Are stock exchanges integrated in the world? - A critical Analysis

Varadi, Vijay Kumar and Boppana, Nagarjuna

University of Hyderabad

May 2009

UNIVERSITY OF HYDERABAD

Are stock exchanges integrated in the world?

A critical analysis

Vijay & Dr. Boppana Nagarjuna

In the recent rapid reforms made the global into a global village in nature and in terms of efficiency, transparency. The information flow in one market may affect the other markets in the world, because of its integration. In this regard, this paper explores the objective whether there is any integration of markets taken place or not. For reaching the objective, we have used rigorous time series techniques for the equal period of data (1st January, 2001 to 30th April, 2009) of 17 stock exchanges in the world, which includes Asia, Europe, north America, Latin America etc.,. Our findings are markets within the region are well integrated both in terms of short run and long run equilibrium, because of its less cross-country restrictions. Many of the markets are showing granger causal relations between each other.

Is Stock Exchanges are integrated in the world – Critical Analysis

V.Vijay Kumar[1] and Dr. Boppana Nagarjuna[2]

Introduction:

Economic reforms in the process of globalization positively changes in its nature of world stock exchanges. Many research scholars would pose a question, is stock exchanges are become integrated in the reform period. In the recent years, the world economies are moving its own dimension, is experiencing a new kind of financial crisis with its integrity and efficiency. Recent years are evident to stock exchanges, stock prices are falling drastically and majority of investment in stock market and its allied services is evaporating and no idea how it makes people miserable.

The integration of stock exchanges produces a number of significant efficiency gains, some of which are passed on by the exchanges to their users (intermediaries, investors and issuers) in the form of lower fees, and some of which accrue directly to users. The integration of exchanges eliminates the duplication of costly infrastructure, thus reducing the average cost of processing a trade. The competitive constraints imposed by other trading mechanisms and the bargaining power of users induce the integrated exchange to pass on those cost savings to its members by reducing trading fees. Final investors can then benefit from this reduction in the explicit costs of trading in the form of lower brokerage fees.

Many researchers are found that co-integration among national stock markets may be implied by one or more of the following factors: less cross-country restrictions on stock investment and foreign ownership. A question then arises here: what kind of co-integration, linear or nonlinear, are these factors supposed to result in? So far, all of the studies on international stock market integration that adopt cointegration

[1] Research Scholar, Department of Economics, University of Hyderabad. varadivk@gmail.com

[2] Senior Faculty, Department of Economics, University of Hyderabad. bnss@uohyd.ernet.in

analysis have taken the former for granted if cointegration is indeed present, while completely ignoring the latter. Therefore, it is of importance to detect the possible existence of linear and nonlinear cointegration among national stock markets.

However, the former studies specifies and estimates a nonlinear regression model without paying attention to the possible non-stationarity of the regressand and the regressors that are the transformations of the original time series. Thus the study is unable to cut loose from the problem of spurious regression which cointegration techniques have been developed to overcome. In the latter study, the authors use the original series and their cross-products and squares in the cointegration regression model after unit root tests are applied to ensure that all the complex elements in the vector are integrated of the same order (order one). Furthermore, the normality condition for employing the Johansen method is violated. Even though the authors argue that no autocorrelation in the residuals is more important than the normality condition, this does not mean that the latter is unimportant as finitesample critical values are computed using normally distributed data.

In the theoretical literature, financial market integration derives from various postulates such as the law of one price (Cournot (1927).   Despite distinguishing features, these postulates share a common perspective: if risks command the same price, then the correlation of financial asset prices and the linkage among markets comes from the movement in the price of risks due to investors’ risk aversion. Based on these theoretical postulates, financial integration at the empirical level is studied using several factors. Among several others in the applied finance literature, have used the cointegration hypothesis to assess the international integration of financial markets. Taylor and Tonks (1989) found that the cointegration technique is useful from the perspective of the international capital asset price model. Kasa (1992) suggested that the short-term return correlation between stock markets is not appropriate from the perspective of long-horizon investors driven by common stochastic trends.

The cointegration model is useful since it not only distinguishes between the nature of long-run and of short-run linkages among financial markets, but captures the interaction between them as well. What is striking about the empirical literature is that studies on the subject have brought to the fore various useful perspectives relating to price equalisation, market equilibrium, market efficiency and portfolio diversification (Chowdhry et al (2007)).

