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INTEGRATION OF INDIAN STOCK MARKET WITH SELECTED GLOBAL STOCK MARKETS

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ABSTRACT

The study is an attempt to find the stock market integration between Indian stock market and stock markets of U.K., Japan, France, Singapore, Australia and South Korea. It helps international investor in portfolio diversification. The returns of daily closing prices for the period of fifteen years from 1 Jan. 2001 to 31 Dec. 2015 have been used. The statistical tools and techniques viz. descriptive statistics, correlation analysis and econometric techniques called ADF test, Johenson's Co-integration test, Granger causality test, VAR, Variance decomposition and impulse response are used to find out the analytical results. The results show the significant positive correlation between Indian and Singapore stock market. It also shows that there exist no long run relationship between Indian and other selected stock markets.

KEYWORDS: *Stock Market Integration, Econometric Techniques, ADF Test, Portfolio Diversification.*

Introduction

Stock market integration assists international investors in portfolio diversification by reducing risk and increasing returns. In financial assets, there are two types of risk, one is systematic risk and the other is unsystematic risk. The unsystematic risk is the risk that can be reduced by diversification. Stock markets are said to be integrated if they have long run relationship which indicate the presence of co integration among the markets. We can get gains by portfolio diversification if the stock markets are low co integrated. If the stock markets are integrated then diversification benefits might be limited according to modern portfolio theory. There are a lot of reasons of stock market integration such as capital flows, technological advancements, openness in economies in terms of trade, internet connectivity, flow of information etc. This topic is also important for academicians, policy makers and international fund managers.

Review of Related Literature

Bodla and Turan (2004) study on the stock market of India, Taiwan, Singapore, Japan and Hong Kong and collected monthly data from 1992 to 2002 of these markets. By using autocorrelation they found low correlation between India and other Asian stock markets. Ahmed, Ashraf and Ahamed (2005) investigated the long run relationship between US, Japan and India. Using data from 1999 to 2004 they find that there was no long run relationship of India with US and Japan. Menon and Shubha (2009) covered the period from April 1997 to May 2007 of India, U.S., China, Singapore and Hong Kong and they showed the absence of co integration between Indian and American and Hong Kong stock markets and also show strong co integration between India and Singapore.

Sharma and Bodla (2011) collected daily closing prices of India, Pakistan and Sri Lanka form 2003 to2010. By using granger causality test, VAR model and Variance decomposition analysis and they concluded that NSE granger cause Karachi stock exchange and Colombo stock exchange but not the vice versa.

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Batareddy et al. (2012) used ten years index data from 1998 to 2008 of emerging markets namely India, China, South Korea and Taiwan and developed markets namely USA and Japan and find the presence of one Co-integrating vector or long run relationship between these emerging and developed stock markets.

Rajwani S. and Mukherjee (2013) conducted over a period of 21 years and examined the long run relationship between Indian and other seven Asian stock markets namely Indonesia, China, Hong Kong, Japan, Taiwan, South Korea and Malaysia. By using co integration test they found no co integration between Indian and other selected Asian countries.

Tripathi, Seth and Kumar (2013) collected monthly data from 2003 to 2012 of India and other markets of world and by using ADF test, correlation analysis; they find a positive and significant correlation between India and other selected economies.

Roa (2014) take monthly closing prices of India, Australia, Hong Kong, Indonesia, Japan, Malaysia, South Korea, Singapore and Taiwan from April, 2004 to March, 2014 and find high correlation and bidirectional casual relationship between Indian and other selected stock markets.

Research Methodology

- **Data:** The study use daily closing prices of selected stock market indices for the period from 1st Jan. 2001 to 31st Dec. 2015 from Yahoo finance. Following stock market indices are taken for study: NIKKIE 225 (Tokyo Stock Exchange) for Japan, FTSE 100 (London stock exchange) for UK, CAS-40 (Euronext Paris Stock Exchange) for France, KOSPI (Korea stock exchange) for Korea, STRAITS TIMES Index (Singapore Stock Exchange) for Singapore, All ordinaries (Australian Securities Exchange) for Australia and BSE SENSEX (Bombay stock exchange) for India. The total number of observations is 3911. There were missing values in the data of some of the stock exchanges for some days, when some stock exchanges were closed which were filled-up by taking the average of the two nearest cases. We take the natural log (ln) of the ten series on which the further analysis shall be performed. The formula of calculating the natural log of indices/closing prices is given as follows:

  Rt = ln (Pt /Pt-1)

