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STUDY OF STOCK MARKET INTEGRATION OF INDIA WITH USA

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Abstract:-Previous studies give contradictory results on whether Indian stock market is integrating with that of US stock market. We applied the diverse methodology such as Granger Casualty, Johnson co integration test and Impulse response to find consistent results that USA stock market affect Indian stock market. The results are consistent in both crisis and post crisis period. Investors are not diversifying their risk profile, when they are investing into global markets. They are equally vulnerable to any crisis, whether they are investing in Indian stock market or in USA market

Keywords: Stock Market Integration , US stock market , global markets , economic reforms .

INTRODUCTION

In 1991, the process of economic reforms has been initiated and India opened itself to the international finance. Indian stock market is no more in isolation, and therefore integrated with the global stock market. The study of stock market integration is very crucial to the understanding of the investors who are now investing beyond their national territories. In the awakening of financial crisis and debt crisis in United States and European countries, this will affect investors in other country as well. The stock market integration has made investment one global unit and concentrated the risk profile of the investors. The present study seeks to analyze stock market integration of India with USA. USA can be seen as proxy for other international market as it is one of the largest economies. Integration of Indian stock market with USA will also tell Indian investors vulnerability to the crisis in the global economies. Over the last decade, Indian export to USA has increased by 176 %. It implies that USA Stock market is very important for Indian stock market.

LITERATURE REVIEW

Behera finds that contrary to general belief, Indian stock market is not co-integrated with the developed market as yet. Of course, some short-term impact does exist, although it is found to be unidirectional for obvious reasons. That is to say, the developed stock markets, viz., USA, UK and Hong Kong stock markets Granger cause the India stock market but not vice versa. Bataraddy et al. (2012) support the presence of long run relationship emerging and developed stock market which includes India and USA as well by using data from 1998 to 2008. Dhal (2009) finds out that the Indian market was integrated with regional and global markets in terms of stock prices measured in US dollar but not local currencies, a finding attributable to role of foreign investors participating in the Indian market. Regional and global stock markets had differential impact on the Indian market in the long run as well as the short run. In terms of the long-run co integration relation, India's dependence on the global markets, such as the United States and the United Kingdom, was substantially higher than on regional markets such as Singapore and Hong Kong. The global crisis did not fling away the co integration among the stock markets. It had a moderating impact, albeit, marginally, on the long-run coefficients pertaining to the integration among the regional and global markets studied here. Within Asia, Singapore and Hong Kong markets had a significant influence, while the Japanese market had a weak influence on the Indian market

DATA AND VARIABLES

We have selected BSE Sensex and S&P 500 as our index. The empirical analysis is carried out by using daily closing price data. The sample period spans from Jan 2007 to April 2014 with 1753 observations. We first calculate each index returns by using the below formula. We are also affirmative that by using relative data of returns rather than prices, we are able to provide better results than previous studies.

Index Return = ln Pt/lnPt-1
Where lnPt in natural log Index value today
lnPt-1 in natural log Index value one day before today

Table 1 Correlation between Return of BSE SENSEX and S & P 500

2014	0.209554
2013	0.336498
2012	0.283237
2011	0.261293
2010	0.307177
2009	0.335514
2008	0.385395
2007	0.203632
TOTAL	0.330436

The table1 states that the correlation between the BSE SENSEX and the S&P 500 has been quite high during the period. Assuming US to be the proxy of global market, it also means that Indian stock market has now become more integrated with other countries as well. It simply shows that Indian stock market is now more open to other stock markets.

DESCRIPTIVE STATISTICS

We have divided our results into two time period. One is crisis period 2007 and other is post crisis period 2008-2014. We have got these descriptive statistics for S& P 500 Returns and BSE SENSEX Returns. If you compare the standard deviation of the two countries, Indian stock market seems to more volatile over both the time period. The Jarque beratest suggest that distribution seems to be not normal. The mean return seems to be around zero for both Indian and American stock market.

Table 2 Summary statistics

	US stock Returns		Indian stock return	
	Crisis Period	Post Crisis Period	Crisis Period	Post Crisis Period
Mean	-2.72E-05	-0.000173	-0.001644	-5.98E-05
Median	-0.000697	-0.000730	-0.001406	-0.000209
Maximum	0.035344	0.094697	0.048328	0.127960
Minimum	-0.028787	-0.109579	-0.048690	-0.159900
Std. Dev.	0.010592	0.015532	0.015818	0.017168
Skewness	0.445962	0.214045	0.251821	-0.080029
Kurtosis	4.058637	12.12798	4.315213	12.86858
Jarque-Bera	18.12442	5298.983	18.76003	6181.756
Probability	0.000116	0.000000	0.000084	0.000000
Sum	-0.006180	-0.263768	-0.373200	-0.091125
Sum Sq. Dev.	0.025354	0.367156	0.056544	0.448615
Sum	-0.006180	-0.263768	-0.373200	-0.091125
Observations	227	1523	227	1523

