FINANCE INDIA

VOL XXXII NO. 3 SEPTEMBER 2018 ISSN 0970 - 3772

The quarterly journal of Indian Institute of Finance

FINANCE INDIA
© Indian Institute of Finance
Vol. XXXII No. 3, September 2018
Pages – 805 – 814

A Study on Cointegration between Indian and Chinese Stock Markets

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Abstract

The objective of this study is to analyze the connections that exist amongst the Indian & the Chinese Stock Markets. To find the presence & the extent of co movement, Cointegration analysis of Indian and the Chinese stock markets has been made over 15 years time period using Johansen test of Cointegration. The results of the study reveal that there exists long causality amongst the two stock markets. As regards the short run causality, Chinese stock market affect the Indian stock market in short run but this is not the case with the Indian stock market. Thus, there is long run bidirectional causality between the two markets but unidirectional short run causality. In case of disequilibrium, Chinese markets adjust faster towards equilibrium. For an investor, the study has provided useful insight for investment. The result of the study reveal the fact that an investor will not likely get any benefit of diversifying portfolio between the two stock markets since the two markets show evidence of moving in the same direction in long run.

I. Introduction

WITH GLOBALIZATION AND Liberalization of restrictions on international flow of capital and trade, Indian market is expected to be more integrated with other stock markets of the world. Liberalization and Globalization and the development in information technology has paved the way for more trade and inflow of foreign capital into the country. The world has become a global village. Economic linkages have intensified. Any happening in one part of the world influences the part either directly or indirectly. This paper aims to contribute to our understanding of the globalization and integration of two developing Asian stocks markets namely India and China.

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Submitted November 2015; *Accepted* August 2017

India and china both are key developing markets. India and China have been named as the most promising emerging markets due to their sustained and rapid economic growth in the past two decades. During this period the trade volume capital flows and mutual investments among the two countries have also increased rapidly. After the halt of trading relations between the two nations because of war in 1962, trading activity resumed in 90's as there was a wave of liberalization and globalization all around. Since 2000, trade between China and India has grown nearly twice as fast as each country's trade with the rest of the world. India is china's one of the largest trade partner. Therefore, it is of great academic and practical importance to understand the links between these crucial global markets.

Stock markets serve as economic barometers. To study the relationship between the two economies, the relationship between the stock markets can be studied as a proxy. Stock markets facilitate direct financing. Movements in stock markets appear to reflect not only domestic economic conditions but also the level of confidence that domestic and foreign investors have in an economy. This study by testing if there is any co-movement of Indian and Chinese stock markets, will provide an insight as to whether the investor could benefit by diversifying his portfolio between the two markets or not.

Diversification is a strategy which helps in minimizing risks. Diversification minimizes risk since stock indices of different countries are affected by different factors and hence need not always move in the same direction. 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 possible gains out of diversification but also give indication of the vulnerability of the country's stock market to the happening in other countries.

As the level of international stock market Cointegration increases, the benefit of diversification falls. Furthermore, Markowitz portfolio theory proposes that risk is minimized when there is a low correlation between assets.

A lot of studies have been made to study Cointegration between various stock markets. Many of the studies relating to the cointegration of emerging markets to the larger established markets have found possible diversification benefits while other studies have found a high degree of cointegration, indicating that long-term diversification is not likely to be beneficial. All of the studies we have examined do agree that cointegration is a good parameter to determine possible co-movements between equity markets, with the most popular process undoubtedly being Johansen's methods. (Maggiora and Spring, 2009).

The present study attempts to empirically analyze the connections that exist amongst the stock markets of the two Asian countries i.e. Indian and the Chinese Stock Markets. To find the presence and the extent of co-movement, cointegration analysis of Indian stock markets and the Chinese

stock market has been made over 15 years time periods. The results of the study will aid us to gain insight on the benefits of diversifying the portfolio between Indian and Chinese stock markets and will also help in knowing the status of the Indian capital market in the current scenario.

II. The Study : Objectives, Literaure Review and Methodology

2.1 *Objectives of the Study*

The main objective of the study is to find out the cointegration between Indian and Chinese stock markets using the Johansen Test of Cointegration.

2.2 *Literature Review*

Few of the research articles reviewed for the study are listed below:

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 (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 and the pair-wise, multiple and fractional cointegrations between the Indian stock market and US, UK and Japan stock markets. 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.

Nath and Samanta (2003) examine the dynamic linkages between the foreign exchange and stock markets for India. The results showed that generally returns in these two markets are not inter-related, though in recent years, the return in stock market had causal influence on return in exchange rate with possibility of mild influence in reverse direction.