  Where: Rt = Return on day 't', Pt =Index closing value on day 't',

  Pt-1 = Index closing value on day 't-1', ln= Natural log

- **Tools and Techniques**

(i) Statistical tools

(a) Descriptive Statistics

Mean is computed as:

$$\text{Mean} = \frac{\sum x_i}{N} \qquad \text{.. (1)}$$

The standard deviation is computed as:

$$\sigma = \sqrt{\frac{\Sigma(x_i-\mu)^2}{N}} \qquad \text{.. (2)}$$

Skewness measures the deviation of the distribution from symmetry:

$$\text{Skewness} = \frac{nM_3}{(n-1)(n-2)S^3} \qquad \text{................................ (3)}$$

Where:

$$M_3 = \sum_{i=1}^{M}(x_i - \bar{x})^3$$

Kurtosis measures the "peakedness" of a distribution. Kurtosis is computed as

$$\text{Kurtosis} = \frac{n(n+1)M_4-3M_2^2(n-1)}{(n-1)(n-2)(n-3)S^4} \qquad \text{.................................. (4)}$$

The Jarque bera computed as follows

$$J_B = \frac{n}{6}\left(S^2 + \frac{1}{4}k^2\right) \text{.................................. (5)}$$

(b) Correlation Analysis

Karl Pearson's coefficient of correlation is used, which computes as follows:

$$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{N\sigma_x\sigma_y} \quad \ldots\ldots(6)$$

Where, is correlation coefficient and $\sigma_x = \sqrt{\frac{\sum x^2}{N}}$, $\sigma_y = \sqrt{\frac{\sum y^2}{N}}$

(ii) Econometric Techniques

(a) Augmented Dickey Fuller Test

The analysis of econometrics can be performed on a series of stationary nature. A process is said to be stationary if it's mean and variance remain unchanged over time. In other words, a time series is said to be stationary if it's probability distribution remains unchanged as time proceeds. To test the unit root problem, the most widely used test is ADF. The general form of ADF test can be written at level and first difference are as follows:

$$\Delta Yt = \alpha + \beta t + \delta Yt\text{-}1 + \sum \sum_{i=1}^{k} \gamma i \Delta Y \gamma i + \mu t \quad \ldots\ldots (7)$$

$$\Delta\Delta Yt = \alpha + \beta t + \delta \Delta Yt\text{-}1 + \sum_{i=1}^{k} \gamma i\, \Delta\Delta Yt - 1 + \mu t \quad \ldots\ldots (8)$$

Hence, if the hypothesis, $\delta = 0$ is rejected for the above equations then it can be concluded that the time series does not have a unit root and is integrated of order zero I (0) i.e. it has stationary properties.

(b) Granger Causality Test

After the stationarity of log series of the seven stock exchanges, we perform the Granger's causality model in order to observe whether the return at each stock exchanges granger causes the return at the remaining six stock exchanges. In Granger's Causality, there are bivariate regressions of the under-mentioned form:

$$Yt = \alpha 0 + \alpha 1Yt\text{-}1 + \ldots + \alpha 1Yt\text{-}1 + p1Xt\text{-}1 + \ldots + \beta 1Xt\text{-}1 + \varepsilon t \quad \ldots\ldots (9)$$

$$Xt = \alpha 0 + \alpha 1Xt\text{-}1 + \ldots + \alpha 1Xt\text{-}1 + p1Yt\text{-}1 + \ldots + \beta 1Yt\text{-}1 + \mu t \quad \ldots\ldots (10)$$

For all possible pairs of (X, Y) series in the group. Where εt and μt are two white noise random disturbance terms.

(c) Johansen's Co-integration Test

The Johansen (1988) (1991, 1995) procedure tests the presence of long run relationship between the variables and to perform the Co-integration analysis. If the two or more series are found to be co-integrating, consider a VAR of order p:

$$Yt = A\,1\,y\,t\text{-}1 + \ldots\ldots + A\,p\,y\,t\text{-}p + B\,x\,t + \varepsilon\,t \quad \ldots\ldots (12)$$

We may rewrite this VAR as,

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + B x_t + \epsilon_t \quad \ldots\ldots (13)$$

Where,

$$\Pi = \sum_{i=1}^{p} A_i - I, \qquad \Gamma_i = -\sum_{j=i+1}^{p} A_j$$

(d) Vector Auto Regression (VAR) Model

The study follows the application of Granger's causality with the Vector Auto Regression (VAR) Model. The vector auto regression (VAR) is commonly used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables.

(e) Variance Decomposition Analysis and Impulse Response

The variance decomposition analysis has applied to find out the extent up to which the selected indices one influenced by each other. While impulse response functions find the effects of a shock to one endogenous variable on to the other variables in the VAR, variance decomposition separates the variation in an endogenous variable in to the component shocks to the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in effecting the variables in the VAR.

