45	At most 1
0.0427	32.416	53.12	60.16	At most 2
0.0371	18.500	34.91	41.07	At most 3
0.0139	6.430	19.96	24.60	At most 4
0.0062	1.970	9.24	12.97	At most 5

*** denotes rejection of the hypothesis at 1% level of significance, LR test indicates 1 cointegration equation at 5% significance level*

TABLE-7: JOHANSEN COINTEGRATION TEST (MAXIMUM EIGEN VALUE STATISTIC) (January 1, 2006 to March 31 2012) (Weekly Data)

Eigen Value	Likelihood Ratio (Trace)	5% Critical Value	1% Critical Value	Null	Alternative
0.1478	51.37	40.30	46.82	r = 0	r = 1
0.0915	30.63	34.40	39.79	r = 1	r = 2
0.0427	13.91	28.14	33.24	r = 2	r = 3
0.0371	12.07	22.00	26.81	r = 3	r = 4
0.0139	4.460	15.67	20.20	r =4	r = 5
0.0062	1.970	9.24	12.97	r = 5	r = 6

Table 7, presents the max-Eigen value statistic and comparing with the critical values corroborates the earlier result of only one cointegrating vector. Since only one cointegrating vector was found among the selected markets, it can be concluded that the level of integration between theses markets is low. Hence, it can be concluded here that there is weak integration among such markets and the markets are more affected by their domestic fundamentals.

However, the existence of a single co integrating relation among stock price indices give rise to the concern that any particular stock price indicator pertaining to Western or Asian market could be critical for the integration of stock markets. After ascertaining that at best a single cointegration relation among the selected markets, it is of interest to derive some useful perspectives from the sign condition and size of the coefficient in the long run cointegration relationship pertaining to stock price indices. Since we are interested here in the Indian market in relation to western and the Asian markets, Cointegrating vector normalized to Indian stock market (Table-8).

TABLE 8: COINTEGRATION RELATIONS OF STOCK PRICES (January 1, 2006 to March 31 2012, weekly data)

Stock Prices	Cointegration Coefficient	T-Statistic
Sensex	**1.00**	**-**
FTSE100	**13.30**	**19.007**
S&P500	**-6.82**	**10.576**
Hang Sang	**-10.32**	**12.921**
Kospi	**0.82**	**2.213**
SSE	**2.86**	**3.811**
Constant	**-0.93**	**4.806**

The American (-6.82) and Hong Kong (-10.32) coefficients have negative signs indicate the differential risks associated with such markets relative to the Indian market. Except for the Hong Kong in the Asian Markets, the value of the coefficients for the Korean and the Chinese market is relatively small but positive. There is strong long period positive relationship between the Indian market and UK market with high value of coefficient and positive. However, such value is also high but negative, that is Indian market and American market move in opposite direction in long period. Hong Kong and the American markets are competitive for Indian market. If the US stock market rises amid better macro economic fundamentals, then investors would prefer US stock markets than India. The positive association of the Indian market with the London market may be plausible because the latter is considered as a benchmark by most international investors.

Short-Run Market Linkages

The nature of short-run integration of stock markets is evident from the coefficient of the error correction term in the VECM pertaining to the six stock price indices (Table-9). The coefficients of the error correction terms indicate that significant positive short term relationship of the Hong Kong, China and Korea with the Indian market is prevailing. It also seems from the table the US and London market bears insignificant short period relationship with the Indian market.

TABLE-9: SHORT RUN DYNAMICS OF STOCK MARKETS: ERROR CORRECTION EQUATIONS (Coefficient of the Error Correction Term)

Stock Prices	Coefficient (T- Value)
Sensex	0.012 (3.212)
FTSE100	0.005 (1.732)
S&P500	0.005 (1.796)
Hang Sang	0.169 (4.844)
Kospi	0.168 (5.38)
SSE	0.0172 (4.50)

VARIANCE DECOMPOSITION ANALYSIS

Apart from the long and short term dynamics, VEC model of stock prices is useful for identifying the relative importance of each stock price to others, based on the dynamic interaction among markets through impulse response functions and forecast error variance decomposition. The latter, in particular, is useful for estimating the importance of innovations in one market to other markets and the nature of volatility transmission across markets (Chen et. al., 2002).

