A study on cointegration between indian and american stock markets

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ABSTRACT

The process of globalization has had a deep impact of the financial markets worldwide. With the liberalization of the Indian capital markets and relaxation of restrictions on international flow of capital and trade, it is likely to expect the Indian stock market to be integrated with other world markets. The recent policies of our government have given way to many foreign institutional investors to invest in our stock markets. These policy changes and initiatives would definitely have a profound impact on behavior of stock markets. The present study aims to test whether the Indian stock market is interdependent on the American Stock Markets. The New York Stock Exchange is the largest stock exchange in the world in terms of Market Capitalization. Many Indian companies have listed their companies' shares in America. Hence the extent of cointegration between the major Indian stock exchanges with the leading stock markets of America like NYSE, S&P500 and the NASDAQ is tested using the Engle Grangler test of Cointegration. The data is collected for the time period Jan 1st 2000 to 31st Dec 2008. Such studies will be helpful to understand the extent of dependence of the Indian capital market with developed markets of the world and will serve as a useful benchmark to understand the status of Indian capital market in the current scenario.

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Introduction

The linkages between the stock markets of the world are increasing over the years due the effect of globalization. The speed of Global integration – the intensification of international economic linkages among nations is high and is bound to increase in the coming years. Internationalization of trade and finance, interdependence among countries and policy changes among nations to suit the world order is the norm of the day. The process of internationalization results in a greater stock of foreign factors of production within countries inviting more foreign investment, technology and technology experts. The financial markets around the world have expanded beyond boundaries with money moving from one country to another in form of loans, FDI, foreign currency markets etc. The international linkage of national money and capital markets has also grown rapidly with the removal or relaxation of restrictions on financial flows across national borders, deregulation of financial institutions and international financial innovations. Technological growth has made a great impact on the growth and development of the markets, where an investor can view the prices of currencies and stock prices twenty four hours a day. Tremendous changes have taken place in the way companies operate due to pressures from global competition. Companies world wide are consolidating their operations, moving to other countries to find and tap new markets, or to achieve economies of scale. The term stock market cointegration in this study refers to identifying the presence of long term dependencies across two stock markets.

Stock market cointegration

The present study tries to examine the cointegration of the Indian stock market in recent years, with the major stock markets in the US which is said to be one of the developed and sophisticated markets in the world. The study of the existence of interlinkages among international capital markets has serious implications on determining the extent of portfolio diversification as well as macroeconomic policies of individual countries. Investors prefer to hold securities from a variety of firms because such diversification reduces portfolio risk, similarly, investors who buy shares in foreign as well as domestic companies seek to avoid some market risk and earn returns through global diversification. Diversification is rewarding since stock indices of different countries are affected by different factors and hence need not always move in the same direction, or be perfectly correlated. In the recent years we can see that capital markets in Asia have become the main destination for many investors to invest their money. International capital market relationships, not only have implications for portfolio diversification, but also have important implications on how economic policy changes can be initiated at the national level

for different countries which will have a bearing on foreign trade and there by the foreign exchanges balances of a country.

In a country like India, where the stock market is undergoing significant transformation with the liberalization measures, there are also concerns regarding its exposure to risk in case of a global/ regional crisis, i.e. a need to know how far a depression or crisis in another market can affect the Indian stock market in a more and more globally integrated environment. Hence, the analysis of the nature of co- movements or long term dependencies with other developed and regional emerging markets would not only give an idea of the of possible gains out of portfolio diversification to be reaped from the Indian market but also may give some indication of the vulnerability of the country's stock market in case of a regional crisis.

The liberalization of Indian capital market has led to more integration of Indian markets with other stock markets of the world. We see money moving in and out of our markets through various options like FII's and Depository receipts. In the present study, we try to determine the degree to which there is integration between the Indian stock market and American stock markets. Since Indian capital markets are one among the emerging stock markets of the world, there is enough curiosity among researchers to identify the extent of its cointegration with other leading stock markets of the world. Investments through the FII route is a key integrating factor for markets as the flow of funds into the market depends on the foreign institutional investors' perception about the domestic stock market and about alternative markets, at different points of time. It is this shifting of funds between foreign markets that leads to a kind of long term relationship among markets.

