Is Stock Market of Bharat Interlinked with other Selected Nations: Evidence From Asia & Europe?

Dr. Shailesh Kumar Singh[1], Rashmi Rakesh[2]
[1, 2] Assistant Professor, Faculty of Commerce & Management, Maharishi University of Information Technology, Lucknow, UP (India)
Email – [1]sksinghneetu1@gmail.com; [2]rashmirakesh19@yahoo.com

Abstract: *The paper studies the integration of Bharat stock market with China, Hong Kong and United States. Daily closing prices of BSE SENSEX (Bharat), HSI (Hong Kong Stock Exchange), SSE composite Index (Shanghai Stock Exchange) and S&P500 (New York stock exchange) for the period from 1st January 2001 to 31st December 2015 have been collected from the website yahoofinace.com. Augmented Dickey Fuller Test, Granger Causality test, Vector Auto Regression Model, Variance Decomposition Analysis and Impulse Response Function are used for the purpose of analysis. The findings show that there is no long run equilibrium relationship between the markets under study but Bharat stock market was found integrated with Hong Kong and United States in short run. So, there exist benefits of portfolio diversification for international investors in countries under the study.*

Key Words: *Integration, Variance Decomposition, Impulse response, Portfolio Diversification, Vector Auto Regression,*

1. INTRODUCTION:

The globalization of capital flows has led to the growing relevance of capital markets. Bharat is one of the countries with an expanding capital market that is increasingly attracting funds from foreign countries which increase integration. Integration is a process by which markets become open and unified so that participants in one market have an unrestricted access to another market. Financial market integration implies that in the absence of administrative and informational barriers, risk adjusted returns on assets of the same tenure in each segment of the market should be comparable to one another. Financial integration can be classified in two parts, direct and indirect financial integration. Direct financial integration is also known as capital market integration. Capital market integration is a process by which capital markets are integrated with one another. Indirect financial integration refers to a situation in which the return on an investment in one country is indirectly linked to return on investments in other countries.

Stock market integration refers to a status where investors of one country can buy and sell equities (without limits) that are issued in another country and as a result, identical securities are issued and traded at the same price across markets after modification for foreign exchange rates. It plays an essential role in development of stock market as well as economy of the country. It affects the macroeconomic policies and market effectiveness, so it is important for academicians and policy makers. For international investors, stock market integration helps in portfolio diversification. They can maximize their returns and minimize risk with the help of portfolio diversification can be described as a way to reduce portfolio risk through combining assets with expected return that are less correlated.There are two type of risk, one is systematic and other is unsystematic. The systematic risk can be caused by inflation, interest rates, recessions, wars etc. The systematic risk cannot be eliminated. The unsystematic risk is linked only to specific assets and stems from financial leverage, managerial inefficiency, technological change in production process etc. and it can be managed by portfolio diversification. Returns represent the equity market. The risk and return always have a positive relationship. According to modern portfolio diversification theory, if the stock markets are integrated then benefits of portfolio diversification might be limited and vice-versa. In other words if integration exists then the strategy of portfolio diversification may no longer apply. As economies opened up and become more liberalized, integration of global economies become unavoidable. The present study examines the integration between the stock market of Bharat and Hong Kong, China and United States.

2. REVIEW LITERATURE:

Wong, Aggarwal and Du (2004) investigated the short run and long run equilibrium relationship between Bharat stock market and world major developed stock markets by using weekly data of BSE 200 (Bharat), S&P 500 (US), FTSE 100 (UK) NIKKEI 225 (Japan) from January 1, 1991 to December 31,2003 and found that Bharat stock market was co integrated with stock markets of United States, United Kingdom and Japan. There was unidirectional causality run from both US stock market and Japan stock market but not from the UK stock market to the stock

market of Bharat and there was no causality run from the Bharat stock market to any of the market from the US, UK or Japan.

Venkata (2006) investigated the short term and long run equilibrium relationship between stock markets of Bharat and other seven developed countries namely Switzerland, France, Germany, Japan, UK, USA and South Korea and seven developing countries namely Indonesia, Taiwan, Argentina, Israel, Brazil and Mexico. Daily closing prices have been collected from yahoofinance.com for the period from 1st July 1997 to 8th July 2005. ADF, co-integration test, Granger causality and variance decomposition have been used and found that Bharat stock market get influenced by most of the developed country's stock markets and also by most of the developing stock markets.