Chen, Lobo and Wong(2006), examined bilateral relations between three pairs of stock markets India- US, India–China and China–US by using fractionally integrated vector error correction model (FIVECM) to examine Cointegration mechanism. The found that all the three pairs of stock markets are fractionally cointegrated. The US stock markets play a dominant role in the relations with the other two markets whereas, there is an interactive relationship between the Indian and Chinese stock markets.

Subha and Nambi (2010), tested the extent of cointegration between the major Indian stock exchanges with the leading stock markets of America like NYSE, SandP500 and the NASDAQ using the Engle Granger test of Cointegration. The data has been collected for the time span of 8 years starting from 1st January 2000 to 31st December 2008. The study found that

the Indian Stock Market has no dependence with the NASDAQ and the SandP 500 confirming the absence of cointegration between the Indian and American Stock markets

Joshi (2013), tried to explore the dynamics of co movement of stock markets of USA ,Brazil, Mexico, China and India during the period from January, 1996 to July, 2007 using the Johansen and Juselius multivariate cointegration and VECM model using daily closing price data. It attempts to analyze the speed of adjustment coefficients using daily, weekly and monthly data. It also tries to examine the efficiency of the stock market as a result of initiatives and regulatory measures taken by NSE and SEBI respectively. The analysis reveals that there is an evidence of cointegration among the markets demonstrating that stock prices in the countries studied here share a common trend. The results reveal that the speed of adjustment of Indian stock market is higher than other stock markets of the world.

Srikanth and Aparna (2012), studied the degree of Indian stock market integration with other stock markets. In this study, month-wise average prices of BSE-Sensex, NYSE, NASDAQ, SandP500, HangSeng, Nikkei225, SSE Composite index and FTSE100 have been selected. Multiple Correlations has been computed for the select stock market indices. Statistical Significance of the correlation has been tested by applying correlation t-test. The results of these studies support the view that there is a substantial integration between domestic and international financial markets. BSE-Sensex has witnessed greater fluctuations which has been indicated by very high Coefficient of variation compared to other select indices. Sensex, the Indian bench market index, has shown strong association with NYSE and Hang Seng. Chinese stock index i.e., SSE Composite index has exhibited strong correlation with BSE- Sensex and with Hang Seng. Japanese stock index i.e., Nikkei225 has strong correlation with all the select indices except Sensex, HangSeng and SSE Composite index. The European index i.e., FTSE100 has exhibited strong correlation with all the US stock market indices and with Nekkei225, the Japanese stock market index.

2.3 *Research Methodology*

Cointegration is the statistical equivalence of the economic theoretic notion of stable long run relationship. It is based on the properties of the residuals from the regression analysis when the individual series are non-stationary. The studies examined agree that Cointegration is a good parameter to determine possible co-movements between equity markets, with the most popular process undoubtedly being Johansen's methods. (Maggiora and Skerman, 2009). 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.

2.3.1. *Data*

We include the Hang Sang index to proxy Chinese stock market and SandP CNX Nifty to proxy Indian stock market. The sample data on daily closing prices has been retrieved from yahoofinance.com. The data ranges for

a period of approximately 15 years starting from 1st January 2000 to 30st June 2014. Closing Indices value has not been converted to a common currency. Alexander (2001) strongly advocates cointegration analysis between markets should be completed in each indices local currency. Not converting to a common currency will eliminate any possible exchange rate volatility.

2.3.1.1 *Hang Seng Index*

Hang Seng Index comprise of 50 largest companies on Hong Kong stock market representing 58% of the market capitalisation. It is a free float-adjusted market capitalization-weighted stock market index in Hong Kong and is main indicator of the overall market performance in Hong Kong..

2.3.1.2 *SandP CNX Nifty*

SandP CNX Nifty represents 22 sectors of the economy and comprise of 50 most popular stocks which record highest trading volume and represents on an average about 63% of the Free Float Market Capitalization. As a benchmark index, the Nifty Index can be treated as a true replica of the Indian stock market.

For the entire 14.5 year daily data sample timeframe, there are a total of 3861 observations. Due to different non-trading days in each of the countries, the entire sample data has been vigorously examined to ensure consistent data between the two indices. If an index is missing a trading day a data point has been inserted consistent with the previous day's closing price, to ensure all dates match and also to represent zero transactions completed on that particular day.

2.3.2 *Analytical Tools*

For the purpose of studying Cointegration, a stepwise procedure needs to be followed. The following analytical tools have been used for the purpose (a) Unit Root Tests (ADF); (b) Johansen's cointegration testing; (c) Trace test; (d) Max Eigenvalue test; (e) VECM

The Johansen Cointegration process is a maximum likelihood method that determines the number of cointegrating vectors in a non-stationary time series Vector Autoregression (VAR) with restrictions imposed, known as a vector error correction model (VECM). Johansen's estimation model is as follows:

$$\Delta X_t = \mu + \sum_{i=1}^{r} \Gamma_i \Delta X_{t-1} + \alpha\beta' X_{t-1} + \varepsilon_t$$

where, X_t (nx1) vector of all the non stationary indices in the study

r_i (nxn) matrix of coefficients

α (nxr) matrix of error correction coeffecients where r is the number of cointegrating relationships in the variables so that 0<r<n. it measures the speed at which the variables adjust to their equilibrium.

