Co-Movement and Integration Among Stock Markets : A Study of 14 Countries

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Abstract

This paper explored the comovement among 14 stock markets, namely BSE, BVSP, FTSE -100, Hang Seng, JKSE, KSE, KSE (Korea), MXX, NASDAQ, NIKKI, RTS, SSE, SSMI, and TSEC. Daily index of all stock markets covering a period from January 1, 1998 to January 31, 2017 were used. The correlation analysis showed that BSE remained somewhat positively correlated with Hang Seng (0.45), FTSE-100 (0.32), MXX (0.27), NASDAQ (0.24), and BVSP (0.23). Results of Granger causality test indicated that the returns of BSE were dependent on BVSP, FTSE - 100, and MXX only. Outcome of Johansen cointegration test indicated that there was a long run relationship among selected stock markets. From this present study, FIIs (foreign institutional investors), individual investors, institutional investors, public investors, and HNIs (high net worth individuals) will be benefited. All these stakeholders can take their decisions for their investments in the overseas markets by looking at the short-term and long-term integration of BSE with other selected markets.

Key words : **comovement, cointegration, Granger causality, emerging markets**

JEL Classification : F210, F290, F320, F360, G110, G150

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The stock market is the barometer for the economy of any country. Since many years, the stock market has been important for the economists, researchers, investors, governments, and policy makers. In past years, the Indian stock market has witnessed many ups and down with other international markets. Many well-known researchers made attempts to study the comovement among the selected markets in the 1980s and 1990s (Cheung & Mak, 1992 ; Hilliard, 1979). Currently, a co-movement of stock markets is among the most popular topics in finance for research. The study of the existence of co-movement among international capital markets has serious implications over the economic policies of a nation. Till date, studies have not covered international economic events. In this study, the comovement of 14 selected stock markets covering the period from January 1998 to January 2017 is examined. The selection of the time period was done considering various global ups & downs, global recession, growth of the world market, emergence of new market in the world, and so forth. This study aims at exploring the short and long-term relationship between 14 stock exchanges.

Review of Literature

Various studies directly or indirectly related to the objective of this study have been reviewed. There are various studies, which have evaluated various aspects of comovement, that is, prices, returns, risk, volatility, etc. The past studies have showed that the Indian capital market is affected by many international markets. For example,

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Shahzad, Kanwal, Ahmed, and Rehman (2016) evaluated the comovement among the stock markets applying ARDL and revealed the existence of co-movement among the markets. Hoque (2007) found the existence of cointegration of the USA market with the Bangladesh market. Majid, Meera, Omar, and Aziz (2009) evaluated the comovement among the ASEAN - 5 stock exchanges using cointegration and found the existence of co-movement and cointegration among the markets.

Karim and Ning (2013) studied the co-integration of ASEAN countries by the OLS and panel data regressions. They found the existence of integration among the markets. Dunis, Sermpinis, and Karampelia (2013) studied the co-movement and integration among the stock markets of EMU nations. They applied the econometric methodologies and found the existence of integration among the markets. Seth and Sharma (2015) studied the co-movement and integration among the Asian and U.S. markets. They applied the Granger causality test and Johansen cointegration test and found the existence of short term and long term cointegration among the markets. Chen and Shen (2009) studied the co-integration and co-movement among the stock markets of U.K., U.S.A., Japan, and Germany . They applied Granger's causality and co-integration test and found the integration among the markets. Wong, Agarwal, and Du (2004) studied the co-movement among some developed countries and found the integration among the markets. Jang and Sul (2002) studied the comovement and integration among the Asian markets using the Granger causality test and Johansen cointegration test. They found the existence of short term and long term co-integration among the exchanges. Aktar (2009) argued about the existence of short term co-integration among the markets.

Recently, many researchers have found the existence of comovement and integration of BSE with other markets (Bhattacharjee & Swaminathan, 2016 ; Mitra & Bhattacharjee, 2015 ; Vohra, 2016). Chakrabarty and Ghosh (2011) found a positive impact of co-integration on portfolio diversification. Babu and Srinivasan (2014) found co-integration among the spot and futures markets.

Contrary to the above, many researchers found the non-existence of integration among the markets. For example, Qadan and Yagil (2015) found the non-existence of cointegration among the markets of G-7 nations. Johnson and Soenen (2009) studied the co-movement among the stock markets of the EU and found a negative relationship among various markets. Bhar and Hamori (2008) examined the co-movement and integration among the European markets and found that there was no co-integration among the markets.