Mukherjee and Bose (2008) examined Bharat stock market movements with other markets in Asia and the U.S. in the times of reforms. Daily closing values for the period from Jan. 1, 1999 to June 30, 2005 of the selected stock markets of Japan, Hong Kong, Korea, Malaysia, Singapore, Taiwan, Bharat and U.S. have been collected. Descriptive statistics, correlation analysis, ADF test, co-integration test, granger causality and VAR have been used for the purpose of analysis. The results found that U.S. market lead to all Asian markets and observe the linkages between Bharat market and other Asian and developed markets. The Bharat stock market has been led by major stock index returns in U.S., Japan and other Asian markets such as Hong Kong, South Korea and Singapore.

Dhal S. (2009) examined the stock market integration between Bharat and Singapore, Hong Kong, United States, U.K. and Japan. Daily as well as weekly stock price indices over the period from April 1993 to July 2009 have been collected. ADF test, Co-integration test and Variance Decomposition analysis have been used for the purpose of analysis. The results found that within Asia, Singapore and Hong Kong markets had a significant influence, while the Japanese market had a weak influence on the Bharat Market.

Dhanraj S., Gopalaswamy A. K. and Suresh B.M. (2013) examined the short term stock market interdependence between US and six major Asian stock markets namely China, Hong Kong, Bharat, Singapore and Taiwan. Other two largest stock exchanges in the Asian Pacific region namely Japan and Australia have also been included in the study. The data of daily closing stock indices from January 1, 1999 to December 31, 2009 have been collected from Yahoo finance. Granger causality test, Forecast error variance decomposition analysis and VAR model were used. The empirical results revealed the dominance of US stock market on Asian markets and the other important finding was that major crisis events can influence the relationship among stock markets.

Tripathi V., Seth R. and Kumar M. (2013) examined the inter linkages and long run equilibrium relationship of Bharat stock market with other markets of the world (U.S., Europe, other emerging markets and world). The data consisted of monthly standard indices covering from Jan. 2003 to July 2012 from the official website of MSCI. The results found that there was a positive and significant correlation between Bharat and all other economies.

Rao K.M. (2014) investigated the short run and long run relationship between Bharat stock market and the stock indices of major countries in Asia Pacific region. Monthly closing prices of Bharat(SENSEX), Australia (All Ordinaries), Hong Kong (Hang Seng), Indonesia (JKSE) Japan (Nikkie 225), Malaysia (KLSE), South Korea (KOSPI), Singapore (STI) and Taiwan (TSEC) for the period from April 2004 to March 2014 were taken from yahoo finance. The correlation, ADF, Granger Causal test and co-integration test have been used and the results indicated high correlation, stationary data, bidirectional relationship and long run relationship between Bharat and other selected stock markets.

3. RESEARCH METHODOLOGY:

3.1 Objectives of the Study

1. To find out the cause and effect relationship between Bharat and selected stock markets.
2. To study the long run equilibrium relationship between the stock markets of Bharat, Hong Kong, China and United States.
3. To determine the short term linkages between Bharat and other selected stock markets.

3.2 Hypotheses

H_{01}=There is no cause and effect relationship among the above said stock markets.
H_{02}= There is no long run equilibrium relationship between different markets.
H_{03}=There is no short term linkages between the returns of Bharat and selected stock markets.

3.3 Database

Daily closing prices of selected stock market indices for the period from 1st Jan. 2001 to 31st Dec. 2015 have been collected from Yahoo finance. Following stock market indices are taken for study: S& P 500 as an indicator for the US stock prices (New York Stock Exchange), HSI for Hong Kong (Hong Kong Stock Exchange), SSE composite Index for China (Shanghai Stock Exchange)and BSE SENSEX as an indicator for Bharat stock prices (Bombay Stock

Exchange).The missing values in the data of some of the stock exchanges for some days have been filled-up by taking the average of the two nearest cases. Natural log of the selected series gives the daily return of the given indices under the study. The formula of calculating the natural log of indices/closing prices is given as follows:

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

Where:

R_t = Return on day 't', P_t =Index closing value on day 't',
P_{t-1} = Index closing value on day 't-1', ln= Natural log