Harvey (1995) suggested that the improvement in market efficiency is consistent with increasing integration with world markets. If markets are predictable and foreign investors are sophisticated, then investors are likely to profit from the predictability of returns. Hassan and Naka (1996) suggest that in cointegrated markets, price movements in one market immediately influence other markets, consistent with efficient information sharing and free access to markets by domestic and foreign investors. Another viewpoint is that national stock markets are different since they operate in the economic and social environments of different countries. Accordingly, a country's financial market is efficient when prices reflect the fundamentals and risks of that country, rather than the fundamentals and risks of other countries. Several studies have, however, argued that financial integration could occur due to real economic interdependence or linkages among economic fundamentals across nations. For instance, the profit and loss account and the balance sheet of a domestic company relying on a large volume of exports and imports can be affected by the macroeconomic fundamentals of other countries.

Based on these considerations, the current paper attempts to detect non-linearity in the long-run equilibrium relationship between several national stock markets. It is organized as follows.

Motivation of the study:

When we plot (Figure 1) the closing prices of different stock markets, we found the falling trend in all markets at same point. It makes to go in deep, study about the reflection and affect of stock prices on other markets relatively.

Objectives and Hypothesis:

This paper major objective is to understand the co-integration relationship between intra and inter stock exchanges in the world and how they are integrated towards reaching the efficiency.

H_0: Stock Markets are well co-integrated and leads to major fall or leads to financial crisis
H_1: Otherwise

Data Sources:

World stock exchanges price series is collected and taken support from various data sources; such as world stock exchanges, yahoo finance, BSE and its own stock exchanges for daily data of closing price series for almost 25 major stock exchanges in the world. The data which includes ie., **in Asia and Pacific Markets** we have Bombay Stock Exchange (BSE), All Ordinaries, Shangai, Hang Seng, Jakarta Composite, KLSE, Nikkei 225, Staraits Times; **in European Markets** we have ATX (Vienna), CAC-40 (Paris), DAX, AEX –General (Amesterdom), MIBTEL (Milan), Swiss Market, FTSE 100; **in Latin American Markets** we have MERVAL, Bovespa and IPC (Mexico) **and in North American Markets** we have S&P TSX Composite, Dow Jones Index, S&P 500 index and Nasdaq-100.

Data:

The data we have considered in this paper is daily data for the period 1st January, 2001 to 30th April, 2009. The data includes closing prices of the every stock market indices.

Methodology:

To study the above said objectives, I have followed the following methodology. First I have changed the raw data into the return form for normalize the data. Then I have concentrated on descriptive statistics i.e., Mean, standard deviation, minimum, maximum, skewness, kurtosis and J-B Statistic to know the behavior of the data. After that, I just regress RBSE (return series of Bombay Stock Exchange) as a dependent variable, other variables are independent variables to check whether there is any relationship taken place, but D-W statistics shows autocorrelation exists. I checked the correlation matrix for at what stages all these variables correlated each other.

Although regression analysis deals with the dependence of the variable on other variables, it does not necessarily imply causation. To find lag length of the variable, whether they have any unit root or stationary, I have used ADF statistics with level form and ADF statistics with first difference, I found in level form there is a unit root.

A Vector Error Correction Model:

The finding that many time series may contain a unit root has spurred the development of the theory of non-stationary time series analysis. Engle and Granger (1987) pointed out that a linear combination of two or more non-stationary series may be stationary. If such a stationary, linear combination exists, then the non-stationary time series are said to be cointegrated. The stationary linear combination is called the co-integrating equation and may be interpreted as a long-run equilibrium relationship between the variables. Although the two series may be non stationary they may move closely together in the long run so that the difference between them is stationary. The series RBSE and RAEX_E are said to be integrated of the order one, denoted by I(1), if they become stationary after first difference. If there are two such series which are I(1) integrated and their linear combination is stationary, then these two series are said to be cointegrated. This relationship is the long run equilibrium relationship between RBSE and RAEX_E.