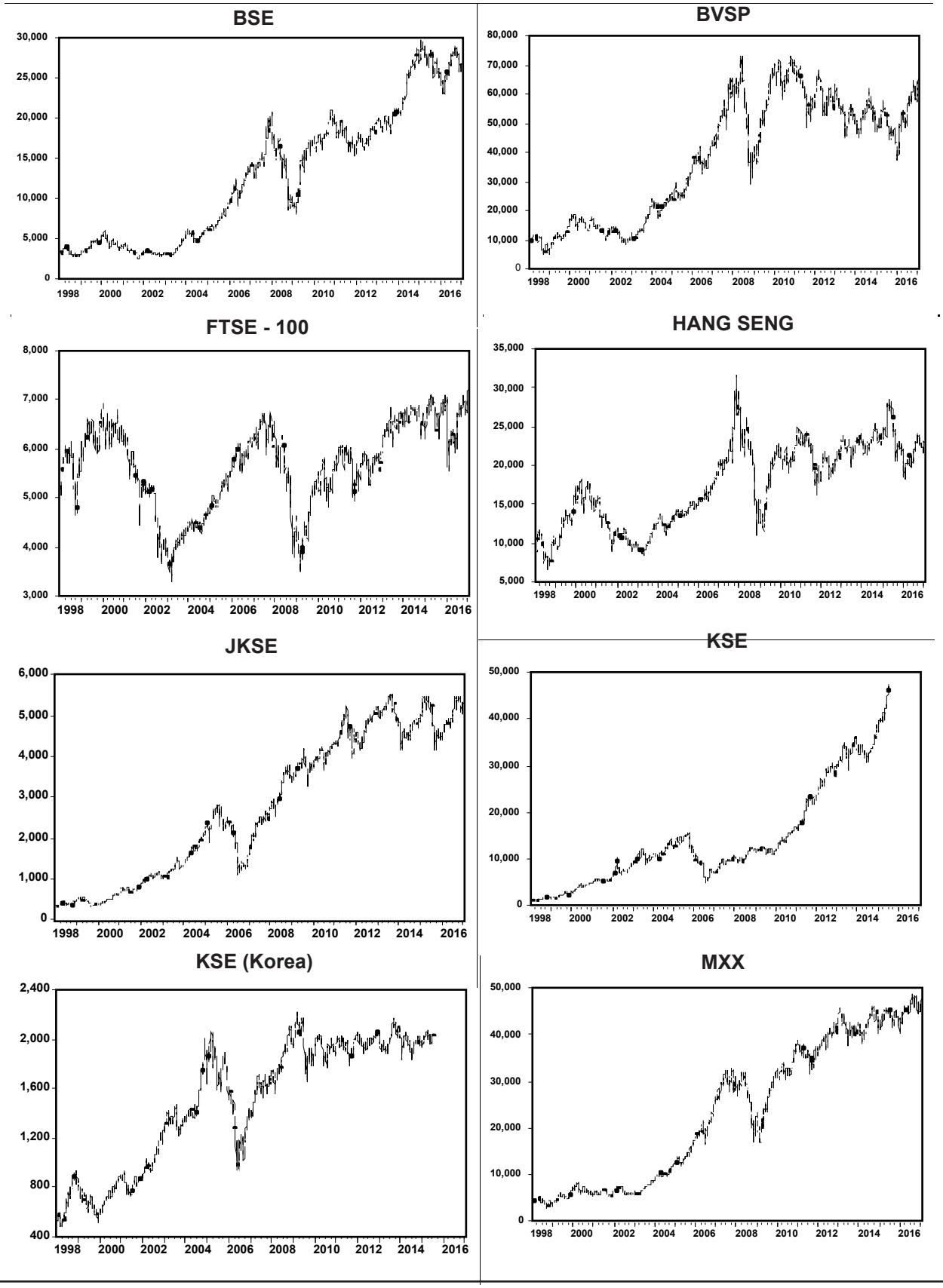
Research Methodology

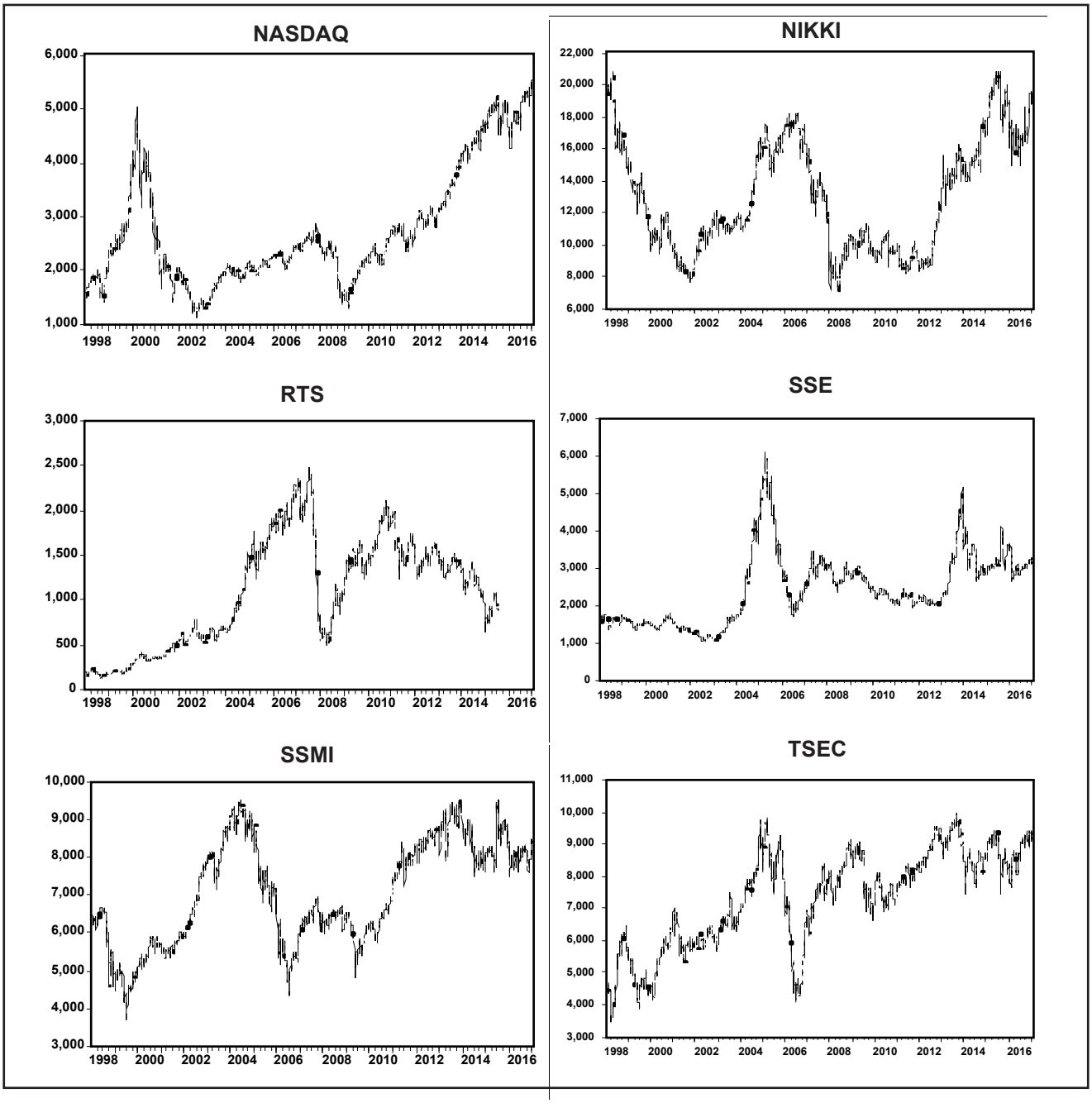
This paper has used correlation, Granger causality test, and Johansen's cointegration test to determine the comovement among selected markets and to study the long and short run association among all exchanges. ADF and PP approaches are used to check the stationarity of data. To perform various statistical tests, Eviews 7 and SPSS 20 were used. Data were taken from various sources such as Google finance and Yahoo finance covering a period of January 1, 1998 to January 31, 2017. The study covers 14 exchanges, namely, BSE Sensex (India), Hang Seng (Hong Kong), MXX (Mexico), FTSE-100 (U.K.), Nikki (Japan), NASDAQ (U.S. market), JKSE (Indonesia), BVSP (Brazil), KSE (Pakistan), KSE- Korea Stock Exchange (South Korea), RTS (Russia), SSE (China), SSMI (Switzerland), and TSEC (Taiwan).

Data Analysis and Results

The Figure 1 shows the momentum of co-movement among the selected markets. Both SSM & TSEC remained volatile over a period of time and remained in upward trend from the year 2010 with volatility ; SSE remained in upward trend till 2005 and fell in 2006. The market remained volatile till 2013 and moved up. RTS remained in upward trend till 2007 and with global recession, it fell in the year 2008. But from the year 2009, the market

Figure 1. Trend of Various Market Indices





remained volatile and moved towards an upward trend. Nikki remained in volatile mode over a period of time. From the year 2012, the market remained in upward trend. NASDAQ remained in growing trend from 1998 to 2001, but fell in 2002 and remained in the same situation till 2008. Moreover, from 2009, the market recovered and remained in upward trend. The MXX also remained in upward trend over