4. ECONOMETRIC TECHNIQUES:

4.1 Augmented Dickey Fuller Test

The analysis of econometrics can be performed on a series of stationary nature. We use the Augmented Dickey Fuller Test to confirm whether or not the series are stationary or not. 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:

$\Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \sum_{i=1}^{k} \gamma i \Delta Y \gamma_i + \mu_t$ .....(1)

$\Delta\Delta Y_t = \alpha + \beta t + \delta \Delta Y_{t-1} + \sum_{i=1}^{k} \gamma i \Delta\Delta Yt - 1 + \mu_t$.....(2)

If $\delta = 0$, then the series is said to have a unit root and is non-stationary. 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.

4.2 Granger Causality Test

After the stationarity of series, we perform the Granger's causality model in order to observe whether the return at Bharat stock exchange granger causes the return at the stock exchanges of Hong Kong, China and United States or vice versa. The Granger (1969) approach to the question of whether x causes y is to see how much of the current y can be explained by past values of y and then to see whether adding lagged values of x can improve the explanation. y is said to be Granger-caused by x if x helps in the prediction of y , or equivalently if the coefficients on the lagged x 's are statistically significant. It is pertinent to note that two-way causation is frequently the case; x Granger causes y and y Granger causes x. In Granger's Causality, there are bivariate regressions of the under-mentioned form:

$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \ldots + \alpha Y_{t-1} + X_{t-1} + \ldots + \beta X_{t-1} + \varepsilon_t$ .....(3)

$X_t = \alpha_0 + \alpha_1 X_{t-1} + \ldots + \alpha X_{t-1} + {}_1 Y_{t-1} + \ldots + \beta Y_{t-1} + \mu_t$ .....(4)

for all possible pairs of (X, Y) series in the group. Where ε_t and μ_t are two white noise random disturbance terms.

4.3 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. E, Views supports VAR-based co-integration tests using the methodology developed in Johansen (1991, 1995) performed using a Group object or an estimated Var object.

Consider a VAR of order:

$Y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + B x_t + \varepsilon_t$ .....(5)

where: y_t is a k-vector of non-stationary I(1) variables, x_t is a d-vector of deterministic variables, and ε_t is a vector of innovations. We may rewrite this VAR as,

where

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

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

4.4 Vector Auto Regression (VAR) model

If there is no co-integration between Bharat and other selected stock markets then Vector Auto Regression is capable to discover the short run relationships. 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. The VAR approach sidesteps the need for structural modelling by treating every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system. The mathematical representation of a VAR is:

$Y_t = A_1 Y_{t-1} + \ldots\ldots\ldots + A_p Y_{t-p} + B X_t + \varepsilon_t$.....(6)

where Y_t is a k vector of endogenous variables, X_t is a d vector of exogenous variables, A_1, ... , A_p and B are matrices of coefficients to be estimated, and ε_t is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables.

4.5 Variance Decomposition Analysis

The variance decomposition analysis has applied to quantify the extent up to which the selected indices one influenced by each other. We can also examine the short run dynamic relationship by variance decomposition. While impulse response functions trace the effects of a shock to one endogenous variable 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.

4.6 Impulse Response

Impulse responses have been applied to trace out the responsiveness of the dependent variables in the VAR to shocks to each of the variables. So, for each variable from each equation separately, a unit shock is applied to the error, and the effects upon the VAR system over time are noted. Thus, if one g variables in a system, a total of g^2 impulse responses could be generated. The way that this is achieved in practice is by expressing the VAR model as a VMA--that is, the vector autoregressive model is written as a vector moving average. Provided that the system is stable, the shock should gradually die away.

