CO-MOVEMENT OF INDICES: AN EMPIRICAL STUDY WITH REFERENCE TO BOMBAY STOCK EXCHANGE (BSE) AND NATIONAL STOCK EXCHANGE (NSE)

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Abstract: Capital market integration is the process by which capital markets are integrated with one another rather than segmented, leading to the convergence of market risk and price. The current study examines the co-movement between Bombay stock exchange (BSE) and National stock exchange (NSE). The study uses the daily closing price of major stock indices from 1st January 2007 to 31st December 2018. The research methodology tools include Augmented Dickey- Fuller (ADF) test and Phillips Perrson (PP) test for testing of stationarity and use of VAR (Value at Risk) techniques like Granger Causality test and Johansen and Juselius co-integration test in order to find the integration. The study found evidence for both the short-run and long-run relationship between the stock exchanges.

I. Introduction

Stock market in India is undergoing transformation with liberalization measures. The two most important stock exchanges of India are Bombay Stock Exchange (BSE) and National Stock Exchange (NSE). Bombay Stock Exchange was founded in 1875. It is Asia's first and the fastest stock exchange in the world with the speed of 6 micro seconds and one of India's leading exchange groups. Over the years BSE has facilitated the growth of the Indian corporate sector by providing an efficient capital-raising platform. BSE provides an efficient and transparent market for trading in equity, debt instruments, derivatives and mutual funds. BSE SME is India's largest SME platform which has listed over 250 companies and continues to grow at a steady pace. BSE StAR MF is India's largest online mutual fund platform which process over 27 lakh transactions per month and adds almost 2 lakh new SIPs ever month. BSE Bond, the transparent and efficient electronic book mechanism process for private placement of debt securities, is the market leader with more than Rs 2.09 lakh crore of fund raising from 530 issuances. BSE's popular equity index the S&P BSE SENSEX is India's most widely tracked stock market benchmark index. It is traded internationally on the EUREX as well as leading exchanges of the BRCS nations (Brazil, Russia, China and South Africa)

The National Stok Exchange of India Ltd. (NSE) is the leading stock exchange in India and the second largest in the world by number of trades in equity shares. National Stock Exchange is located in Mumbai. It came in to existence in 1992. NSE launched electronic screen-based trading in 1994, derivatives trading (in the form of index futures) and internet trading in 2000. NSE has a fully-integrated business model comprising our exchange listings, trading services, clearing and settlement services, indices, market data feeds, technology solutions and financial education offerings. NSE also oversees compliance by trading and clearing members and listed companies with the rules and regulations of the exchange. NSE is a pioneer in technology and ensures the reliability and performance of its systems through a culture of innovation and investment in technology. NSE believes that the scale and breadth of its products and services, sustained leadership positions across multiple asset classes in India and globally enable it to be highly reactive to market demands and changes and deliver innovation in both trading and non-trading businesses to provide high-quality data and services to market participants and clients.

Review of Literature

Various initiatives are taken by the government over the years for the development and growth of various financial markets in India especially the stock markets. These measures aim at integrating various financial markets in India. Several studies have been conducted to analyse the inter-linkages and integration of stock markets worldwide. The current study aims to analyse market integration between Bombay stock exchange and National stock exchange. In this section review of various studies is discussed to understand the methodologies and tools used to study the integration of stock markets.

Guidi and Ugur (2014) investigated the integration of South-Eastern European stock markets, namely, Bulgaria, Romania, Slovenia and Turkey, with developed countries namely, Germany, UK and USA. Using co-integration analysis this study found that the South-Eastern European markets are co-integrated with German and UK markets but no such evidence was noticed with the US stock markets during the period 2000-2013.

Dasgupta (2014) examined short-run and long-run integration and linkages of Indian stock markets with BRIC stock markets using Johansen co-integration test and Granger Causality test. The study found that Indian stock markets recorded co-movement with Brazilian, Russian and Chinese stock markets during the study period from January 2003 to December 2012.