A principal feature of cointegrated variables is that their time paths are influenced by the extent of any deviation from long-run equilibrium. If the system is to return to its long run equilibrium, the movement of at least one variable must respond to the magnitude of the disequilibrium. If cointegration exists between St and Ft, then Engle and Granger representation theorem suggests that there is a corresponding Error Correction Model (ECM). In an ECM, the short term dynamics of the variables in the system are influenced by the deviations from the equilibrium.

The present research, seeks to determine whether there exists an equilibrium relationship between the different indices. Engle and Granger suggest a four step procedure to determine if the two variables are cointegrated. The first step in the analysis is to pre-test each variable to determine its order of integration, as cointegration necessitates that the two variables be integrated of the same order. Augmented Dickey-Fuller (ADF) test has been used to determine the order of integration. If the results in step one show that both the series are I(1) integrated then the next step is to establish the long run equilibrium relationship in the form

$$RBSE_t = \beta_0 + \beta_1 RAEX\_E_t + e_t$$

Where RBSE is the log of Bombay stock exchange index; RAEX_E is the log of aex_E index prices at time t and e_t is the residual term. In order to determine if the variables are cointegrated we need to estimate the residual series from the above equation. The estimated residuals are denoted as (ê). Thus the ê series are the estimated values of the deviations from the long run relationship. If these deviations are found to be stationary, then the RBSE and RAEX_E series are cointegrated of the order (1,1). To test if the estimated residual series is stationary Engle- Granger test for co-integration was performed.

The third step is to determine the ECM from the saved residuals in the previous step.

$$\Delta RBSE_t = \alpha_1 + \alpha_{RBSE}\hat{e}_{t-1} + lagged\left(\Delta RBSE_t, \Delta RAEX\_E_t\right) + \varepsilon_{RBSE,,t}$$

$$\Delta AEX\_E_t = \alpha_1 + \alpha_{RAEX\_E}\hat{e}_{t-1} + lagged\left(\Delta RBSE_t, \Delta RAEX\_E_t\right) + \varepsilon_{RAEX\_E,t}$$

In the above equations, $\Delta RBSE_t$ and $\Delta RAEX\_E_t$ denote, respectively, the first differences in the log of spot and futures prices for one time period. $\hat{e}_{t-1}$ is the lagged error correction term from the co-integrating equation and $\varepsilon_{RBSE,t}$ and $\varepsilon_{RAEX\_E,t}$ are the white noise disturbance terms.

The above equations describe the short-run as well as long-run dynamics of the equilibrium relationship between spot index and futures index. They provide information about the feedback interaction between the two variables.

In the equation $\Delta RBSE_t$ has the interpretation that, change in $RBSE_t$ is due to both, short-run effects. From lagged futures and lagged spot variables and to the last period equilibrium error $\hat{e}_{t-1}$, which represents adjustment to the long-run equilibrium. The coefficient attached to the error correction term measures the single period response of changes in spot prices to departures from equilibrium. If this coefficient is small then spot prices have little tendency to adjust to correct a disequilibrium situation. Then most of the correction will happen in the other index prices.

The last step involves testing the adequacy of the models by performing diagnostic checks to determine whether the residuals of the error correction equations approximate white noise. The reverse representation of Engle and Granger's Co-integration analysis along with the empirical findings has been given in the appendix. A pair wise Granger Causality test was done to establish the cause and effect relationship between the different series.

For causality, we have used Granger causality test which assumes that the information relevant to the prediction of the respective variables. The test involves estimating the following regressions:

$$RBSE_t = \sum_{i=1}^{n} \alpha_i AEX\_E_{t-i} + \sum_{j=1}^{n} RBSE_{t-j} + u_{1t}$$
$$AEX\_E_t = \sum_{i=1}^{m} \lambda_i AEX\_E_{t-i} + \sum_{j=1}^{m} \delta_j RBSE_{t-j} + u_{2t}$$

Where it is assumed that the disturbances u_{1t} and u_{2t} are uncorrelated.