5. ANALYSIS AND RESULTS:

5.1 Augmented Dickey Fuller Test

The Augmented dickey fuller test is used to confirm that the series are stationary or not. This method is applied on closing prices of selected indices. In the table 1 and 2, we show the results of ADF on closing prices at level and Ist difference to see the stationarity of series, which are as follows:

Table 1: Augmented Dickey Fuller Test on Closing Prices at Level

	Intercept	Trend	None
Bharat	-0.5152(-3.4318)	-2.874(-3.9603)	1.2479(-2.5655)
Hong Kong	-1.6073(-3.4318)	-2.8681(-3.9603)	-0.035(2.5655)
China	-1.5051(-3.4318)	-1.958(-3.9603)	-0.1690(-2.5655)
U.S.	-0.3119(-3.4318)	-1.9081(-3.9603)	0.8110(-2.5655)

Source: Computed

Intercept	Trend	None	Level of significance
1%	-3.4318	-3.9603	-2.565
5%	-2.8620	-3.41095	-1.9409
10%	-2.5671	-3.1272	-1.6160

Table 2: Augmented Dickey Fuller Test on Closing Prices at First Difference

	Intercept	Trend	None
Bharat	-59.036(-3.4318)	-59.0313(-3.9603)	-58.9967(-2.5655)
Hong Kong	-64.6504(-3.4318)	-64.642(-3.9603)	-64.655(2.5655)
China	-28.333(-3.4318)	-28.335(-3.9603)	-28.332(-2.5655)
U.S.	-67.661(-3.4318)	-67.684(-3.9603)	-67.6563(-2.5655)

Source: Computed

Intercept	Trend	None	Level of significance
1%	-3.4318	-3.9603	-2.565
5%	-2.8620	-3.41095	-1.9409
10%	-2.5671	-3.1272	-1.6160

The results of table 1 show that the series are non stationary in nature but in table 2, at the first difference in all the cases t-statistics is more than the test critical value (irrespective of sign), this implies that the null hypotheses is rejected and the variable does not have a unit root, which confirms that the series are stationary after differencing one.

5.2 Granger Causality Test

Now we proceed to perform the granger causality analysis for the selected benchmark indices. The granger causality test conducted to see whether Bharat stock market cause other markets and vice versa in short run. Table 3present the findings of granger's causality test for the stock exchanges under study.

Table 3:PairWise Granger Causality Test

Lags: 2

Null Hypothesis:	Ob	F-Statistic	Prob.
H.K. does not Granger Cause Bharat	3911	4.57668	**0.0103**
Bharat does not Granger Cause H.K.	-	40.4116	**4.00E-18**

CHINA does not Granger Cause Bharat	3911	3.11814	**0.0443**
Bharat does not Granger Cause CHINA	-	7.3452	**0.0007**
U.S. does not Granger Cause Bharat	3911	104.528	**6.00E-45**
Bharat does not Granger Cause U.S.	-	0.46236	**0.6298**

Source: Computed, Level of significance 5%

The table 3 presents the results about the application of granger's causality model to the selected stock markets. From the Probability values of the Granger causality test, the acceptance and rejection decision for the null hypothesis can be taken. While 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. Going by this rule, we accept the following null hypothesis-

R Bharat does not granger causes R U.S.

But we accept the under mentioned alternate hypothesis:

1. R H.K. granger causes R Bharat
2. R Bharat granger causes R H.K.
3. R China granger causes R Bharat
4. R Bharat granger causes R China
5. R U.S. granger causes R Bharat

The bidirectional causal relationship is found between Bharat stock market and the stock market of Hong Kong and China. Also, there exists unidirectional relationship between Bharat and US.

5.3 Johansen's Co-Integration Analysis

Co-integration of two or more time series suggests that there is a long run equilibrium relationship between them. In Johansen's approach, we applied Johansen's co-integration test to see whether Bharat stock market is co integrated with other stock markets under the study. It must be noted that the closing prices (which are non stationary in nature) of the selected indices are used to test the co-integration among the markets not the return series. The results of Johansen's co-integration test are as follows:

Table 4: Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None	0.003793	32.98893	47.85613	0.5574
At most 1	0.003626	18.1342	29.79707	0.5562
At most 2	0.000895	3.933184	15.49471	0.9088
At most 3	0.00011	0.431646	3.841466	0.5112

Source: Computed

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

Table 5: Unrestricted Co-integration Rank Test (Maximum Eigen Value)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.003793	14.85473	27.58434	0.7596
At most 1	0.003626	14.20102	21.13162	0.3488
At most 2	0.000895	3.501538	14.2646	0.9078
At most 3	0.00011	0.431646	3.841466	0.5112

Source: Computed

Max-eigen value 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

Table 4 and 5 shows that there is no co integrating equation at the 0.05 level in trace statistics and maximum eigen value. So, the results of Johansen's co-integration said that there is no co-integration or no long run equilibrium relationship between Bharat and the stock markets Hong Kong, China and United States. In our study, there is no co-integration between Bharat and other selected stock markets so, Vector Auto regression is capable to discover the short run relationships of Bharat stock market with other selected stock markets.