a period of time. Furthermore, MXX fell in the year 2008 and recovered in the year 2009. Three markets namely, JKSE, KSE, and KSE (South Korea) over all remained in upward trend over a period of time (except 2016 ; it fell in the year 2016). Hang Seng fluctuated from 1998 to 2002 and after that, the market maintained an increasing trend till 2007. With global recession in the year 2008, the market fell, but from the year 2009, the market remained in upward trend with fluctuation. FTSE-

100 remained a volatile market over a period of time with two downward trends in the year 2002 and 2008. After 2009, the market remained in a growing phase with high volatility. BVSP grew from 1998 to 2007, but with recession in the year 2008, it fell. From the year 2009, the market recovered with a fluctuating trend over a period of time. BSE remained in growing momentum from 1998 until 2007. The market fell from 2008 and recovered in 2009. From the year 2010, BSE remained fluctuating and moved in upward trend. Thus, overall, the markets showed up and down movements in the last 18 years.

(1) Analysis of Top Rises and Falls : The Figure 2 shows that BVSP has uppermost average daily rise of 14.71% and average fall of 11.43% trailed by RTS with the highest average daily rise of 13.81% and average daily fall of 13.40%. The next one is Hang Seng with a rise and fall of 10.61% and -9.58%, respectively. BSE has the highest rise of 9.47% and highest fall of -9.18%. The positive difference in rise and fall is found in TSEC (0.07%), BSE (0.29%), RTS (0.41%), KSE (0.41%), Hang Seng (1.03%), NASDAQ (1.35%), MXX (1.38%), SSE (1.80%), SSMI (1.84%), and BVSP (3.29%). The negative difference in rise and fall is found in Nikki (-0.40%), FTSE-100 (-1.15%), JKSE (-1.25%), and KSE (Korea) (-2.68%).