Empirical Results

Crisis period 2007

We have selected appropriate lag by using VAR Lag Order Selection Criteria. It is 2 according to Final prediction error, Akaike information criterion, Schwarz information criterion, Hannan-Quinn information criterion, as given by table 3 in appendix. Secondly, we check unit root test on the two series of BSE SENSEX returns and S & P 500 returns so that it can be used for further processing. The data is stationary at level as well as first difference (table 4). It can be used for further tools. After checking the stationary of data, we conduct the granger causality between US and Indian stock market. At lag 2, both Indian stock market as well as US stock market granger causes each other simultaneously (Table 5). In order to check the long run association between Indian and US stock market, we have conducted Johnson co integration test. Both trace test as well as maximum eigen value test indicates 2 co integrating equation, which suggest that there is long run association between Indian and American stock market (table 6)Impulse response graph given below shows that Indian stock market changes in the same direction to a shock in the US stock market within 2 days and then it starts normalize to that shock. The response of American stock market to any shock in the Indian stock markets seems to vary from positive to negative, which is not clear.

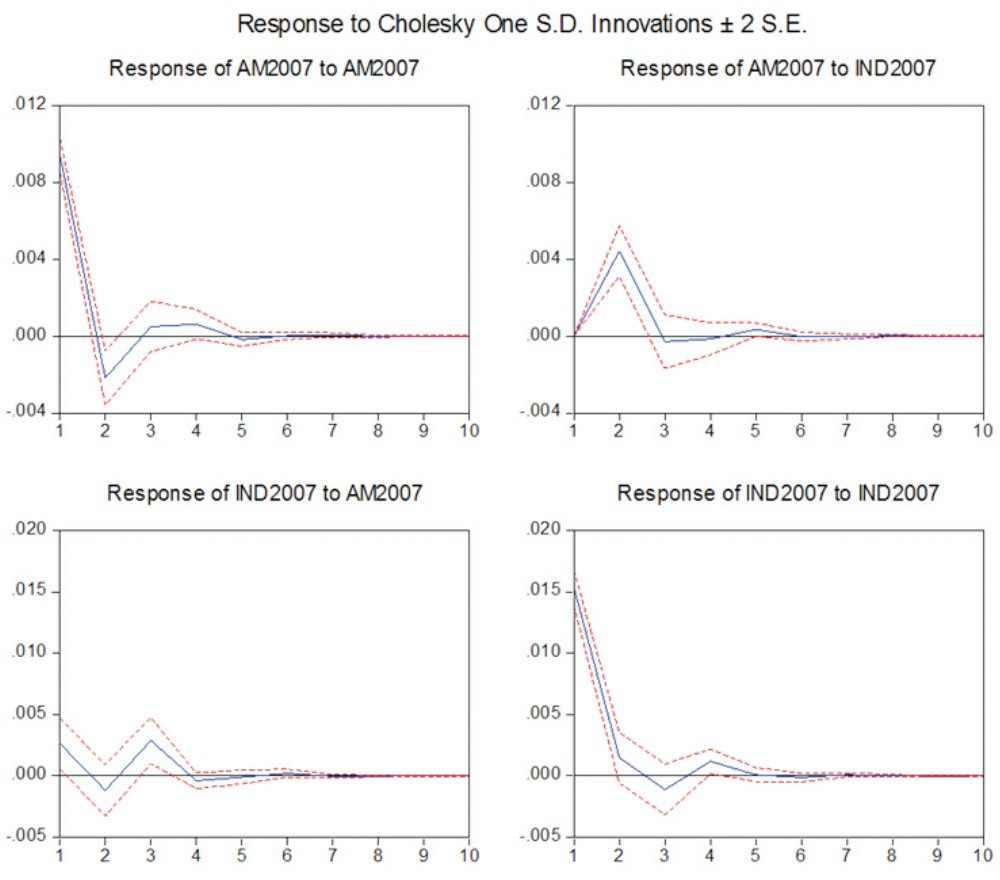


Figure 1 Impulse Response Graph between Indian and USA Returns in 2007

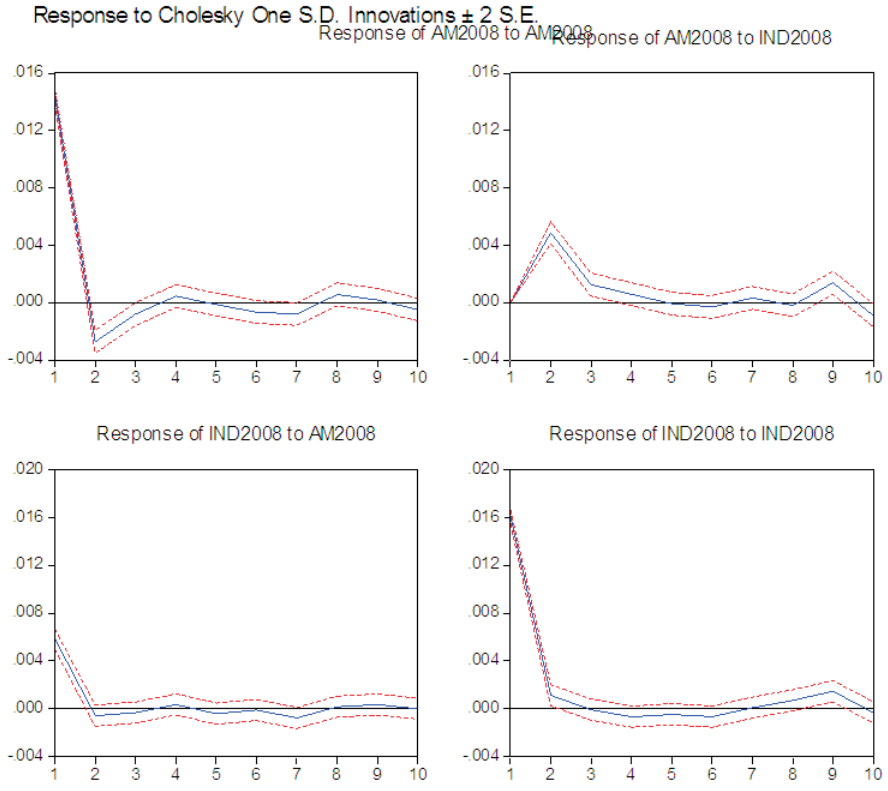
Post Crisis period 2007

We have selected appropriate lag by using VAR Lag Order Selection Criteria. It is 2 according to Schwarz information criterion while it is 10 according to Final prediction error, Akaike information criterion, Schwarz information criterion and LR criteria (Table 7). Secondly, we check unit root test on the two series of BSE SENSEX returns and S & P 500 returns so that it can be used for further processing. The data is stationary at level as well as first difference. It can be used for further tools (table 8). After checking the stationary of data, we conduct the granger causality between US and Indian stock market. At lag 2, both Indian stock market as well as US stock market granger