Results Discussion:

As we discussed earlier, the simple/ descriptive statistics reveals (Table 1) that all series of indices behavior in terms of Mean, Standard Deviation, skewness, kurtosis and J-B statistic. The mean is a measure of the center of the distribution of the series. Whereas, standard deviation is the measure of degree of desperation of the data from the mean value, it indicates form the table spread exists in all indices. Skewness is a measure of symmetry. In the given table, except rallord, rshagai (negative skewness having left tail) all are having positive skewness, but rnasdaq_na is having positive skewness i.e., (1.013) which indicates a long right tail exists. Kurtosis is a measure of whether the data are peaked or flat relative to a normal distribution i.e, k=3. But in the given indices there is no such series are to be seen. But, all the indices are negative excess kurtosis with having heavy peaked in its nature..

Table 1: Simple Statistics

Variable	Mean	Std Dev	Min	Max	Skewness	Kurtosis	J-B
Rbse	0.01744	0.00968	0.00479	0.03847	0.372299	-1.35197	204.576
raex_e	0.25175	0.05987	0.15581	0.45884	0.702415	-0.068381	169.879
Rallord	0.02544	0.00614	0.01459	0.03741	-0.184831	-1.367147	172.243
ratx_e	0.05207	0.02590	0.02007	0.09968	0.255174	-1.520951	220.020
rcac40_e	0.02397	0.00528	0.01621	0.04162	0.578205	-0.599483	145.701
rdax_e	0.02113	0.00634	0.01234	0.04540	0.861994	0.337652	265.022
rdja_na	0.00966	0.00142	0.00706	0.01528	0.579020	0.340848	125.139
rftse_e	0.01985	0.00332	0.01485	0.03043	0.471153	-0.804038	131.767
rhangseng	0.00721	0.00203	0.00316	0.01189	0.070610	-0.755893	50.779
rmexico_la	0.00924	0.00511	0.00305	0.01968	0.334909	-1.434489	215.238
rmibtel_e	0.00433	0.0008974	0.00291	0.00708	0.499589	-0.524792	109.384
rnasdaq_na	0.06769	0.01539	0.03664	0.12436	1.013820	-0.775439	404.697
rshangai	0.05816	0.01983	0.01642	0.09891	-0.426033	-0.551224	88.439
rsp500_na	0.08729	0.01513	0.06391	0.14792	0.879686	0.405621	279.945
rsptx_na	0.01096	0.00274	0.00663	0.01756	0.066348	-1.196638	124.480
rstaraits	0.05026	0.01403	0.02580	0.08242	0.118407	-0.902155	74.708
rswiss_e	0.01570	0.00331	0.01049	0.02721	0.434573	-0.449368	82.212

The correlation matrix (table 2) reveals that, there is a positive correlation between Bombay stock exchange index with other indices. Bombay stock index is having positive i.e., nearer to one relationship is having allord, atx_e, sptx_na, stratits. And positive with greater than 0.5 indices are cac40_e, dax_e. dja_na, ftse_e, mibtel, nasdaq, sp500_na and swiss_e. But there is least correlation between Bombay stock exchange index with aex_e and shangai.