5.4 Vector Auto Regression Analysis

The table 6 presents the results of VAR model at selected stock markets to see the short run relationship between Bharat and other selected stock markets (applied on return series). 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 integration of the stock exchange with the other is tested at the lag of 1 and 2. The return at lag 0 is taken in the column wise the returns at all the stock exchanges at lag 1 and lag 2 are taken in the rows. The results of VAR model are as follows:

Table 6: Vector Auto Regression Estimates

Standard errors in ( ) & t-statistics in [ ]

	Bharat	**H.K.**	**CHINA**	**U.S.**
Bharat(-1)	0.004565	0.085992	0.047899	0.011389
	-0.01816	-0.01667	-0.02039	-0.01573
	[0.25137]	**[5.15813]**	**[2.34878]**	[0.72392]
Bharat(-2)	-0.04577	0.017513	0.013015	0.011016
	-0.0182	-0.01671	-0.02044	-0.01577
	[-2.51441]	[1.04797]	[0.63667]	[0.69854]
H.K.(-1)	-0.06922	-0.21621	-0.05596	0.00566
	-0.02113	-0.0194	-0.02373	-0.01831
	[-3.27581]	**[-11.1450]**	**[-2.35816]**	[0.30915]
H.K.(-2)	0.033254	-0.01155	-0.02555	-0.01535
	-0.01939	-0.01781	-0.02178	-0.0168
	[1.71458]	[-0.64841]	[-1.17298]	[-0.91370]
CHINA(-1)	-0.02356	-0.03962	0.013844	-0.00421
	-0.01535	-0.0141	-0.01724	-0.0133
	[-1.53428]	**[-2.81052]**	[0.80285]	[-0.31619]
CHINA(-2)	0.00631	-0.00391	-0.01898	-0.00815
	-0.01534	-0.01408	-0.01723	-0.01329
	[0.41132]	[-0.27733]	[-1.10184]	[-0.61302]
U.S.(-1)	0.277549	0.542615	0.178906	-0.10156
	-0.01946	-0.01787	-0.02186	-0.01686
	[14.2618]	**[30.3712]**	**[8.18598]**	**[-6.02384]**
U.S.(-2)	0.152335	0.163077	0.062363	-0.04102
	-0.02144	-0.01968	-0.02408	-0.01857
	[7.10492]	**[8.28491]**	**[2.59002]**	**[-2.20823]**
C	0.00045	-2.00E-06	8.15E-05	0.000116
	-0.00023	-0.00021	-0.00025	-0.0002
	[1.99662]	[-0.00968]	[0.32186]	[0.59170]

Source: Computed

The table 6 shows that the returns at Bharat, at the lag of 0 is influenced by the return at H.K. at lag 1, returns at US at the lag 1 and 2. The returns in H.K. at lag 0 are influenced by the returns in Bharat at lag 1, returns in H.K. at lag 1,

returns in China at lag 1 and returns at U.S. at lag 1 and 2. Returns in China at lag 0 are influenced by the returns in Bharat at lag 1, returns in H.K. at the lag 1, returns in U.S. at lag 1 and 2. Returns in U.S. at lag 0 moves independently and is not influenced by any other variable. The study of the VAR model leads us to the conclusion that in short run Bharat is influenced by Hong Kong and U.S. and influence to Hong Kong and China.

5.5 Variance Decomposition Analysis

The Variance decomposition is also used to see the short run dynamic relationship between Bharat and other selected stock markets. The variance decomposition analysis of the selected stock exchanges is presented by the tables from 7 to10. The following tables decompose the returns at the selected stock exchanges for a period ranging from 1 to 10:

Table 7: Variance Decomposition of Bharat

Period	S.E.	Bharat	H.K.	CHINA	U.S.
1	0.014078	100	0	0	0
2	0.014455	94.9745	0.037171	0.108475	4.879855
3	0.01451	94.2543	0.353383	0.109982	5.282333
4	0.014513	94.22422	0.366965	0.110384	5.298433
5	0.014513	94.2222	0.36766	0.110466	5.299677
6	0.014513	94.22213	0.367726	0.110474	5.299672
7	0.014513	94.22211	0.367729	0.110474	5.29969
8	0.014513	94.22211	0.36773	0.110474	5.29969
9	0.014513	94.22211	0.36773	0.110474	5.29969
10	0.014513	94.22211	0.36773	0.110474	5.29969

Source: Computed

Table 8: Variance Decomposition of H.K.