Objectives of the study

The objective of the study is to find out the cointegration between Indian and American stock markets using the Engle Granger Test of Cointegration.

Review of past studies

With the liberalization of Indian capital markets, there have been significant amount of research carried out to determine the extent of dependence of Indian capital market with its global counter parts. For the last two or three decades, researchers worldwide have shown interest in studying the dependence of various stock markets. The review of the past studies shows that the presence or absence of cointegration can throw meaningful insight into the working and policies of a particular stock exchange. Few of the research articles reviewed for the study are listed below. ***David (1994)*** in his working paper studied the market linkages using Cointegration rank test with

special application to the US Natural Gas Industry. Likelihood based tests for cointegration was applied to data from natural gas spot markets. The Johansen method was used to study the spatial market linkages. The results indicated that the natural gas spot markets at dispersed locations in the pipeline network are strongly connected. Out of 19 market pairs examined, most of the market pairs (13) satisfied a more stringent condition for perfect market integration. ***Chan, Benton and Min (1997)*** conducted a study on integration of stock markets by including 18 nations covering a 32 year period. These markets were analyzed both separately and collectively in regions to test for the weak form market efficiency. The cross country market efficiency is tested by using Johansen's cointegration test. The results showed that only small number of stock markets shown evidence of cointegration with others. ***Bala and Mukund (2001)*** in their study examined the nature and extent of linkage between the US and the Indian stock markets. They used the theory of cointegration to study the interdependence between the Bombay stock exchange (BSE), the NYSE and NASDAQ. The data consisted of daily closing prices for the three indices from January 1991 through December 1999. The results supported that the Indian stock market was not affected by the movements in US markets for the entire sample period. ***Wong, Agarwal and Du Jun (2004)*** have empirically investigated the long-run equilibrium relationship and short-run dynamic linkage between the Indian stock market and the stock markets in major developed countries by examining the Granger causality relationship and the pair-wise, multiple and fractional cointegrations between the Indian stock market and the developed stock markets such as US, UK and Japan. The findings of the study revealed that the Indian stock market is statistically, significantly co-integrated with stock markets of United States, United Kingdom and Japan. There is existence of a unidirectional granger causality running from the US, UK and Japanese stock markets to the Indian stock markets. Indian stock index and the mature stock indices form fractionally cointegrated relationship in the long run with a common fractional, nonstationary component and revealed the cointegration relationship using the Johansen method.

In the recent times the Indian stock market has become more open to the rest of the world and, the relationship between the Indian market and the developed stock markets may keep changing. Hence the current study tries to re-examine the nature of co-movement between Indian market and the American markets.

Data & Timeline

The daily stock index returns of Indian and American markets are chosen for the study. The daily stock index returns of BSE (India) and NASDAQ, S&P500 are obtained from their respective websites. The analysis and the interpretation performed in this study are for a period of 9 years starting from January 1st 2000-December 31st 2008.

Methodology

The relative strength of linear relationship is measured by the **Correlation coefficient.** The **Engle Granger Test of Cointegration** is used to test the stock market relationships of various stock markets.

Test of cointegration

Cointegration is a relatively new concept introduced by Granger (1983) and Engle and Granger (1987). Two variables are said to be cointegrated when a linear combination of the two variables is stationary implying that there is a long term relationship existing between them. Lack of cointegration suggests that no such relationship exists.

Null Hypothesis: There is no linear dependence among the indices of the Bombay Stock Exchange and the S&P500 - AMERICAN stock exchange.

Alternate Hypothesis: There is linear dependence among the indices of the Bombay Stock Exchange and the S&P500 AMERICAN stock exchange.

Null Hypothesis: There is no linear dependence among the indices of the Bombay Stock Exchange and the NASDAQ-AMERICAN stock exchange.

Alternate Hypothesis: There is linear dependence among the indices of the Bombay Stock Exchange and the NASDAQ-AMERICAN stock exchange.

Testing for cointegration involves testing the residuals from an Ordinary Least Square regression for the time series (BSE & NASDAQ) and residuals are obtained.

$$Y_t = ß_0 + ß_1 x_t + ß_2 z_t + \varepsilon \qquad (1)$$

Regress y on x and z. The residuals are obtained from the Ordinary least square and a Dicky fuller unit root test is carried out to check for unit root. If a unit root is not present the residuals are stationary and the variables are cointegrated.