causes each other simultaneously. (Table 9).In order to check the long run association between Indian and US stock market, we have conducted Johnensosn cointegratoion test. Both trace test as well as maximum eigen value test indicates 2 cointegrating equation, which suggest that there is long run association between Indian and American stock market(table 10).

Impulse Response diagram shows that Indian stock market takes 2 days to respond to any shock in the USA stock market in the same direction and normalize after 3 days to that shock, whereas response of Indian stock market to Indian market is not clear

Figure 2 Impulse Response Graph between Indian and USA Returns for 2008 onwards



CONCLUSION AND IMPLICATIONS

Our results in both periods (crisis and post crisis) using various methodologies seem to be consistent. While, Granger Causality suggests that both Indian stock market and USA stock market granger causes each other, whereas Johnson co integration test indicates there have been long run association between Indian stock market and USA market. Under both periods, Impulse response seems to indicating that USA stock market seems to create a reaction into Indian stock market. Overall we can say that Indian stock market seems to be reacted by the effect in the US Stock market. This integration is not affected and interrupted by the period of crisis. Investors are not diversifying their risk profile, when they are investing into global markets. They are equally vulnerable to any crisis, whether they are investing in Indian stock market or in USA market.

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Appendix

3.VAR Lag Order Selection Criteria
Endogenous variables: AM2007 IND2007
Exogenous variables: C

Sample: 1 1750
Included observations: 216

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1269.959	NA	2.73e-08	-11.74036	-11.70910	-11.72773
1	1297.694	54.70143	2.19e-08	-11.96013	-11.86638*	-11.92226*
2	1302.623	9.628391	2.17e-08*	-11.96873*	-11.81247	-11.90560
3	1304.783	4.180156	2.21e-08	-11.95169	-11.73293	-11.86331
4	1310.143	10.27399*	2.18e-08	-11.96429	-11.68302	-11.85065
5	1310.842	1.325667	2.25e-08	-11.93372	-11.58994	-11.79483
6	1313.413	4.834123	2.28e-08	-11.92049	-11.51421	-11.75636
7	1314.035	1.156443	2.35e-08	-11.88921	-11.42042	-11.69982
8	1314.412	0.695485	2.43e-08	-11.85567	-11.32438	-11.64103
9	1318.328	7.143308	2.44e-08	-11.85489	-11.26109	-11.61500
10	1319.147	1.477275	2.51e-08	-11.82543	-11.16913	-11.56028
11	1320.808	2.968314	2.57e-08	-11.80377	-11.08496	-11.51337