Tripathi and Sethi (2012) examined the short-run and long-run inter-linkages of the Indian stock market with emerging markets namely, Brazil, Hungary, Taiwan, Mexico, Poland and South Africa over the period from 1st January 1992 to 31st December 2009 using Johansen co-integration test and Granger causality test. Analysis revealed short-run and long-run inter-linkages of the Indian stock market with these markets.

Naranyan et al. (2004) examined the linkage between the stock markets of Bangladesh, India, Pakistan and Sri Lanka and found that unidirectional Granger causality running from stock prices in Pakistan to India, Sri Lanka to India and from Pakistan to Sri Lanka in the short run.

Golaka et al. (2003) examined the interdependence of the three major stock markets in South Asia. The results of the study revealed that no co-integration was found for the entire period which leads one to conclude that there is no long-run equilibrium relationship among India, Singapore and Taiwan.

Mukhopadyay (2002) empirically investigated the short-run co-movement of US and Indian stock markets during the period from 1999 to 2001 by applying Granger causality test. They supported a unidirectional granger causality running from the US stock market to the Indian stock market.

Research Design

The present study is based on the secondary data related to daily closing values of Bombay stock exchange and National stock exchange over the period from 1st January 2007 to 31st December 2018. In addition to this other relevant information has been collected from various published reports, books, periodicals and websites. The present study analyses the co-movement of indices of Bombay stock exchange and National stock exchange by testing the stationarity of the data using unit root tests namely Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test. Long-term and short-term relationships among the indices have been found out with Johansen and Juselius co-integration test and Granger Causality test respectively.

Objectives of the Study

The primary objective of the study is to investigate the short-run and long-run linkage between BSE and NSE.

The following secondary objectives are formulated to realize the primary objective.

1. To examine whether the stock indexes are normally distributed.
2. To evaluate whether the stock indexes are stationary.
3. To examine the volatility of stock index.
4. To find the short-run and long-run co-movement among BSE and NSE stock index.

Empirical Analysis

To analyse the stationarity property of all the variables used in the study Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test are used. All the tests have been conducted with constant, with constant and trend and without constant and trend. Integration between Bombay stock exchange and National stock exchange is explained here with the help of Johansen Co-integration technique. Hence it is a necessary condition that the variables under study should not be integrated of order zero i.e., I(0). At the same time, it should be of the same order as variables of same order only can co-integrate each other.

Descriptive statistics of stock market indices are presented in Table 1. Standard deviation of S&P BSE SENSEX is highest, thus showing highest volatility during the period of the study followed by S&P BSE 500, NIFTY 100, S&P BSE 100, NIFTY, NIFTY 500, NIFTY 200 and S&P BSE 200.

Table 1 Descriptive Statistics

	NIFTY	NIFTY 100	NIFTY 200	NIFTY 500	S&P BSE 100	S&P BSE 200	S&P BSE 500	S&P BSE SENSEX
Mean	6597.35	6600.06	3446.29	5460.86	6718.19	2762.23	8685.51	21816.91
Median	5904.10	5808.15	3005.65	4688.00	5955.96	2406.89	7492.41	19602.23
Maximum	11738.5	12028.30	6244.40	9992.00	12035.70	5043.26	15846.20	38896.63
Minimum	2524.20	2388.60	1258.07	1966.85	2413.05	963.41	2983.02	8160.40
Standard Deviation	2162.84	2319.97	1195.12	1961.74	2262.42	973	3085.65	6958.98
Observations	2973	2973	2973	2973	2973	2973	2973	2973