The results of the forecast Error Variance Decomposition arising from the VECM for India's stock market over weekly horizon is summarized in Table-9. The table reveals that 91.85 percent variation in the Bombay stock market is due to the domestic factors. Whereas the London market is a significant contributor in the Indian market volatility followed by the Korean market. American market is also a significant contributor. However, Hong Kong and the Chinese market have minimum contribution in the Indian stock market variation. So we may conclude that Indian market is relatively closed market and more influenced by the domestic factors and the fundamentals of the economy itself in general and the industrial sector in particular. The 8 per cent variation is contributed by the other markets dominated by the London market.

TABLE-10: VARIANCE DECOMPOSITION OF BOMBAY STOCK EXCHANGE (January 1, 2006 to March 31 2012, Weekly Data)

Stock Prices	Variance
Sensex	**91.85**
FTSE100	**4.45**
S&P500	**1.35**
Hang Sang	**0.20**
Kospi	**2.00**
SSE	**0.15**

GRANGER CAUSALITY

Johansen cointegration analysis is able to determine whether the long run relationship exists between two variables, where as the Granger causality test helps to determine the direction of causation. The results of the pair wise Granger causality tests are presented in the table-11. The results reveal that London, U.S. and Hong Kong relations are one directional that is Indian market is affected by such markets where as Indian market is unable to influence these markets. India and Korea bear two ways causation that is Indian market is equally capable to influence the Korean markets as it is influenced by this market. However, entirely different result has been observed in the case of China. Indian Market is effective enough to influence the Chinese market but stayed unaffected from the changes in the Chinese market.

TABLE-11: PAIR WISE GRANGER CAUSALITY TESTS

Null Hypothesis	Obs.	F-Statistic	Probability
FTSE100 does not Granger Cause Sensex	324	4.55*	0.011
Sensex does not Granger Cause FTSE100		0.14	0.871
S&P500 does not Granger Cause Sensex	324	8.04*	0.004
Sensex does not Granger Cause S&P500		0.13	0.876
Hang Sang does not Granger Cause Sensex	324	4.23*	0.015
Sensex does not Granger Cause Hang Sang		0.80	0.450
Kospi does not Granger Cause Sensex	324	2.43*	0.089
Sensex does not Granger Cause Kospi		4.76*	0.009
SSE does not Granger Cause Sensex	324	1.63	0.198
Sensex does not Granger Cause SSE		7.50*	0.006

CONCLUDING REMARKS

This study deals with the investigation of integration of Indian market with the Asian and the western markets during January, 2006 to March, 2012. Mean returns in the Asian markets are higher than the western markets during the study period. However, Asian markets are more volatile than the western markets. All the markets differ significantly from the normal distribution implying thereby that is in each stock market there exist opportunities for investors to benefit from abnormal returns. Cointegration level is low among the selected markets i.e. there is weak long period relationship among such markets and markets are more affected by their domestic fundamentals. The American and Hong Kong markets have differential risk associated with such markets relative to Indian market. There is strong long period positive relationship between Indian and UK markets. Hong Kong and American markets are competitive for Indian market. The positive association of the Indian market with the London may be plausible because the latter is considered as a benchmark by most international investors. Besides, Asian markets bear significant short period relationship with Indian market; however such relationship is insignificant in the case of western markets. Indian Market is relatively closed and more influenced by the fundamentals of the economy itself in general and industrial sector in particular. Only 8 per cent variation is contributed by other markets dominated by the London market. London, US and Hong Kong markets are able to affect the Indian market but immune from the Indian market. Indian and Korean markets bear two ways causation. However, Indian market is effective enough to influence the Chinese market but unaffected from the changes in the Chinese market.

SCOPE FOR FUTURE RESEARCH

The present research can be extended to more number of nations especially in the period of European debt crisis and improved trade relations with Asian nations in recent years; hence, a comprehensive research can be carried out to have more insights of integration of such markets.

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