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

4. Augmented Dickey-Fuller test statistic

Crisis period	P AT LEVEL	P AT FIRST DIFFERENCE
Us return	0.0	0.0
Indian Return	0.0	0.0

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5. Pairwise Granger Causality Tests
Date: 07/01/14 Time: 04:22
Sample: 1 1750
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
IND2007 does not Granger Cause AM2007	225	25.5955	1.E-10
AM2007 does not Granger Cause IND2007	6.34529	0.0021	

6.
Sample (adjusted): 4 227
Included observations: 224 after adjustments
Trend assumption: Linear deterministic trend
Series: AM2007 IND2007
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.325612	146.3744	15.49471	0.0001
At most 1 *	0.228569	58.12977	3.841466	0.0000

Trace test indicates 2 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.325612	88.24459	14.26460	0.0000
At most 1 *	0.228569	58.12977	3.841466	0.0000

Max-eigenvalue test indicates 2 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

AM2007	IND2007
-205.5526	95.02274
79.97687	78.78006

Unrestricted Adjustment Coefficients (alpha):

D(AM2007)	0.005911	-0.002036
D(IND2007)	-0.002569	-0.008074

1 Cointegrating Equation(s): Log likelihood 1322.955

Normalized cointegrating coefficients (standard error in parentheses)

AM2007	IND2007
1.000000	-0.462279
	(0.05115)

Adjustment coefficients (standard error in parentheses)

D(AM2007)	-1.215095
	(0.13245)
D(IND2007)	0.528120
	(0.24070)

7. VAR Lag Order Selection Criteria
Endogenous variables: AM2008 IND2008
Exogenous variables: C

Sample: 1 1750
Included observations: 1512

Lag	LogL	LR	FPE	AIC	SC	HQ
0	8239.919	NA	6.35e-08	-10.89672	-10.88968	-10.89410
1	8327.391	174.5959	5.68e-08	-11.00713	-10.98601	-10.99927
2	8349.030	43.13478	5.55e-08	-11.03046	-10.99527*	-11.01736
3	8359.309	20.46279	5.51e-08	-11.03877	-10.98950	-11.02042*
4	8362.124	5.597557	5.52e-08	-11.03720	-10.97385	-11.01361
5	8363.879	3.483170	5.53e-08	-11.03423	-10.95681	-11.00540
6	8369.532	11.20973	5.52e-08	-11.03642	-10.94492	-11.00234
7	8372.506	5.889846	5.53e-08	-11.03506	-10.92948	-10.99575
8	8381.210	17.21073	5.49e-08	-11.04128	-10.92163	-10.99672
9	8385.223	7.924859	5.49e-08	-11.04130	-10.90757	-10.99150
10	8390.092	9.602839*	5.49e-08*	-11.04245*	-10.89464	-10.98741
11	8392.063	3.882803	5.50e-08	-11.03977	-10.87788	-10.97948

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

8. Augmented Dickey-Fuller test statistic

Crisis period	P AT LEVEL	P AT FIRST DIFFERENCE
Us return	0.0	0.0
Indian Return	0.0	0.0

9. Pairwise Granger Causality Tests

Sample: 1 1750
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
IND2008 does not Granger Cause AM2008	1521	95.4522	9.E-40
AM2008 does not Granger Cause IND2008		3.66446	0.0258

10.
Sample (adjusted): 12 1523
Included observations: 1512 after adjustments
Trend assumption: Linear deterministic trend
Series: AM2008 IND2008
Lags interval (in first differences): 1 to 10

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.108406	297.6951	15.49471	0.0001
At most 1 *	0.078860	124.2013	3.841466	0.0000

Trace test indicates 2 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.108406	173.4938	14.26460	0.0001
At most 1 *	0.078860	124.2013	3.841466	0.0000

Max-eigenvalue test indicates 2 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

AM2008	IND2008
-353.5759	243.6642
106.9801	131.4307

Unrestricted Adjustment Coefficients (alpha):

D(AM2008)	0.004402	-0.001922
D(IND2008)	-0.000785	-0.004931

1 Cointegrating Equation(s): Log likelihood 8329.962

Normalized cointegrating coefficients (standard error in parentheses)

AM2008	IND2008
1.000000	-0.689143
	(0.04126)

Adjustment coefficients (standard error in parentheses)

D(AM2008)	-1.556273
	(0.13152)
D(IND2008)	0.277696
	(0.16217)