Period	S.E.	Bharat	H.K.	CHINA	U.S.
1	0.012924	20.97992	79.02008	0	0
2	0.014539	17.81309	63.42035	0.330798	18.43576
3	0.014548	17.82835	63.42429	0.330418	18.41694
4	0.014553	17.8247	63.39291	0.331002	18.45139
5	0.014554	17.82457	63.39265	0.331001	18.45178
6	0.014554	17.82457	63.39265	0.33101	18.45178
7	0.014554	17.82457	63.39265	0.33101	18.45178
8	0.014554	17.82457	63.39265	0.33101	18.45178
9	0.014554	17.82457	63.39265	0.33101	18.45178
10	0.014554	17.82457	63.39265	0.33101	18.45178

Source: Computed

Table 9: Variance Decomposition of CHINA

Period	S.E.	Bharat	H.K.	CHINA	U.S.
1	0.01581	2.54202	11.23656	86.22142	0
2	0.015973	2.85623	11.01671	84.46672	1.660346
3	0.015982	2.858058	11.02444	84.41343	1.704077
4	0.015984	2.860733	11.02177	84.3921	1.725403
5	0.015984	2.860783	11.02176	84.39204	1.725421
6	0.015984	2.860787	11.02177	84.392	1.72545
7	0.015984	2.860787	11.02177	84.392	1.72545
8	0.015984	2.860787	11.02177	84.392	1.72545
9	0.015984	2.860787	11.02177	84.392	1.72545
10	0.015984	2.860787	11.02177	84.392	1.72545

Source: Computed

Table 10: Variance Decomposition of U.S.

Period	S.E.	Bharat	H.K.	CHINA	U.S.
1	0.012196	7.276365	3.590645	0.148055	88.98493
2	0.012254	7.222477	3.581114	0.146782	89.04963

3	0.012262	7.215986	3.638575	0.154577	88.99086
4	0.012262	7.215842	3.641858	0.154845	88.98746
5	0.012262	7.215834	3.641881	0.154862	88.98742
6	0.012262	7.215842	3.641885	0.154862	88.98741
7	0.012262	7.215842	3.641885	0.154862	88.98741
8	0.012262	7.215842	3.641885	0.154862	88.98741
9	0.012262	7.215842	3.641885	0.154862	88.98741
10	0.012262	7.215842	3.641885	0.154862	88.98741