The first difference of the residuals ΔY_t is regressed against the first lag of the residual

Y_{t-1} and sufficient lags of Y_t.

$$\Delta Y_t = (Y_t - Y_{t-1}) = u_t \qquad (2)$$

The results of the unit root test, t-statistics has to be compared with specially calculated critical values. If the estimated **| |** exceeds any of these critical values the null hypothesis that there is no cointegration among the variables can be rejected. Else accept the null hypothesis.

For example, the daily closing index values of BSE (India) and NASDAQ composite index (US) are taken to see whether there is any relationship between the Indian stock market and the US markets. The Engle Granger test of Cointegration is applied and **t** values are estimated. In the given situation the estimated EG DF statistic is –1.0636. The Engle-Granger 1%, 5% and 10% critical values are -2.5899, -1.9439, and -1.6177. Since the EG DF statistic is found to be less than the critical value specified by Engle and Granger, the Null Hypothesis that there is no dependence between the US stock markets and the Indian stock markets is accepted.

Analysis and intepretation

The test of cointegration is applied to the BSE SENSEX and the top American stock indices like the S&P 500 and NASDAQ. The results are tabulated.

Table 1. showing Engle Granger Test of Cointegration between NASDAQ-BSE

Index	X variable	Standard error	Test T statistic CR DF	1% EG critical value	5% EG critical value	10% EG critical value
				-2.5899	-1.9439	-1.6177
BSE-NASDAQ	-0.0040	0.0038	-1.0636	ACCEPT	ACCEPT	ACCEPT

Null Hypothesis (H_0) : There is no linear dependence between the indices of the BSE-NASDAQ stock exchanges.

Alternate Hypothesis (H_1): There is linear dependence between the indices of the BSE- NASDAQ stock exchanges.

The daily closing index values of BSE (India) and NASDAQ (AMERICAN) are taken to see whether there is any relationship between the Indian stock market and the American markets. The Engle Granger test of Cointegration is applied and **t** values are estimated. The critical value for Engle-Granger statistics at 1%, 5% and 10% are -2.5899, -1.9439, and -1.6177 respectively.

For the BSE-NASDAQ stock indices the estimated EG DF (Engle-Grange, Dicky-Fuller) test statistic is -1.0636. Since the EG DF statistic is found to be lesser than the critical value specified by Engle and Granger statistics at all levels, the Null Hypothesis that there is no dependency is accepted. We recognize the view that there is no dependence between the American stock markets and the Indian stock markets. Chart 1 depicts the comovement of index values of BSE and NASDAQ during the period of study.