(2) Descriptive Statistics : The Table 1 shows the descriptive statistics of 3823 daily index data of all 14 markets. A normal distribution has skewness and kurtosis value of 0 and 3, respectively. Here, the Table 1 shows the values of skewness and kurtosis, which further reveals that the markets are not normally distributed. Moreover, it enhances that further tests could be carried out.

(3) Correlation : The Table 2 shows the results of correlation. BSE is not highly correlated with any of the markets in any of the ways, that is, negative or positive. BSE remains somewhat positively correlated with Hang Seng (0.45), FTSE-100 (0.32), MXX (0.27), NASDAQ (0.24), and BVSP (0.23). BSE does not have a significant

Figure 2. Average of 10 Major One Day Rises and Falls of 14 Exchanges

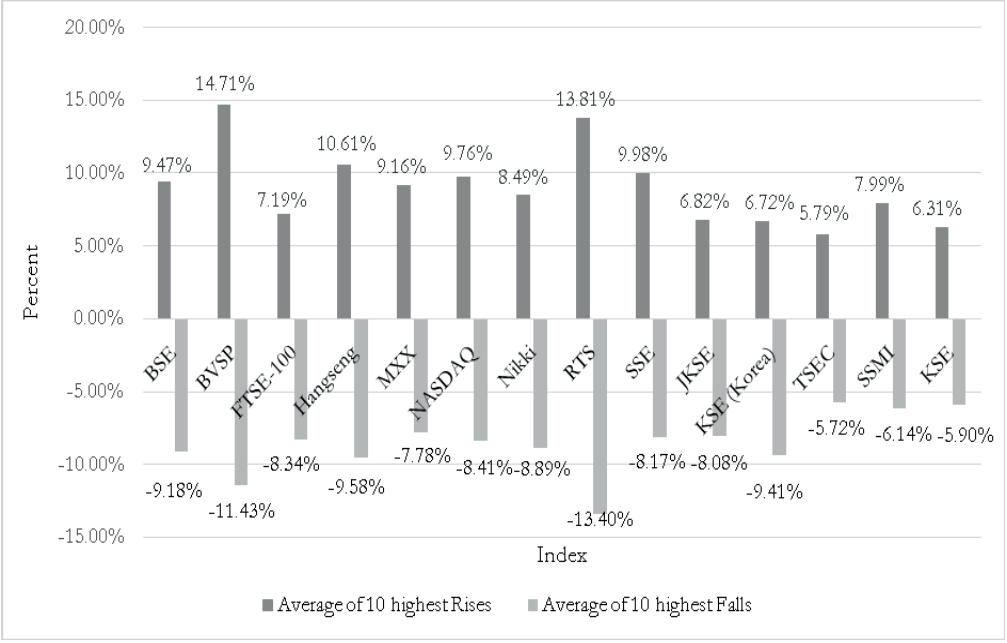


Table 1. Descriptive Statistics

Particulars	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability	Observations
BSE	11732.1	10858.5	29681.77	2600.120	7540.13	0.421390	2.01351	268.156	0.0	3823
BVSP	37263.25	38405.00	73517.00	4761.000	21073.07	0.007395	1.431960	391.6930	0.00	3823
FTSE_100	5603.350	5766.600	7104.000	3287.000	842.7987	-0.50	2.324350	228.8419	0.00	3823
Hangseng	17243.47	16998.06	31638.22	6660.420	5307.302	0.060346	1.883713	200.8132	0.00	3823
JKSE	2625.064	2389.562	5523.290	337.4750	1701.137	0.166357	1.537739	358.2320	0.00	3823
KSE	14281.44	11154.83	47424.63	1075.160	10793.53	1.026144	2.916209	670.9599	0.00	3823
KSE (S. Korea)	1505.362	1681.820	2228.960	468.7600	507.4327	-0.52	1.782066	411.6801	0.00	3823
MXX	21895.87	20438.13	46357.24	2856.100	14370.84	0.176615	1.466263	394.5847	0.00	3823
NASDAQ	2578.635	2339.380	5218.860	1114.110	907.5538	1.063035	2.448928	752.1290	0.00	3823
NIKKI	12545.68	11543.71	20868.03	7054.980	3263.674	0.530792	2.205946	279.9525	0.00	3823
RTS	1088.672	1178.810	2487.920	131.0200	603.4164	0.061501	1.865949	207.2705	0.00	3823
SSE	2377	2224.71	6092.060	1011.500	953.262	1.065224	2.23454	965.769	0.00	3823
SSMI	6964.7	6637.30	9531.500	3675.400	1366.83	0.066440	1.88874	199.521	0.00	3823
TSEC	7226.5	7509.17	9973.120	3446.260	1506.02	-0.38	2.15849	206.097	0.00	3823