(iii) Empirical Results

a. Descriptive Statistics

The findings regarding the descriptive statistics (apply on returns) are given below:

Table 1: Descriptive Statistics from 2001 to 2015

	India	U.K.	Japan	France	Singapore	Australia	South Korea
Mean daily % return	0.048	0.0003	0.007	-0.005	0.0107	0.0133	0.0341
Median daily % return	0.095	0.0265	0.031	0.025	0.0123	0.0433	0.061
Maximum daily % return	15.99	9.384	9.566	10.59	7.530	5.360	11.28
Minimum daily % return	-11.8	-9.264	-12.11	-9.472	-8.6900	-8.553	-12.80
Std. Dev. daily % return	1.449	1.20	1.477	1.483	1.1097	0.9718	1.423
Skewness	-0.1732	-0.142	-0.584	0.012	-0.289	-0.5666	-0.522
Kurtosis	11.65	9.8293	9.1102	8.099	9.3225	9.306	9.6619
Jarque B.	12222.2	7617.5	6309.7	4240.3	6572.187	6692.99	7413.8
Probability	0	0	0	0	0	0	0

Source: Computed Data.

In table 1, the highest mean return is 0.048% (percent) in India, while the lowest is -0.0058% (percent) in France. It can reveal that all the stock indices have provided the positive daily average returns expect France. The standard deviation of the Japan stock market is 1.48 percent, which shows the highest risk in the France stock market. In case of skewness, the statists show that all the stock exchanges show a negative skewness statistic except France. It implies that the return distributions of the shares traded in these markets have a higher probability of earning positive returns. All the series are leptokurtic in nature as the Kurtosis statistics for all the stock exchanges to be more than 3. The p value is 0.0000 for all the stock market indicates that the null hypothesis of normality can be rejected for all the selected stock exchanges. The Jarque-Bera statistic is very high for all stock markets, 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.

b. Correlation Analysis

Table 2: Correlation between India and Other Selected Stock Markets from the Year 2001 to 2015

	India	U.K.	Japan	France	Singapore	Australia	S.K.
India	1						
U.K.	0.360835	1					
Japan	0.341029	0.31404	1				
France	0.341601	0.893538	0.302565	1			
Singapore	0.500785	0.410829	0.533154	0.390586	1		
Australia	0.374528	0.339261	0.595579	0.31088	0.55941	1	
S.K.	0.396335	0.295207	0.583414	0.285825	0.572094	0.554046	1

Correlation is significant at the 0.01 level (2-tailed).
Source: Computed Data

The table 2 shows the results of correlation analysis (implemented on return series). India is significant correlated with Singapore with the correlation coefficient equal to 0.50. It is indicating towards a strong relationship between India and Singapore.

c. Unit Root Test / Augmented Dickey Fuller (ADF) Test

Unit root test is used to check whether the time series are stationary or not. ADF is applied on daily closing prices of every market. The results of ADF are as follows:

Table 3: Augmented Dickey Fuller Test on Closing Prices at Level

	Intercept	Trend	None
India	-0.5152(-3.4318)	-2.874(-3.9603)	1.2479(-2.5655)
UK	-2.1877(-3.4318)	-3.3091(-3.9603)	-0.320(-2.5655)
Japan	-1.1692(-3.4318)	-1.6174(-3.9603)	0.1299(-2.5655)
France	-2.6538(-3.4318)	-2.604(-3.9603)	-0.8372(-2.5655)
Singapore	-1.3679(-3.4318)	-1.846(-3.9603)	0.2198(-2.5655)
Australia	-1.6473(-3.4318)	-1.9285(-3.9603)	0.4056(-2.5655)
South Korea	-1.58075(-3.4318)	-2.5581(-3.9603)	0.6388(-2.56565)

Level of significance 1%
Source: Computed Data

Table 4: Augmented Dickey Fuller Test on Closing Prices at First Difference

	Intercept	Trend	None
India	-59.036(-3.4318)	-59.0313(-3.9603)	-58.9967(-2.5655)
UK	-65.5123(-3.4318)	-65.5108(-3.9603)	-65.5207(-2.5655)
Japan	-65.199(-3.4318)	-65.2168(-3.9603)	-65.204(-2.5655)
France	-65.428(-3.4318)	-65.438(-3.9603)	-65.434(-2.5655)
Singapore	-63.593(-3.4318)	-63.587(-3.9603)	-63.595(-2.5655)
Australia	-64.5486(-3.4318)	-64.5414(-3.9603)	-64.547(-2.5655)
South Korea	-61.8604(-3.4318)	-61.8587(-3.9603)	-61.843(-2.56565)

Level of significance 1%
Source: Computed Data

In all the cases t-statistics is more than the test critical value (irrespective of sign), this implies that the variable does not have a unit root, which confirms that all the series are stationary at first difference.