Chart -1 BSE - NASDAQ

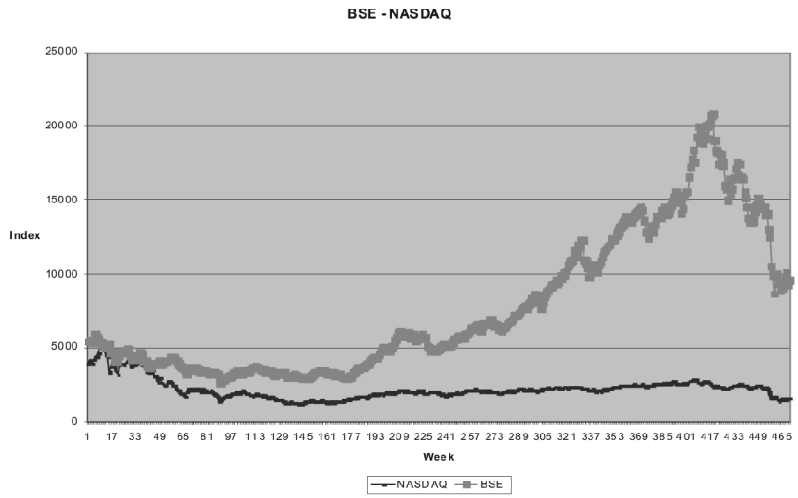


Table 2. Showing Engle Granger Test of Cointegration between S&P500 -BSE

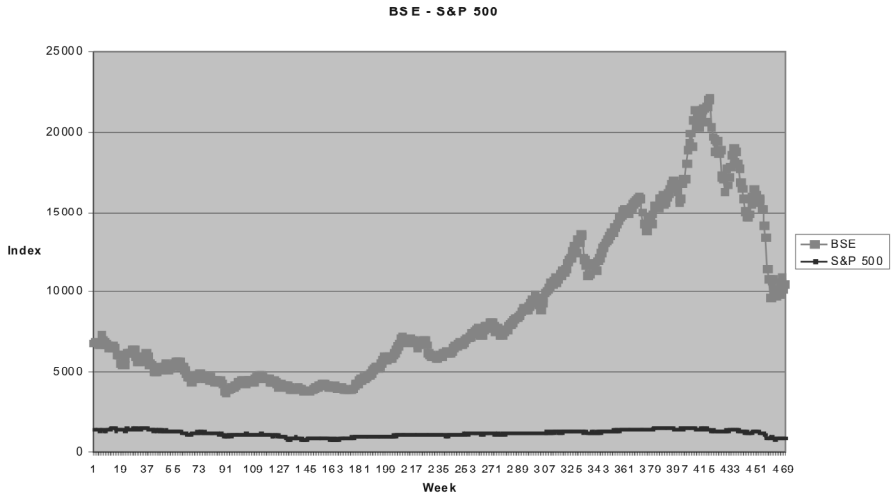
Index	X variable	Standard error	Test T statistic CR DF	1% EG critical value	5% EG critical value	10% EG critical value
				-2.5899	-1.9439	-1.6177
BSE-S&P500	-0.0109	0.0070	-1.5483	ACCEPT	ACCEPT	ACCEPT

Null Hypothesis (H_0): There is no linear dependence between the indices of the BSE-S&P 500 (American) stock exchanges.

Alternate Hypothesis (H_1): There is linear dependence between the indices of the BSE- S&P 500 (American) stock exchanges.

The daily closing index values of BSE (India) and S&P 500 (AMERICAN) are taken to see whether there is any relationship between the Indian stock market and the American markets. The Engle Granger test of Cointegration is applied and **t** values are estimated. The critical value for Engle-Granger statistics at 1%, 5% and 10% are -2.5899, -1.9439, and -1.6177 respectively.

For the BSE-S&P 500 stock indices the estimated EG DF (Engle-Granger, Dicky-Fuller) test statistic is -1.5483. Since the EG DF statistic is found to be lesser than the critical value specified by Engle and Granger statistics at all levels, the Null Hypothesis that there is no dependency is accepted. We recognize the view that there is no dependence between the American stock markets and the Indian stock markets. Chart 2 depicts the comovement of index values of BSE and S&P 500 during the period of study.



Consolidated Results of Engle Granger Test of Cointegration

Sl. No	Index	**Correlation Coefficient**	**Test T statistic CR DF**	1%	5%	10%	**Result**
				EG critical value	EG critical value	EG critical value	
				-2.5899	**-1.9439**	**-1.6177**	
1	BSE-NASDAQ	**0.206**	-1.0636	ACCEPT	ACCEPT	ACCEPT	No Cointegration
2	BSE-S & P500	**0.5857**	-1.5483	ACCEPT	ACCEPT	ACCEPT	No Cointegration

The consolidated results of the Engle Granger test show no cointegration between the BSE-NASDAQ and BSE-S&P 500. S&P 500 index represents fairly all top companies from various industries while NASDAQ constitutes the technology companies. The correlation coefficient between the two indices also shows low level of correlation over the years. The results show empirical evidence of lack of cointegration or long term dependencies between the Indian and American stock markets.

Conclusion

The cointegration of Indian equity markets with the American markets has been studied using the Engle Granger test of cointegration. This study has focused on Indian equity market's dependency with the developed market like the American stock markets. The stock index values (closing prices) are obtained for the BSE and the top American stock markets and the Engle Granger test of Cointegration is used to examine the interdependence among these stock markets. Interdependence/dependence was examined for the period January 1st 2000 – Dec 31st 2008. During the period of study the results of the test show that the Indian Stock Market shows no dependence with the NASDAQ and the S&P 500 confirming the absence of cointegration between the Indian and American Stock markets.

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