Table 2. Correlation Matrix

	BSE	BVSP	FTSE_100	Hangseng	JKSE	KSE	KSE (Korea)	MXX	NASDAQ	NIKKI	RTS	SSE	SSMI	TSEC
BSE	1.00	0.23	0.32	0.45	0.01	-0.02	-0.01	0.27	0.24	0.01	0.01	0.02	-0.02	-0.02
BVSP	0.23	1.00	0.45	0.29	0.01	0.00	-0.01	0.35	0.29	0.04	0.01	-0.01	0.01	0.03
FTSE_100	0.32	0.45	1.00	0.43	0.01	-0.01	0.00	0.38	0.42	0.02	-0.01	-0.01	-0.01	0.00
Hangseng	0.45	0.29	0.43	1.00	0.01	-0.01	-0.01	0.34	0.32	-0.01	-0.02	-0.01	0.00	0.02
JKSE	0.00	0.01	0.01	0.01	1.00	0.01	-0.02	0.01	0.01	-0.02	0.00	0.01	0.00	0.01
KSE	-0.02	0.00	-0.01	-0.01	0.01	1.00	0.59	-0.02	-0.01	0.00	0.45	-0.01	0.01	0.01
KSE (Korea)	-0.01	-0.01	0.00	-0.01	-0.02	0.59	1.00	-0.01	0.00	-0.01	0.44	0.00	0.04	0.01
MXX	0.27	0.35	0.38	0.34	0.01	-0.02	-0.01	1.00	0.63	0.03	0.00	0.00	-0.02	0.01
NASDAQ	0.24	0.29	0.42	0.32	0.01	-0.01	0.00	0.63	1.00	0.00	-0.01	0.01	-0.02	-0.03
NIKKI	0.01	0.04	0.02	-0.01	-0.02	0.00	-0.01	0.03	0.00	1.00	-0.07	0.00	0.01	-0.01
RTS	0.00	0.01	-0.01	-0.02	0.00	0.45	0.44	0.00	-0.01	-0.07	1.00	0.01	0.00	-0.01
SSE	0.02	-0.01	-0.01	-0.01	0.01	-0.01	0.00	0.00	0.01	0.00	0.01	1.00	0.02	-0.03
SSMI	-0.02	0.01	-0.01	0.00	0.00	0.01	0.04	-0.02	-0.02	0.01	0.00	0.02	1.00	0.01
TSEC	-0.02	0.03	0.00	0.02	0.01	0.01	0.01	0.01	-0.03	-0.01	-0.01	-0.03	0.01	1.00

correlation with rest of the markets. BVSP is somewhat positively correlated with FTSE-100 (0.45), MXX (0.35), NASDAQ (0.29), Hang Seng (0.29), and BSE (0.32). Moreover, BVAP is not correlated with rest of the markets significantly. FTSE- 100 is somewhat positively correlated with BVSE (0.45), Hang Seng (0.43), NASDAQ (0.42), MXX (0.38), and BSE (0.32). However, FTSE-100 is not much related with the rest of the markets. Hang Seng is somewhat positively correlated with the BSE (0.45), FTSE- 100 (0.43), MXX (0.34), NASDAQ (0.32), and BVSP (0.29) only. Five markets, namely, JKSE, Nikki, SSE, SSMI, and TSEC are not correlated with any of the markets. KSE is somewhat positively correlated with KSE (South Korea) and RTS only. MXX is somewhat positively correlated with NASDAQ (0.63), FTSE- 100 (0.38), BVSP (0.35), Hang Seng (0.34), and BSE (0.27). MXX does not have a significant correlation with the rest of the markets. NASDAQ is somewhat positively correlated with MXX (0.63), FTSE-100 (0.42), Hang Seng (0.32), BVSP (0.29), and BSE (0.24). NASDAQ is not related with any of the markets. RTS is related only with the KSE and KSE (South Korea). The correlation is a measurement of the comovement among the return of two securities or markets (Chandra, 2017). The market where the BSE has negative correlation or very less amount of correlation, investors can invest in that market in order to reduce the level of systematic risk.

(4) Unit Root Test : The ADF & PP tests are applied to check stationarity of data which is needed for conducting Granger causality and cointegration analysis. The study has tested the stationarity of all these series in E views 7 Econometric software. The results of unit root test are shown in the Table 3.

Here, each market is tested for stationarity using unit root test. H0 can be rejected at all the levels of 1%, 5%, & 10% with t - statistics value of -3.438, -2.864, and 2.568, respectively. It further reveals the non-stationarity of markets and indicates that further tests can be conducted on the data.

(5) Granger Causality Test : The Table 4 shows the results of Granger causality test. The Table 4 shows the results of Granger causality test for all the markets. From the results, it can be observed that BSE is dependent on BVSP,

Table 3. Unit Root Test

Stock Market	ADF Test	PP Test
BSE	-60.18 (0.0001)	-60.73 (0.0001)
BVSP	-60.44 (0.0001)	-60.69 (0.0001)
FTSE-100	-63.68 (0.0001)	-65.61 (0.0001)
Hangseng	-63.40 (0.0001)	-63.40 (0.0001)
MXX	-60.49 (0.0001)	-60.90 (0.0001)
NASDAQ	-65.28 (0.0001)	-65.91 (0.0001)
NIKKI	-64.10 (0.0001)	-64.20 (0.0001)
RTS	-42.39 (0.0001)	-42.13 (0.0001)
JKSE	-56.76 (0.0001)	-56.76 (0.0001)
KSE	-31.96 (0.0000)	-32.98 (0.0000)
KSE (Korea)	-34.64 (0.0000)	-34.57 (0.0000)
SSE	-59.50 (0.0001)	-59.54 (0.0001)
SSMI	-57.46 (0.0001)	-57.47 (0.0001)
TSEC	-57.01 (0.0001)	56.94 (0.0001)

Notes : The critical values of ADF and PP test are -3.438, -2.864 and 2.568 at 1%, 5%, and 10% significance levels, respectively.