d. Johenson's Co-Integration Analysis

Co-integration of two or more time series suggests that there is a long run or equilibrium relationship between them. As we found that all the series are stationary at first difference and now, we proceeds with Johenson's approach. We applied Johenson's co-integration test on closing prices (which are non stationary in nature) to see whether Indian stock market is co integrated with other stock markets included in the study. The results of Johenson's co-integration at trace (table V) and maximum eigen value (table VI) are mentioned as follows:

Table 5: Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical value	Prob.**
None *	0.011154	124.5904	125.6154	0.0576
At most 1 *	0.008032	80.74381	95.75366	0.3403
At most 2 *	0.005112	49.21922	69.81889	0.6713
At most 3 *	0.004622	29.18484	47.85613	0.7595
At most 4 *	0.001575	11.07566	29.79707	0.9593
At most 5 *	0.000897	4.914767	15.49471	0.8178
At most 6 *	0.000359	1.405464	3.841466	0.2358

Trace test indicates no co-integration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: Computed Data

Table 6: Unrestricted Co-integration Rank Test (Maximum Eigen value)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical value	Prob.**
None *	0.011154	43.84659	46.23142	0.0882
At most 1 *	0.008032	31.52458	40.07757	0.3297
At most 2 *	0.005112	20.03438	33.87687	0.7543
At most 3 *	0.004622	18.10918	27.58434	0.4861
At most 4 *	0.001575	6.160893	21.13162	0.9795
At most 5 *	0.000897	3.509303	14.2646	0.9072
At most 6 *	0.000359	1.405464	3.841466	0.2358

Max-eigenvalue test indicates no co-integration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: Computed Data

Table 5 shows that there is no co-integrating equation at the 0.05 level in trace statistics. We compare the Trace statistics with the critical value and see that in all the cases the critical value is more than it's trace value. This implies that there exist no co-integration equation and the results conclude that no series are co-integrated. So there is no long run equilibrium relationship between Indian stock market and other selected stock indices. The results of table VI (Maximum Eigen Value) also confirms the results of trace value.

e. Granger Causality Test

We accept the null hypothesis for the cases with probability value above 0.05, we reject the ones with lesser than 0.05 probability value. The table VII presents the result of granger's causality model (applied on return series) to the stock exchange of all selected countries.

Table 7: Pair wise Granger Causality Test (Lag 2)

Null Hypothesis	F-statistic	Probability
R U.K. does not granger cause R India	32.4181	1.00E-14
R India does not granger cause R U.K.	2.54831	0.0783
R Japan does not granger cause R India	1.7256	0.1782
R India does not granger cause R Japan	61.7674	4.00E-27
R France does not granger cause R India	34.7103	1.00E-15
R India does not granger cause R France	1.65253	0.1917
R Singapore does not ganger cause R India	3.43654	0.0323
R India does not granger cause R Singapore	16.0971	1.00E-07
R Australia does not granger cause R India	2.37662	0.093
R India does not granger cause R Australia	65.3846	1.00E-28
R S.K. does not granger cause R India	7.09452	0.0008
R India does not granger cause R S.K.	38.5502	3.00E-17

Level of significance 5%
Source: Computed Data

We accept the following null hypothesis:

- R India does not granger causes R U.K.
- R Japan does not granger causes R India.
- R India does not granger causes R France
- R Australia does not granger causes R India.

We accept the under mentioned alternate hypothesis:

- R U.K. granger causes R India
- R India granger causes R Japan
- R France ganger causes R India
- R Singapore granger causes R India
- R India granger causes R Singapore
- R India granger causes R Australia
- R S.K. granger causes R India
- R India granger causes R S.K.

The above result indicates that there is unidirectional casual relationship between India and U.K. U.K. granger causes India but not the vice-versa. In case of Japan and India there exists also a unidirectional relationship between two countries. India granger causes Japan but not the vice-versa. The bidirectional causal relationship is found between Indian stock market and the stock market of Singapore and South Korea. But in case of France, the stock market of France granger cause India but not the vice-versa, so there exist unidirectional relationship between the two countries. Also, in case of Australian stock market, there exists unidirectional relationship between India and Australia.

f. Vector Auto Regression Analysis

By the application of the VAR model, we observe that the integration of a stock exchange with the other can be established if the t-value is more than 1.96 (irrespective of sign). The results of vector auto regression (applied on returns) are as follows:

Table 8: Results of Vector Auto Regression Analysis

	India	UK	Japan	France	Singapore	Australia	SK
India(-1)	0.003681	0.037327	0.081628	0.031065	0.042806	0.053723	0.075698
	-0.01898	-0.01585	-0.01777	-0.01957	-0.01414	-0.01122	-0.01772
	[0.19396]	[2.35433]	[4.59416]	[1.58728]	[3.02784]	[4.7899]	[4.27173]
India(-2)	-0.0431	0.015716	0.012939	0.016256	0.031127	0.029226	0.034317
	-0.01895	-0.01584	-0.01775	-0.01955	-0.01412	-0.0112	-0.0177
	[-2.27399]	[0.99249]	[0.72912]	[0.83162]	[2.20440]	[2.6089]	[1.93894]
UK(-1)	0.036719	-0.08766	0.158121	0.047928	0.123903	0.248326	0.087298
	-0.04382	-0.03661	-0.0 4103	-0.04519	-0.03265	-0.0259	-0.04092
	[0.83792]	[-2.39415]	[3.85378]	[1.06048]	[3.79520]	[9.5878]	[2.13329]
UK(-2)	0.118779	-0.00109	-0.0162	0.060154	0.032375	0.061581	0.019176
	-0.04414	-0.03688	-0.04133	-0.04553	-0.03289	-0.02609	-0.04122
	[2.69074]	[-0.02956]	[-0.39186]	[1.32128]	[0.98442]	[2.3602]	[0.46519]
Japan(-1)	-0.03077	-0.01721	-0.19591	-0.00382	-0.07649	-0.06961	-0.12416
	-0.0218	-0.01821	-0.02041	-0.02248	-0.01624	-0.01288	-0.02035
	[-1.41190]	[-0.94493]	[-9.60034]	[-0.16990]	[-4.71060]	[-5.4037]	[-6.10035]

Japan(-2)	-0.02949	-0.04856	-0.00391	-0.05195	-0.01838	-0.01478	-0.02107
	-0.02152	-0.01798	-0.02015	-0.02219	-0.01603	-0.01272	-0.02009
	[-1.37061]	[-2.70103]	[-0.19395]	[-2.34084]	[-1.14674]	[-1.1616]	[-1.04857]
France(-1)	0.111849	0.028688	0.306933	-0.07632	0.120294	0.151338	0.268015
	-0.03481	-0.02909	-0.0326	-0.03591	-0.02594	-0.02058	-0.03251
	[3.21274]	[0.98630]	[9.41611]	[-2.12561]	[4.63799]	[7.3549]	[8.24400]
France(-2)	0.001451	-0.02182	0.100624	-0.06589	0.056859	0.034362	0.116289
	-0.03526	-0.02946	-0.03302	-0.03637	-0.02627	-0.02084	-0.03293
	[0.04115]	[-0.74061]	[3.04774]	[-1.81178]	[2.16438]	[1.6487]	[3.53157]
Singapore(-1)	-0.03906	-0.01954	0.024081	-0.01516	-0.08125	-0.01692	0.033978
	-0.02945	-0.02461	-0.02758	-0.03037	-0.02194	-0.01741	-0.0275
	[-1.32620]	[-0.79405]	[0.87327]	[-0.49902]	[-3.70280]	[-0.97194]	[1.23546]
Singapore(-2)	0.03734	0.01135	0.071126	0.000135	0.010566	0.040066	0.019129
	-0.02945	-0.02461	-0.02757	-0.03037	-0.02194	-0.01741	-0.0275
	[1.26788]	[0.46128]	[2.57940]	[0.00444]	[0.48159]	[2.3018]	[0.69556]
Australia(-1)	-0.06076	-0.03697	-0.14872	-0.08377	-0.10757	-0.21723	-0.13396
	-0.03464	-0.02894	-0.03243	-0.03573	-0.02581	-0.02047	-0.03235
	[-1.75401]	[-1.27754]	[-4.58543]	[-2.34474]	[-4.16837]	[-10.610]	[-4.14133]
Australia(-2)	0.008836	0.028582	-0.02371	0.043518	0.008338	-0.0072	0.022434
	-0.03275	-0.02736	-0.03066	-0.03378	-0.0244	-0.01936	-0.03058
	[0.26980]	[1.04455]	[-0.77328]	[1.28838]	[0.34172]	[-0.3720]	[0.73354]
SK(-1)	0.063014	0.036628	0.012144	0.059267	0.019077	-0.00702	-0.0567
	-0.02218	-0.01853	-0.02076	-0.02287	-0.01652	-0.01311	-0.02071
	[2.84138]	[1.97679]	[0.58484]	[2.59118]	[1.15460]	[-0.5356]	[-2.73789]
SK(-2)	-0.01376	-0.01848	-0.05667	-0.02571	0.004651	-0.03883	-0.06359
	-0.02214	-0.0185	-0.02073	-0.02284	-0.0165	-0.01309	-0.02068
	[-0.62118]	[-0.99872]	[-2.7333]	[-1.12586]	[0.28195]	[-2.9669]	[-3.07530]
C	0.000496	-1.49E-05	9.83E-05	-8.28E-05	0.000106	0.000152	0.000367
	-0.00023	-0.00019	-0.00022	-0.00024	-0.00017	-0.00014	-0.00021
	[2.15697]	[-0.07760]	[0.45717]	[-0.34966]	[0.61854]	[1.1165]	[1.70872]