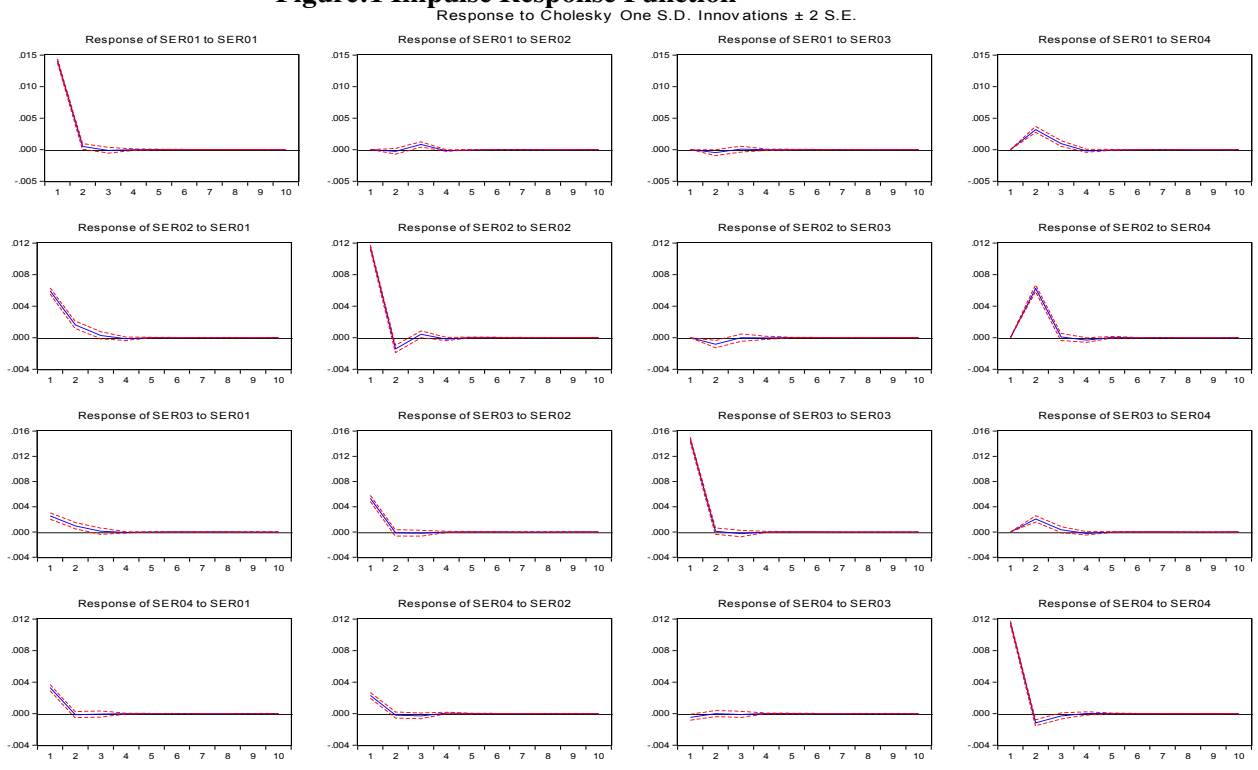
Source: Computed

Table 7 reveals that in case of Bharat stock market, there is some visible impact of United States for the period from 2 to 10. Table 8 shows that the returns of Hong Kong stock exchange is composed by the returns of BSE for the period from 1 to 10 and returns of United States for the period from 2 to 10. Table 9 shows that the returns at Shanghai stock exchange are influenced by returns at BSE and Hong Kong stock exchange for the period from 1 to 10 and also influenced by returns at New York stock exchange for the period from 2 to 10. Table 10 shows that the returns at BSE and Hong Kong stock exchange have some visible impact on returns at New York stock exchange for the period from 1 to 10.

5.6 Impulse Response

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. Impulse response show the effect of shocks for different days separately the cumulative effect of shocks the variance decomposition of the stock indices is based on the analysis of responses of the variables to shocks. Figures 1 presents the impulse response functions for series Bharat(ser01), H.K.(ser02), China (ser03), US(ser04).

Figure:1 Impulse Response Function



The results of figure 1 depict the impulse response of the stock market of Bharat on the other stock markets (Hong Kong, China and U.S.). The Figure shows the number of days on X-axis, and the shock response on Y-axis. The figure exhibits in about how many days the shock at the other stock exchange cools down. However, only the stock market of U.S. exerting some impact on Bharat stock market.

6. CONCLUSION:

The paper investigates the integration between Bharat stock market and the stock market of Hong Kong, China and United States. The ADF test shows that all series are stationary at first difference. The results of granger causality test conclude the unidirectional causal relationship between Bharat and U.S. but there were found the bidirectional causal relationship between Bharat stock market and the stock market of Hong Kong and China. The result of Johansen's co-integration test show no co-integrating vector at trace and maximum eigen value which indicate that there is no long run equilibrium relationship between Bharat stock market with other selected stock

markets. The results of VAR show that Bharat stock market get influenced by US and Hong Kong and influence to Hong Kong and China. But variance decomposition showed that only stock market of US has some visible impact on Bharat stock market in short run. Impulse response also proves this result. Bharat stock market was not found integrated in long run with other selected markets and short run relationship is also not confirmed by all the models. So portfolio diversification benefits are available for international investors in different selected stock markets under the study in long run as well as in short run.