Table 4. Granger Causality Test

Cause	BSE	BVSP	FTSE 100	Hang Seng	JKSE	KSE	KSE (Korea)	MXX	NASDAQ	NIKKI	RTS	SSE	SSMI	TSEC
Caused By														
BSE	---	3.981	0.2795	22.2173	0.4728	0.258	0.4002	4.5904	2.33315	0.1715	0.427	1.050	0.1168	0.4217
***p*-value**	---	0.0188	0.7529	0.003	0.6233	0.772	0.6702	0.0102	0.0972	0.8424	0.651	0.350	0.8897	0.6560
BVSP	38.52	---	44.583	146.642	0.165	0.022	0.189	167.70	80.5508	0.1863	0.313	0.452	1.1350	0.1550
***p*-value**	0.003	---	0.008	0.0001	0.8478	0.977	0.8275	0.0006	0.0008	0.2409	0.830	0.731	0.3215	0.8564
FTSE 100	16.90	6.3701	---	97.8956	0.6416	0.135	0.0798	32.304	37.6044	0.7776	0.041	1.238	0.6009	0.0931
***p*-value**	0.008	0.017	---	0.0016	0.5265	0.872	0.9223	0.0001	0.0001	0.4563	0.958	0.289	0.548	0.911
Hang Seng	25	8.0076	4.0841	---	0.2956	0.690	0.701	8.1554	6.39288	1.2203	0.224	0.244	2.5063	0.5605
***p*-value**	0.364	0.0003	0.0169	---	0.7441	0.501	0.4917	0.0000	0.0017	0.2953	0.798	0.783	0.081	0.571
JKSE	1.647	0.0057	0.0573	0.05498	---	2.256	2.968	0.8894	0.21888	1.8467	0.429	1.794	1.2340	0.4582
***p*-value**	0.192	0.9942	0.9443	0.9465	---	0.104	0.0516	0.411	0.8034	0.1579	0.650	0.166	0.2913	0.6324
KSE	1.633	5.8120	1.2841	1.31977	0.5589	---	0.004	1.3013	1.02737	0.7421	1.554	0.161	0.4576	3.0557
***p*-value**	0.195	0.0003	0.2779	0.2674	0.5719	---	0.995	0.2723	0.3581	0.4762	0.211	0.850	0.632	0.047
KSE (Korea)	2.385	0.5127	0.4920	0.65100	1.0428	1.143	---	0.0315	0.24248	0.8643	0.156	0.116	0.3196	0.9359
***p*-value**	0.092	0.5989	0.6119	0.5216	0.3526	0.318	---	0.9689	0.7847	0.4214	0.855	0.890	0.726	0.3923
MXX	38.16	2.3301	18.903	76.2833	0.1503	0.792	1.9648	---	7.22254	0.4673	0.548	1.562	0.287	1.1173
***p*-value**	0.040	0.0975	0.0007	0.0004	0.860	0.452	0.1404	---	0.0007	0.6267	0.578	0.209	0.750	0.327
NASDAQ	35.21	0.1955	18.077	75.6957	0.4456	0.349	0.5256	0.894	---	0.4655	0.548	1.507	1.8072	1.6414
***p*-value**	0.072	0.8224	0.0002	0.0000	0.640	0.753	0.5912	0.4091	---	0.6279	0.578	0.221	0.1643	0.1939
NIKKI	0.099	0.3754	2.8667	0.79826	3.6764	0.240	0.4071	0.1221	0.59093	---	0.903	0.086	0.048	0.4915
***p*-value**	0.905	0.6870	0.057	0.4502	0.0254	0.786	0.6656	0.885	0.5531	---	0.405	0.917	0.952	0.611
RTS	1.444	1.3974	1.9616	0.22605	1.4030	0.155	0.266	0.3326	0.59977	3.0121	---	0.074	1.6951	0.7401
***p*-value**	0.236	0.2474	0.1408	0.7977	0.2460	0.855	0.766	0.717	0.5940	0.0493	---	0.928	0.183	0.477
SSE	0.655	0.4225	0.3196	0.51492	3.8661	0.232	0.0583	0.288	0.06672	0.2990	1.071	---	0.4340	1.5410
***p*-value**	0.519	0.6554	0.7264	0.5976	0.0210	0.792	0.943	0.749	0.9355	0.7415	0.342	---	0.6479	0.2143
SSMI	1.157	0.9250	0.4028	0.57038	0.4709	0.246	1.2563	1.8591	1.17024	0.5098	2.70	0.052	---	1.0055
***p*-value**	0.314	0.3966	0.6684	0.5654	0.6245	0.781	0.284	0.156	0.3104	0.6004	0.066	0.949	---	0.366
TSEC	0.324	1.1839	0.5176	0.24607	1.2484	0.944	0.1330	0.2853	2.84491	2.2802	0.035	0.490	0.3514	---
***p*-value**	0.722	0.3062	0.596	0.7819	0.2871	0.389	0.875	0.751	0.0583	0.1024	0.964	0.612	0.7034	---