Chart 1 Chart showing various stock index

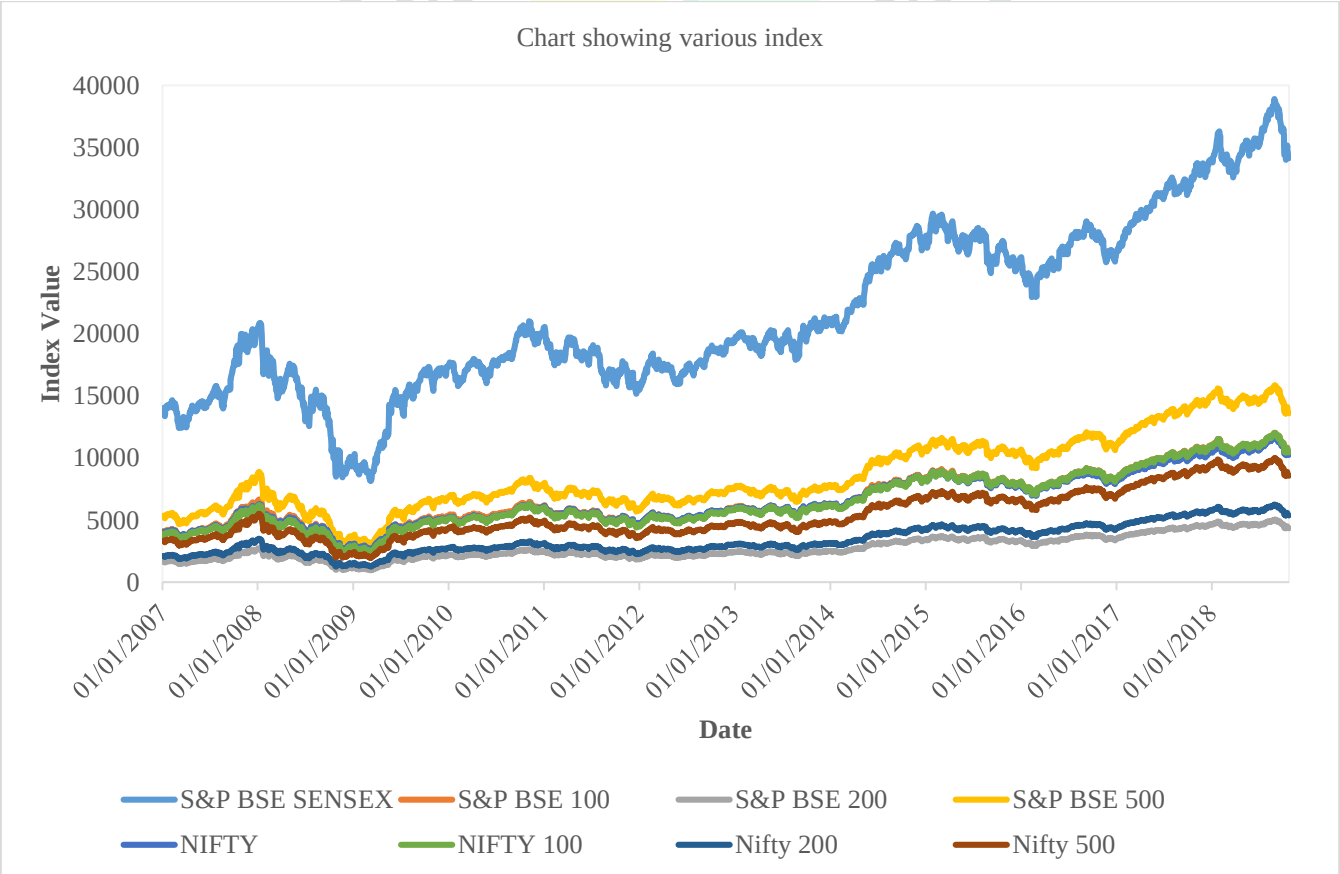

Table 2 & 3 carry the required statistics of Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test for the variables on both level and first difference. ADF and PP unit root tests are carried out with constant, with constant and trend and without constant and trend at level and first difference. Stock market indices when measured in level are not stationary as the value of the test statistics of both ADF and PP unit root test are not significant. But when these variables are tested in first difference, it is evident that both ADF and PP unit root test statistics are negative and statistically significant at 1% level.