REFERENCES:

1. Bhunia A. (2013), "Co-integration and causal relationship among crude price, domestic gold price and financial variable: an evidence of BSE and NSE", *Journal of Contemporary Issues in Business Research*, Vol.2, No.1, pp 1-10.
2. Chancharat, S. (2009), " Stock Market Integration- An Overview", *NIDA Economic Review,* Vol. 4, No. 2, Dec. 2009, pp 23-35.
3. Dhal S., (2009), "Global crises and the Integration of India's stock market", *Journal of Economic Integration,* Vol. 24, No. 4, pp 778-805.
4. Dhanraj S., Gopalaswamy A.K. and Suresh B.M. (2013), "Dynamic interdependence between US and Asian market: An empirical study", *Journal of Financial Economy Policy,* Vol. 5, Issue 2, pp. 220-237. Gujrati, *Basic Econometrics,* pp 849.
5. Mukherjee,P. and Bose, S.(2008),"Does the Stock Market in India Move with Asia? A Multivariate Co-integration- Vector Auto Regression Approach", *Emerging Markets Finance & Trade,* Sep.-Oct.2008, Vol. 44, No. 5 pp. 5-22.
6. Pandian P. , "Security analysis and portfolio management", 2nd edition , pp 127.
7. Rajwani S. and Mukherjee T. (2013), "Is the Indian stock market co integrated with other Asian markets?",*Management Research Review,* Emrald publishing group, Vol. 36, No.9, pp. 899-918.
8. Rao K.M. (2014), "Interrelationship among stock market of India and selected stock price indices of the Asia pecific region", *The Indian Journal of Commerce,* July- September 2014, Vol. 67, No. 3, , pp. 13-20.
9. Seth N and Sharma A K (2015**),** "International stock market efficiency and integration: Evidence from Asian and US markets", *Journal of Advances in Management Research,* Emrald Group Publishing ltd., Vol. 12, Issue 2, pp 88-106.
10. Sharma G. D. and Bodla, (2011), "Interlinkages among stock markets of South Asia", *Asia Pacific Journal of Business Administration,*Vol. 3, No. 2, pp 136.
11. Sharma G D and Mahendru M. (2013)"Are the stock exchanges of emerging economies inter-linked: Evidence from BRICS*", Indian Journal of Finance,* Vol. 7, Issue 1, pp 1-25.
12. Vardhan H., Sinha P. and Vij M. (2015), "Behavior of Indian sectoral stock price indices in the post subprime crises period", *Journal of Advances in management research,* Vol. 12, No.1, pp 15-29 (17).
13. Venkata S.S. (2006), "Indian Capital Market Integration with Select Developed and Developing Countries, 1997-2006"*, Applied Econometrics and International Development,* Vol. 6, No.2, pp 227-248.
14. Wong, W.K., Aggarwal A. and Du J. (2004), "Financial Integration for India Stock Market: A Fractional Co-integration Approach" *Finance India,* Vol. 18, No. 4, pp 1581-1604.
15. Suman (2016), "Inter linkages of Indian stock market with Hong Kong stock market", *Asian Journal of Management Applications and Research,*Vol.6(1), pp 58-63.
16. Suman and Warne D.P. (2013), "Global stock market integration: A Review", *Asia Pacific Journal of Research in Business Management*, 4(8-9), 18-28.
17. Suman and Warne D.P. (2015), "Inter linkages between Indian and United States stock market indices", *International Journal of Information & Futuristic Research,* Vol. 2 (9), pp 3190-3195.
18. Surat S. (2011), "Causality between total expenditure on education and economic growth: A case study of Haryana", *Indian Journal of Economics,* Vol. XIIC, Part 1, Issue 364, pp 1-8.
19. Surat S. (2013), "Public Expenditure and Economic Growth", *Indian Journal of Commerce,* Vol. 66, No. 1, pp 15-22.
20. Tai, C. S. (2007), "Market integration and contagion: Evidence from Asian emerging stock and foreign exchange markets ", *Emerging Markets Review,* Vol. 8, No.4, pp. 264-283
21. Tripathi V., Seth R. and Kumar M. (2013),"Inter linkages, Co-integration and Global Financial Crisis: India's Experience and Preparedness", *The Indian Journal of Commerce,* July-Sept. 2013, Vol. 66, No. 3, pp. 173-188.
22. Valdkhani A. and Chancharat S. (2008), "Dynamic linkages between Thai and International stock markets", *Journal of economic studies*, Vol. 35, No. 5, Emrald group publishing Ltd. pp 425-441.