FTSE-100, and MXX only. BVSP depends only on BSE, FTSE-100, Hang Seng, and KSE only. FTSE 100 depends on BVSP, Hang Seng, MXX, and NASDAQ. Hang Seng is dependent upon BSE, BVSP, FTSE-100, MXX, and NASDAQ. JKSE is affected by only two markets, that is, Nikki and SSE. KSE, KSE (Korea), RTS, SSE, and SSMI are not dependent upon any of the markets. MXX is dependent on BSE, BVSP, FTSE-100, and Hang Seng only. NASDAQ is affected by BVSP, FTSE-100, Hang Seng, and MXX. Nikki is dependent only on RTS, and TSEC depends on KSE. Four markets, namely JKSE, KSE (Korea), SSMI, and TSEC are not dependent upon any of the selected markets. Among all the markets, BVSP & FTSE-100 are the most influential markets.

Granger causality indicates the short term integration of returns among the markets (Granger, 1969). It can be seen that BSE has short-term integration with BVSP, FTSE - 100, and MXX. So, the investor can make their investments in these markets and can get good returns in the short-term.

(6) Cointegration Test : The Table 5 shows the results of the cointegration test.Here, the H0 is $r = 0$ (there is no cointegration), which is rejected at the 5 % level as the trace statistics ($\lambda = 4690.89$) is more than the critical value ($\lambda = 342.45$). In the same line, for two or more co-integrations, in all the cases, the null hypotheses are rejected. It further reveals the existence of co-integration among all exchanges. The Johansen co-integration is concerned with long-term integration with reference to returns. The test reveals the existence of cointegration among all markets. So, the investors can invest in these markets for long-term duration as the returns of BSE is highly linked with these markets.

(7) Principal Component Analysis : Here, KMO value of 0.757 indicates 75.70% accuracy of sample against the required benchmark of 0.5, that is, 50% (Leech, Barrett, & Morgan, 2005). The KMO value of 0.757 falls in the range of 0.70 to 0.79, which is considered as middling for performing factor analysis (Hutcheson & Sofroniou, 1999).

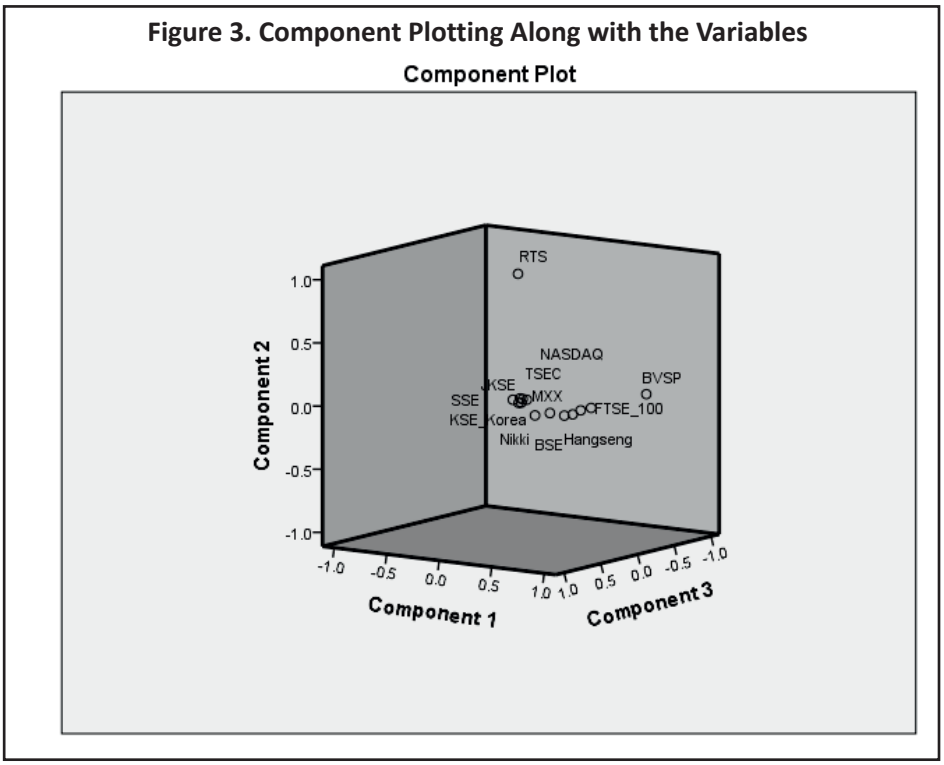
From the Figure 3, it can be inferred that the MXX, JKSE, KSE (Korea), BSE, FTSE-100, SSE, TSEC,

Table 5. Multivariate Cointegration Results (Johansen Test)