Table 2 Table showing Unit Root test results at level

		Augmented Dickey-Fuller Test			Phillips-Perron Test		
Included in Test Equation		**Constant**	**Constant & Trend**	**None**	**Constant**	**Constant & Trend**	**None**
NIFTY	**Test Statistic**	-0.427	-2.571	1.341	-0.343	-2.450	1.459
	Probability*	0.902	0.294	0.955	0.916	0.354	0.965
NIFTY 100	**Test Statistic**	-0.339	-2.446	1.424	-0.256	-2.330	1.546
	Probability*	0.917	0.355	0.962	0.929	0.417	0.971
NIFTY 200	**Test Statistic**	-0.387	-2.327	1.320	-0.352	-2.117	1.373
	Probability*	0.909	0.419	0.953	0.915	0.535	0.958
NIFTY 500	**Test Statistic**	-0.343	-2.254	1.345	-0.258	-2.133	1.423
	Probability*	0.916	0.459	0.956	0.928	0.526	0.962
S&P BSE 100	**Test Statistic**	-0.413	-2.445	1.319	-0.330	-2.362	1.432
	Probability*	0.905	0.356	0.953	0.918	0.399	0.963
S&P BSE 200	**Test Statistic**	-0.334	-2.314	1.376	-0.284	-2.258	1.450
	Probability*	0.918	0.426	0.958	0.925	0.456	0.964
S&P BSE 500	**Test Statistic**	-0.357	-2.236	1.330	-0.186	-2.155	1.568
	Probability*	0.914	0.469	0.954	0.938	0.514	0.972
S&P BSE SENSEX	**Test Statistic**	-0.355	-2.534	1.336	-0.252	-2.394	1.466
	Probability*	0.914	0.311	0.955	0.929	0.383	0.965
Test critical values	**1% level**	-3.432	-3.961	-2.566	-3.432	-3.961	-2.566
	5% level	-2.862	-3.411	-1.941	-2.862	-3.411	-1.941
	10% level	-2.567	-3.128	-1.617	-2.567	-3.128	-1.617
*MacKinnon (1996) one-sided p-values.							

Table 3 Table showing Unit Root test results at level

		Augmented Dickey-Fuller Test			Phillips-Perron Test		
Included in Test Equation		Constant	Constant & Trend	None	Constant	Constant & Trend	None
NIFTY	Test Statistic	-50.993	-50.992	-50.957	-50.888	-50.886	-50.857
	Probability*	0.000	0.000	0.000	0.000	0.000	0.000
NIFTY 100	Test Statistic	-50.406	-50.406	-50.366	-50.281	-50.279	-50.247
	Probability*	0.000	0.000	0.000	0.000	0.000	0.000
NIFTY 200	Test Statistic	-49.529	-49.529	-49.494	-49.397	-49.396	-49.386
	Probability*	0.000	0.000	0.000	0.000	0.000	0.000
NIFTY 500	Test Statistic	-49.023	-49.024	-48.987	-48.916	-48.895	-48.941
	Probability*	0.000	0.000	0.000	0.000	0.000	0.000
S&P BSE 100	Test Statistic	-49.863	-49.863	-49.828	-49.724	-49.722	-49.689
	Probability*	0.000	0.000	0.000	0.000	0.000	0.000
S&P BSE 200	Test Statistic	-49.369	-49.370	-49.332	-49.223	-49.225	-49.201
	Probability*	0.000	0.000	0.000	0.000	0.000	0.000
S&P BSE 500	Test Statistic	-48.733	-48.734	-48.697	-48.631	-48.630	-48.659
	Probability*	0.000	0.000	0.000	0.000	0.000	0.000
S&P BSE SENSEX	Test Statistic	-50.604	-50.606	-50.570	-50.477	-50.477	-50.444
	Probability*	0.000	0.000	0.000	0.000	0.000	0.000
Test critical values	1% level	-3.432	-3.961	-2.566	-3.432	-3.961	-2.566
	5% level	-2.862	-3.411	-1.941	-2.862	-3.411	-1.941
	10% level	-2.567	-3.128	-1.617	-2.567	-3.128	-1.617
*MacKinnon (1996) one-sided p-values.							