β (nxr) matrix of r cointegrating vectors, so that 0<r<n. this is what represents the long-run cointegrating relationship between variables.

III. Empirical Results

An essential perquisite for applying Johansen's test of Cointegration is that time the series should be non stationary and should become stationary after integrating of the same order. The result of Augmented Dickey-Fuller (ADF) test in Table I shows that the closing price data for both the series have been non stationary but becomes stationary after first differencing. So, our data is integrated of order one, I (1) which is a requirement for Johansen's test of cointegration.

Table I

Result of ADF test for Nifty and Hang Seng Index

	Nifty	Hang Seng
Level	-0.044108**	-1.250604**
	(0.95340)	(0.654400)
On first differencing	-57.84880	-62.847780
	(0.00010)	(0.000100)

Notes : ** indicates significance at 5% level
(the values in the parenthesis are p values)

After that Trace Test and Eigen Value Test have been used to determine the number of cointegrating vectors. Johansen (1991) defines two different test statistics for testing cointegration: Trace Test and Maximum Eigen Value Test. Trace Test with null hypotheis (H0: $r = 0$) and alternative (H1: $r > 0$) and the Maximum Eigen Value Test for testing the null that the number of cointegrating vectors is equal to r against the alternative of $r+1$ cointegrating vectors. (Brooks, 2008).

The result of the tests are given in Table II below

Table II

Trace testand Max Eigen Value Test Result

Trace test				Max-Eigenvaluetest			
Hypothesized Number of Cointegrating Equations	Trace statistic	P value	Sig at 5% level	Hypothesized Number of Cointegrating Equations	Max-Eigenvalue Statistic	P value	Sig at 5% level
None	19.590140	0.0114	yes	None	19.57955	0.0066	yes
At most 1	0.010591	0.9177	No	At most 1	0.010591	0.9177	No

Both the Trace test and Max-Eigenvalue test indicate there is one cointegrating equation at the 0.05 level. If the variables are found to be cointegrated it means they share a common stochastic trend and grow proportionallly. Cointegration tells that there exist a relationship between the variables but does not show the direction of that relationship.

For testing the direction of causality, VECM has been used. The appropriate lag length has been has been found to be 7 as suggested by the different lag length criteria. Out of the five methods reported below, three methods indicate the appropriate lag length to 7. So 7 has been chosen as the appropriate lag length to test the causality.

The lag length criteria shows appropriate lag length to be 7 to test the causality (See Table III).

Table III
Results of Various Lag Length Criterion

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-70169.61	NA	2.26e+13	36.42440	36.42765	36.42555
1	-48240.88	43823.30	2.58e+08	25.04380	25.05354*	25.04726
2	-48228.26	25.22111	2.57e+08	25.03932	25.05556	25.04509*
3	-48224.96	6.573305	2.57e+08	25.03969	25.06242	25.04776
4	-48224.69	0.543376	2.57e+08	25.04163	25.07085	25.05201
5	-48222.43	4.504506	2.58e+08	25.04253	25.07825	25.05522
6	-48217.65	9.537534	2.57e+08	25.04212	25.08434	25.05712
7	-48207.20	20.81253*	2.57e+08*	25.03878*	25.08749	25.05608
8	-48205.40	3.581869	2.57e+08	25.03992	25.09513	25.05953

Notes: * indicates appropriate lag length

The VECM equations have been given below. Equation 1 shows the VECM of the Chinese stock market on Indian stock market. The equation 2 shows the VECM of the Indian stock market on Chinese stock market.

Dependent variable Equation

Hang Seng Index D(CHINA) = C(1)*(CHINA(-1) - 2.09619781827*INDIA(-1) - 10024.3038997) + C(2)*D(CHINA(-1)) + C(3)*D(CHINA(-2)) + C(4)*D(CHINA(-3)) + C(5)*D(CHINA(-4)) + C(6)*D(CHINA(-5)) + C(7)*D(CHINA(-6)) + C(8)*D(CHINA(-7)) + C(9)*D(INDIA(-1)) + C(10)*D(INDIA(-2)) + C(11)*D(INDIA(-3)) + C(12)*D(INDIA(-4)) + C(13)*D(INDIA(-5)) + C(14)*D(INDIA(-6)) + C(15)*D(INDIA(-7)) + C(16) (1)