Source: Computed Data

The table 8 shows that the returns in India at lag 0 is influenced by India at lag 2, returns in UK at lag 2 and returns in Japan and South Korea at lag 1. Returns in UK at lag 0 is influenced by the return in UK, India and South Korea at lag 1 and return in Japan at lag 2. Returns in Japan at lag 0 is influenced by the returns in India, UK, Japan and Australia at lag 1, returns in Singapore and South Korea at lag 2 and return in France at lag both 1 and 2. Returns in France at the lag 0 are influenced by returns in Japan at lag 2, returns in France, Australia and South Korea at lag 1. Returns in Singapore at the lag 0 are influenced by the returns in India at lag 1 and 2, returns in UK, Japan, Singapore and Australia at lag 1 and returns in France at lag 1 and 2. Returns in Australia at lag 0 are influenced by returns in India at lag 1 and 2, returns in Japan, France and Australia at lag 1, returns in Singapore and South Korea at lag 2. Returns in South Korea at the lag 0 are influenced by returns in India, UK, Japan and Australia at lag 1, returns in France and South Korea at lag 1 and 2 both.

g. Variance Decomposition Analysis

The variance decomposition analysis of the seven stock exchanges is presented by the tables from 9 to 15. The table decomposes the returns at the seven stock exchanges for a period ranging from 1 to 10.

Table 9: Variance Decomposition of India

Period	S.E.	India	UK	Japan	France	Singapore	Australia	South Korea
1	0.01434	100	0	0	0	0	0	0
2	0.01448	98.24108	1.17076	0.04616	0.27415	0.024458	0.04129	0.20207
3	0.01452	97.68139	1.65493	0.06622	0.27522	0.073732	0.04270	0.20579
4	0.01452	97.64604	1.68037	0.06995	0.27877	0.075526	0.04334	0.20598
5	0.01452	97.64165	1.68396	0.07012	0.27904	0.075523	0.04372	0.20597
6	0.01452	97.64149	1.68403	0.07018	0.27904	0.075525	0.04374	0.205974
7	0.01452	97.64146	1.68406	0.07018	0.27904	0.075526	0.04374	0.205974
8	0.01452	97.64146	1.68406	0.07018	0.27904	0.075526	0.04374	0.205974
9	0.01452	97.64146	1.68406	0.07018	0.27904	0.075526	0.04374	0.205974
10	0.01452	97.64146	1.68406	0.07018	0.27904	0.075526	0.04374	0.205974

Source: Computed Data

Table 10: Variance Decomposition of UK

Period	S.E.	India	UK	Japan	France	Singapore	Australia	South Korea
1	0.0120	13.8403	86.1597	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0120	13.7845	86.0345	0.0225	0.0283	0.0081	0.0230	0.0992
3	0.0120	13.7345	85.8095	0.2106	0.0501	0.0171	0.0500	0.1283
4	0.0120	13.7387	85.7943	0.2179	0.0526	0.0182	0.0501	0.1283
5	0.0120	13.7386	85.7939	0.2179	0.0526	0.0182	0.0501	0.1287
6	0.0120	13.7386	85.7938	0.2179	0.0527	0.0182	0.0501	0.1287
7	0.0120	13.7386	85.7938	0.2179	0.0527	0.0182	0.0501	0.1287
8	0.0120	13.7386	85.7938	0.2179	0.0527	0.0182	0.0501	0.1287
9	0.0120	13.7386	85.7938	0.2179	0.0527	0.0182	0.0501	0.1287
10	0.0120	13.7386	85.7938	0.2179	0.0527	0.0182	0.0501	0.1287

Source: Computed Data

Table 11: Variance Decomposition of Japan

Period	S.E.	India	UK	Japan	France	Singapore	Australia	South Korea
1	0.0134	10.5203	6.6125	82.8672	0.0000	0.0000	0.0000	0.0000
2	0.0148	11.1959	14.9542	71.4677	1.9402	0.0002	0.4345	0.0072
3	0.0148	11.1679	15.0093	71.3378	1.9387	0.0623	0.4356	0.0485
4	0.0148	11.1685	14.9976	71.3057	1.9676	0.0666	0.4439	0.0501
5	0.0148	11.1681	14.9971	71.3066	1.9675	0.0667	0.4439	0.0502
6	0.0148	11.1680	14.9971	71.3065	1.9675	0.0668	0.4439	0.0502
7	0.0148	11.1680	14.9971	71.3065	1.9675	0.0668	0.4439	0.0502
8	0.0148	11.1680	14.9971	71.3065	1.9675	0.0668	0.4439	0.0502
9	0.0148	11.1680	14.9971	71.3065	1.9675	0.0668	0.4439	0.0502
10	0.0148	11.1680	14.9971	71.3065	1.9675	0.0668	0.4439	0.0502