Johansen co-integration model was adopted to test the long run relationship between the Bombay stock exchange and National stock exchange. Co-integration is a property of two or more variables moving together through time, and despite following their own individual trends will not drift too far apart since they are linked together in some sense. It consists of two test statistics, one is trace statistics and the other one is Maximum Eigen value statistics. The results are shown in table 4.

First part of the co-integration results, the trace test, indicating that there exist two co-integrating vectors at 5% level. Second part of the co-integration results, the Maximum Eigenvalue test, also indicates the same result. Therefore, both tests indicate that both the Bombay stock exchange and National stock exchange are integrated, that is, they are trending together which may indicate the fact that assets allocation across the markets may not provide enough opportunities of diversification gains.

Table 4 Table showing Johansen Co-integration test results

Lags interval (in first differences): 1 to 4				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**Critical Value (0.05)**	**Probability****
None *	0.0215	192.8773	159.5297	0.0002
At most 1 *	0.0156	128.3575	125.6154	0.0337
At most 2	0.0098	81.6955	95.7537	0.3103
At most 3	0.0080	52.4071	69.8189	0.5314
At most 4	0.0061	28.6375	47.8561	0.7853
At most 5	0.0021	10.4660	29.7971	0.9726
At most 6	0.0014	4.1790	15.4947	0.8886
At most 7	0.0000	0.0215	3.8415	0.8834
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Lags interval (in first differences): 1 to 4				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**Critical Value (0.05)**	**Probability****
None *	0.0215	64.5198	52.3626	0.0019
At most 1 *	0.0156	46.6620	46.2314	0.0449
At most 2	0.0098	29.2884	40.0776	0.4715
At most 3	0.0080	23.7696	33.8769	0.4725
At most 4	0.0061	18.1714	27.5843	0.4809
At most 5	0.0021	6.2871	21.1316	0.9765
At most 6	0.0014	4.1575	14.2646	0.8424
At most 7	0.0000	0.0215	3.8415	0.8834
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Having done the co-integration test, there is need to capture the degree and direction of correlation among the stock indices under study. Pair-wise Granger Causality study is conducted to understand this. Granger Causality test examines whether lagged values of one series have significant explanatory power for another series. It has null hypothesis of no granger causality. Granger causality test results are summarized in table 4 and it indicates whether there exists significant granger causality and if it exists then in which direction such causality exists among various stock indices.

It can be inferred that S&P BSE SENSEX plays a dominant role among the indices selected for the study from Bombay stock exchange and National stock exchange. At times, pair-wise causality is running both the ways. It is interesting to note that there exists bi-directional granger causality between Nifty and S&P BSE SENSEX, NIFTY 100 and S&P BSE SENSEX, NIFTY 200 and S&P BSE SENSEX, S&P BSE 100 and S&P BSE SENSEX, NIFTY 100 and S&P BSE 100, and NIFTY 200 and S&P BSE 200. Nifty 500 and S&P BSE 200 granger cause S&P BSE SENSEX and not caused in return. S&P BSE 200 granger cause NIFTY 200 and S&P BSE 500 granger cause NIFTY 500.

Table 5 Table showing Granger Causality test results

Variables	NIFTY	NIFTY 100	NIFTY 200	NIFTY 500	S&P BSE 100	S&P BSE 200	S&P BSE 500	S&P BSE SENSEX
NIFTY		-	-	-	-	-	-	↔
NIFTY 100			-	-	↔	-	-	↔
NIFTY 200				-	↔	←	-	↔
NIFTY 500					-	-	←	→
S&P BSE 100						-	-	↔
S&P BSE 200							-	→
S&P BSE 500								-
S&P BSE SENSEX								

Note: → denotes Granger Causality, running from one side to another, whereas ↔ means Causality from both side and - is for no causality.

Conclusion

This study empirically investigates the long run and short run relationship between the Bombay stock exchange and National stock exchange using multivariate Johansen co-integration test and Granger causality test. As a first step stationarity of the indices are tested using Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test. It is found that the selected indices are stationary at level and non-stationary at first difference and it is concluded that the indices are integrated of order I(1). Further the application of Johansen co-integration test and Granger causality test shows that these two markets have both the long run and short run relationship.

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