Nifty D(INDIA) = C(1)*(INDIA(-1) - 0.477054212768*CHINA(-1) + 4782.1364054) + C(2)*D(INDIA(-1)) + C(3)*D(INDIA(-2)) + C(4)*D(INDIA(-3)) + C(5)*D(INDIA(-4)) + C(6)*D(INDIA(-5)) + C(7)*D(INDIA(-6)) + C(8)*D(INDIA(-7)) + C(9)*D(CHINA(-1)) + C(10)*D(CHINA(-2)) + C(11)*D(CHINA(-3)) + C(12)*D(CHINA(-4)) + C(13)*D(CHINA(-5)) + C(14)*D(CHINA(-6)) + C(15)*D(CHINA(-7)) + C(16) (2)

The VECM estimation output has been given below in Table IV.

In the first column(i) in Table IV, Hang Seng Index has been taken as the dependent variable and Nifty has been taken as dependent variable in column (iv).

In Table IV , Column (ii) of Table IV shows the result of the VECM of Chinese stock market on India stock market. C(1) is the coefficient of the one period lagged residual from the cointegrating equation. It is the coefficient of speed towards the long run equilibrium. The coefficient is negative and is significant at 5% since the p value is less than 5% which means Indian

stock market affect Chinese stock market in long run. Also the coefficient of the ECT is -0.005781 . Thus, Chinese market adjust to the disequilibrium at the speed of 0.51%

Table IV

Vector Autoregression Estimates for equation 1 and 2

	Dependent variable Hang Seng Index		Dependent variable Nifty Index	
Coefficients (i)	Estimates (ii)	P. value (iii)	Estimates (iv)	P. value (v)
C(1)	-0.005781	0.0048	-0.003100	0.0007
C(2)	-0.011584	0.4741	0.071356	0.0000
C(3)	-0.012390	0.4438	-0.023850	0.1393
C(4)	0.002298	0.8869	-0.004750	0.7685
C(5)	0.008026	0.6194	-0.022050	0.1716
C(6)	-0.044245	0.0062	-0.015820	0.3269
C(7)	0.014181	0.3790	-0.039400	0.0146
C(8)	0.015144	0.3479	0.026414	0.1014
C(9)	-0.057985	0.4461	0.007597	0.0267
C(10)	-0.015499	0.8387	0.006095	0.0753
C(11)	-0.027453	0.7185	0.000933	0.7851
C(12)	-0.054962	0.4705	-0.004260	0.2128
C(13)	-0.071131	0.3504	-0.000570	0.8672
C(14)	0.20351	0.0075	0.009245	0.0068
C(15)	-0.010984	0.8853	-0.000200	0.9528
C(16)	3.015839	0.4966	1.650069	0.0791

In a similar way, the long run causal relationship from Chinese market to Indian market has been established. The ECT of the VECM model taking nifty as the dependent variable has been -0.0031 which is negative and is significant . We can establish that there is also long run causal relationship from Chinese stock market to Indian stock market. The speed at which the disequilibrium adjusts is .031%. Thus, Chinese stock market adjust to the disequilibrium at a higher speed than Indian stock market .

As regard the short run causality, the significance of the coefficients of the independent variable taking all lags together has been tested using Wald statistic. To test the significance of coefficients the chi square value of Wald statistic has been used testing the null that all the coefficients taken together at all the lags are zero.

Hypothesis H0: $c(9)=c(10)=c(11)=c(12)=c(13)=c(14)=c(15) = 0$
Hypothesis H1: $c(9)=c(10)=c(11)=c(12)=c(13)=c(14)=c(15) \neq 0$

The result of the wald test has been reported in Table V below:

Table V

Result of Wald Test

Dependent variable	Test value	P value	Result
Hang seng	9.286527	0.2327	Null not rejected
Nifty	16.613550	0.0201**	Null rejected

Notes : ** indicates significance at 5% level

The result of Wald test shows that all the coefficients of the Nifty index taken together are insignificant which means the Chinese markets are not affected by the Indian stock markets in short run. But the result of Wald test taking Nifty as dependent variable shows that the coefficients of Chinese index taken together are not zero i.e. Chinese index effect the Indian stock market in short run. Therefore there exists a short unidirectional run causality from Chinese stock market to Indian stock market.

VII. Conclusion

The main objective of the study has been to find out the Cointegration between Indian and Chinese stock markets using the Johansen Test of Cointegration. The study employs approx. 15 years data for Nifty and Hang Seng stock indices representing the Indian and Chinese stock markets respectively. The study found bidirectional long run causal relationship between the two markets. The study also found that the Chinese markets affect Indian market in short run but it is not true vice versa. So there is unidirectional short run causality extending from Chinese to Indian stock market. An investor thus, cannot benefit by diversifying his portfolio between the two markets as the two markets move in same direction.

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