Source: Computed Data

Table 12: Variance Decomposition of France

Period	S.E.	India	UK	Japan	France	Singapore	Australia	South Korea
1	0.0148	12.3082	67.7373	0.0532	19.9013	0.0000	0.0000	0.0000
2	0.0148	12.2659	67.5090	0.0544	19.9031	0.0029	0.0942	0.1705
3	0.0149	12.2190	67.2944	0.2387	19.8859	0.0036	0.1462	0.2122
4	0.0149	12.2225	67.2875	0.2440	19.8834	0.0043	0.1462	0.2122
5	0.0149	12.2225	67.2873	0.2440	19.8833	0.0043	0.1462	0.2125
6	0.0149	12.2225	67.2873	0.2440	19.8833	0.0043	0.1462	0.2125
7	0.0149	12.2225	67.2873	0.2440	19.8833	0.0043	0.1462	0.2125
8	0.0149	12.2225	67.2873	0.2440	19.8833	0.0043	0.1462	0.2125
9	0.0149	12.2225	67.2873	0.2440	19.8833	0.0043	0.1462	0.2125
10	0.0149	12.2225	67.2873	0.2440	19.8833	0.0043	0.1462	0.2125

Source: Computed Data

The table 9 reveals that in case of Indian stock market, there is somewhat visible impact of U.K for the period from 2 to 10. Table 10 shows that the returns of London stock exchange are composed by the returns of BSE for the period from 1 to 10. Table 11 shows that the return at India and UK for the period for 1 to10 and France from the period from 2 to10 influences the Tokyo stock exchange. The table 12 shows that return of U.K and BSE from period 1 to 10 have some visible impact on returns at Euro next Paris stock exchange.

Table 13: Variance Decomposition of Singapore

Period	S.E.	India	UK	Japan	France	Singapore	Australia	South Korea
1	0.0107	24.2962	7.4376	8.0905	0.0523	60.1234	0.0000	0.0000
2	0.0111	23.0756	10.5864	9.0009	0.5653	56.3571	0.3831	0.0316
3	0.0111	23.2654	10.5455	9.0142	0.5677	56.1238	0.4292	0.0542
4	0.0111	23.2586	10.5392	9.0530	0.5719	56.0940	0.4290	0.0544
5	0.0111	23.2580	10.5390	9.0535	0.5719	56.0929	0.4294	0.0553
6	0.0111	23.2580	10.5390	9.0536	0.5719	56.0928	0.4294	0.0553
7	0.0111	23.2580	10.5390	9.0536	0.5719	56.0928	0.4294	0.0553
8	0.0111	23.2580	10.5390	9.0536	0.5719	56.0928	0.4294	0.0553
9	0.0111	23.2580	10.5390	9.0536	0.5719	56.0928	0.4294	0.0553
10	0.0111	23.2580	10.5390	9.0536	0.5719	56.0928	0.4294	0.0553

Source: Computed Data

Table 14: Variance Decomposition of Australia

Period	S.E.	India	UK	Japan	France	Singapore	Australia	South Korea
1	0.0085	13.4715	8.4888	11.3991	0.0345	4.1982	62.4079	0.0000
2	0.0097	12.8556	21.4809	11.1097	1.1448	3.5121	49.8914	0.0056
3	0.0097	12.9478	21.4886	11.1039	1.1626	3.5764	49.6839	0.0367
4	0.0097	12.9643	21.4791	11.1605	1.1813	3.5761	49.5996	0.0391
5	0.0097	12.9636	21.4782	11.1641	1.1813	3.5766	49.5970	0.0393
6	0.0097	12.9636	21.4781	11.1642	1.1813	3.5767	49.5969	0.0394
7	0.0097	12.9636	21.4781	11.1642	1.1813	3.5767	49.5969	0.0394
8	0.0097	12.9636	21.4781	11.1642	1.1813	3.5767	49.5968	0.0394
9	0.0097	12.9636	21.4781	11.1642	1.1813	3.5767	49.5968	0.0394
10	0.0097	12.9636	21.4781	11.1642	1.1813	3.5767	49.5968	0.0394

Source: Computed Data

Table 13 show that returns at the stock exchange of India, U.K. and Japan for the period 1 to 10 have some visible impact on Singapore stock exchange. Table 14 shows that the returns at Indian, London, and Tokyo stock exchanges have some visible impact on Australian securities exchange for the time period 1 to 10 and stock exchange of France for the period from 2 to 10 have some visible impact on Australian stock exchange. The stock market of Singapore also influences the exchange of Australia for the period of 1 to 10.