Hypothesized No. of CE	Eigen value	Trace Statistic (λ)	Critical Value 0.05	Prob.**
None ($r = 0$)	0.255352	4690.895	342.4562	0.9942
At most 1 ($r \leq 1$) *	0.242140	4173.151	340.7402	0.9998
At most 2 ($r \leq 2$) *	0.226323	3686.287	334.9837	1.0000
At most 3 ($r \leq 3$) *	0.203769	3235.696	285.1425	0.0000
At most 4 ($r \leq 4$) *	0.198383	2835.564	239.2354	1.0000
At most 5 ($r \leq 5$) *	0.196601	2447.270	197.3709	1.0000
At most 6 ($r \leq 6$) *	0.185136	2062.876	159.5297	1.0000
At most 7 ($r \leq 7$) *	0.180512	1703.363	125.6154	1.0000
At most 8 ($r \leq 8$) *	0.158836	1353.786	95.75366	1.0000
At most 9 ($r \leq 9$) *	0.149061	1050.055	69.81889	0.0001
At most 10 ($r \leq 10$) *	0.142563	766.6095	47.85613	0.0001
At most 11 ($r \leq 11$) *	0.127296	496.5237	29.79707	0.0001
At most 12 ($r \leq 12$) *	0.116810	257.4288	15.49471	0.0001
At most 13 ($r \leq 13$) *	0.022136	39.30711	3.841466	0.0000

**MacKinnon-Haug-Michelis (1999) *p* - values

Figure 3. Component Plotting Along with the Variables



NASDAQ, Nikki, Hang Seng represent the Component 1 ; whereas, RTS and BVSP returns represent the Component 2. Component 1 can be defined as Asian & North American stock markets and the Component 2 is defined as North Asian and South American Stock markets. The KSE and SSMI represent the Component 3.

Discussion and Conclusion

The study determines the comovements among selected markets and tries to ascertain the long run and short run relationship among all selected markets. BSE is not highly correlated with any of the markets. BSE remains somewhat positively correlated with Hang Seng (0.45), FTSE-100 (0.32), MXX (0.27), NASDAQ (0.24), and BVSP (0.23). BSE does not have a significant correlation with rest of the markets. Analysis on average of top rise and fall shows that the BVSP is the market with the highest daily rise of 14.71% ; whereas, RTS witnesses the highest daily fall of 13.40%. Unit root test reveals the non-stationarity of markets and indicates that further tests can be conducted on data.

The results of Granger causality test indicates that the return of BSE is dependent on BVSP, FTSE-100, and MXX only. BVSP depends only on BSE, FTSE-100, Hang Seng, and KSE only. FTSE 100 depends on BVSP, Hang Seng, MXX, and NASDAQ. Hang Seng is dependent on BSE, BVSP, FTSE-100, MXX, and NASDAQ. JKSE is affected by only two markets, that is, Nikki and SSE. KSE, KSE (South Korea), RTS, SSE, and SSMI are not dependent on any of the markets. MXX is dependent on BSE, BVSP, FTSE-100, and Hang Seng only. NASDAQ is affected by BVSP, FTSE-100, Hang Seng, and MXX. Nikki is dependent only on RTS, and TSEC depends on KSE.

Outcome of Johansen cointegration test indicates the existence of co-integration and long-term association between exchanges. The results of principal component analysis indicate that the markets are fragmented into two regions, namely, Asian & North American stock markets - Component 1 (MXX, JKSE, KSE (South Korea), BSE,

FTSE-100, SSE, TSEC, NASDAQ, Nikki, Hang seng) and the Component 2 as North Asian and South American Stock markets (RTS & BVSP). Overall, it can be concluded that the BSE is integrated with other markets in short-term and long-term. The result is in line with outcome of many studies conducted recently, such as the studies conducted by Mitra and Bhattacharjee (2015) ; Seth and Sharma (2015) ; Bhattacharjee and Swaminathan (2016) ; Shahzad, Kanwal, Ahmed, and Rehman (2016) ; and Vohra (2016). However, the results are contradictory to the outcomes obtained by Qadan and Yagil (2015).

Research Implications

From this present study, FIIs' (foreign institutional investor), individual investors, institutional investors, public investors, and HNIs (high net worth individual) will be benefited. All these stakeholders can take their decisions for their investments in the overseas markets by looking at the short-term and long-term integration of BSE with other selected markets. Moreover, FIIs, individual investors, institutional investors, public investors, and HNIs can reduce the risk of their investment portfolio by investing in the stock market of such a country which has negative or very less correlation and co-integration with BSE. It can help them to reduce the systematic risk of the portfolio. Further, the stock market is considered as a barometer of an economy. The BSE remains somewhat positively correlated with Hang Seng, FTSE-100, MXX, NASDAQ, and BVSP, which reveals the positive economic relations with these countries. In other words, the economic relations of India are positive with respect to Hong Kong, U.K., Mexico, US.A., and Brazil. So, investors can consider this aspect while making investments.

Limitations of the Study and Scope for Further Research

The present study covers the comovements and cointegration among the stock markets, but the interdependency among the markets is not covered. Further, the study has not covered the event specific integration and comovements. In future studies, the dependency of each market upon other markets can be studied using regression analysis. The analysis of dependency can help in making the investments in a better way. The effect of volatility of international markets on the BSE can also be measured by researchers in future studies.

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