Table 15: Variance Decomposition of South Korea

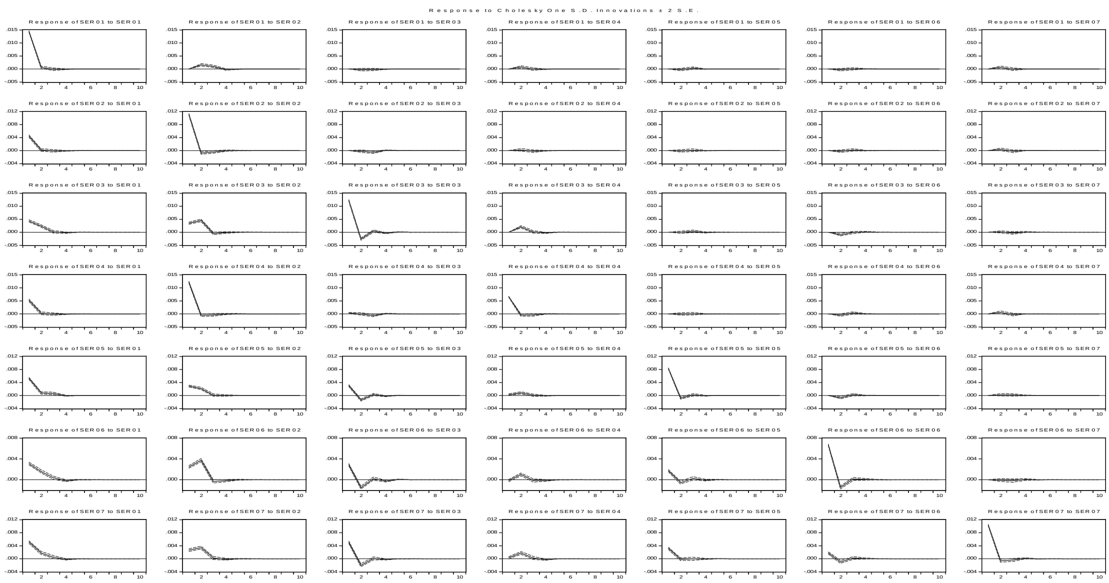
Period	S.E.	India	UK	Japan	France	Singapore	Australia	South Korea
1	0.0134	14.6457	3.9200	14.3269	0.0574	5.7654	1.7795	59.5052
2	0.0142	14.5440	9.2434	14.6310	1.6125	5.1077	2.0653	52.7961
3	0.0143	14.6173	9.2444	14.5990	1.6340	5.0942	2.0852	52.7260
4	0.0143	14.6183	9.2505	14.6067	1.6681	5.0914	2.0853	52.6797
5	0.0143	14.6183	9.2505	14.6065	1.6682	5.0916	2.0854	52.6794
6	0.0143	14.6182	9.2505	14.6065	1.6683	5.0917	2.0854	52.6794
7	0.0143	14.6183	9.2505	14.6065	1.6683	5.0917	2.0854	52.6794
8	0.0143	14.6183	9.2505	14.6065	1.6683	5.0917	2.0854	52.6794
9	0.0143	14.6183	9.2505	14.6065	1.6683	5.0917	2.0854	52.6794
10	0.0143	14.6183	9.2505	14.6065	1.6683	5.0917	2.0854	52.6794

Source: Computed

Table 15 show that returns at BSE, UK, Japan, Singapore and Australia have some visible impact on South Korea stock exchange for the time period from 1 to 10 and France stock exchange for the period from 2 to 10.

h. Impulse Response

Figure



(India (ser01)) UK (ser02) Japan (ser03) France (ser04) Singapore (ser05) Australia (ser06) South Korea (ser07)

The impulse response analysis investigates the influence of random shock on the markets. Impulse responses of returns in various markets to a shock in their own and other market innovations are also examined. It show that only the stock market of UK have some impact on Indian stock market.

Conclusion

The highest mean return is of India and the standard deviation (highest risk) of France stock market. The Jarque-Bera statistic is very high for all stock markets, implying that stock returns differ significantly from the normal distribution. There is a significant correlation between Indian and Singapore stock market. The ADF test confirms the stationarity of the selected series. The Johenson's co-integration test found no co-integration between Indian and other stock markets in the study. The granger causality test indicates the unidirectional causal relationship between Indian stock market and the stock markets of U.K., Japan, France and Australia. On the other hand, there exist a bidirectional causal relationship between India and Singapore and also between India and South Korea. The results of VAR show that India is influenced by U.K., Japan, Singapore, Australia and South Korea. The results of variance decomposition indicate that only the stock market of U.K. have some visible impact on Indian stock market. On the other side Indian stock market have some visible impact on U.K., Japan, France, Singapore, Australia and South Korea. Finally, the impulse response shows that only the stock market of U.K. has some impact on Indian stock market. So we can conclude that there exist portfolio diversification benefits in selected stock markets.

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