Table 2: Cross correlations: For all Markets

	RBSE	RAEX_E	RALLORD	RATX_E	RCAC40_E	RDA_E	RDJA_NA	RFTSE_E	RHANG	RMEX	RMIB	RNASDAQ	RSHANGAI	RSP500_NA	RSPTX_NA	RSTARAITS	RSWISS_E
RBSE	1	0.216	0.914	0.936	0.536	0.648	0.673	0.593	0.904	0.980	0.559	0.631	0.295	0.608	0.926	0.898	0.641
RAEX_E	0.216	1	0.496	0.257	0.914	0.795	0.718	0.861	0.527	0.168	0.864	0.681	0.367	0.769	0.508	0.537	0.837
RALLORD	0.914	0.496	1	0.913	0.734	0.787	0.810	0.778	0.926	0.917	0.759	0.694	0.412	0.760	0.968	0.953	0.805
RATX_E	0.936	0.257	0.913	1	0.541	0.577	0.735	0.610	0.855	0.943	0.622	0.614	0.139	0.688	0.904	0.908	0.642
RCAC40_E	0.536	0.914	0.734	0.541	1	0.940	0.831	0.963	0.768	0.492	0.942	0.831	0.403	0.865	0.758	0.761	0.957
RDA_E	0.648	0.795	0.787	0.577	0.940	1	0.778	0.923	0.832	0.617	0.843	0.807	0.522	0.778	0.815	0.798	0.930
RDJA_NA	0.673	0.718	0.810	0.735	0.831	0.778	1	0.870	0.841	0.646	0.871	0.885	0.382	0.980	0.827	0.889	0.872
RFTSE_E	0.593	0.861	0.778	0.610	0.963	0.923	0.870	1	0.808	0.554	0.928	0.858	0.379	0.901	0.801	0.815	0.970
RHANG	0.904	0.527	0.926	0.855	0.768	0.832	0.841	0.808	1	0.864	0.774	0.807	0.485	0.797	0.946	0.952	0.827
RMEX	0.980	0.168	0.917	0.943	0.492	0.617	0.646	0.554	0.864	1	0.513	0.567	0.295	0.569	0.911	0.881	0.605
RMIB	0.559	0.864	0.759	0.622	0.942	0.843	0.871	0.928	0.774	0.513	1	0.802	0.318	0.902	0.779	0.799	0.928
RNASDAQ	0.631	0.681	0.694	0.614	0.831	0.807	0.885	0.858	0.807	0.567	0.802	1	0.342	0.915	0.760	0.784	0.829
RSHANGAI	0.295	0.367	0.412	0.139	0.403	0.522	0.382	0.379	0.485	0.295	0.318	0.342	1	0.286	0.410	0.374	0.382
RSP500_NA	0.608	0.769	0.760	0.688	0.865	0.778	0.980	0.901	0.797	0.569	0.902	0.915	0.286	1	0.788	0.844	0.887
RSPTX_NA	0.926	0.508	0.968	0.904	0.758	0.815	0.827	0.801	0.946	0.911	0.779	0.760	0.410	0.788	1	0.962	0.828
RSTARAITS	0.898	0.537	0.953	0.908	0.761	0.798	0.889	0.815	0.952	0.881	0.799	0.784	0.374	0.844	0.962	1	0.838
RSWISS_E	0.641	0.837	0.805	0.642	0.957	0.930	0.872	0.970	0.827	0.605	0.928	0.829	0.382	0.887	0.828	0.838	1

Table 3: Regression results

Dependent Variable: RBSE
Method: Least Squares
Sample: 1 2061
Included observations: 2061

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001877	0.000511	-3.676565	0.0002
RAEX_E	-0.009936	0.002503	-3.969651	0.0001
RALLORD	0.182827	0.027857	6.562946	0.0000
RATX_E	-0.004735	0.007179	-0.659570	0.5096
RCAC40_E	0.083059	0.041364	2.007985	0.0448
RDA_E	-0.143537	0.023610	-6.079523	0.0000
RDJA_NA	0.668038	0.187994	3.553507	0.0004
RFTSE_E	-0.554943	0.044480	-12.47632	0.0000
RHANGSENG	1.773305	0.060411	29.35384	0.0000
RMEXICO_LA	0.770191	0.051565	14.93622	0.0000
RMIBTEL_E	-0.398041	0.135576	-2.935923	0.0034
RNASDAQ_NA	0.132507	0.007591	17.45558	0.0000
RSHANGAI	-0.052620	0.002936	-17.92480	0.0000
RSP500_NA	-0.235353	0.022091	-10.65362	0.0000
RSPTX_NA	0.911251	0.058433	15.59482	0.0000
RSTARAITS	0.045955	0.011213	4.098336	0.0000
RSWISS_E	0.456324	0.043808	10.41651	0.0000
R-squared	0.986175	Mean dependent var		0.017438

Adjusted R-squared	0.986067	S.D. dependent var	0.009678
S.E. of regression	0.001142	Akaike info criterion	-10.70320
Sum squared resid	0.002667	Schwarz criterion	-10.65676
Log likelihood	11046.65	F-statistic	9113.088
Durbin-Watson stat	0.166991	Prob(F-statistic)	0.000000

The regression results (table 3) reveal that, majority of the variables are significant at 1% level, even though there is high t-statistic evidence this and also r-square, adjusted r-square is also evidence the same picture about the results. But when we look at the D-W stat with 0.166991 indicates, the regression is having a spurious regression i.e., having high t-values, high r-square and adjusted r-square and F-statistic . It indicates that there is a non-stationary occurs among the series. However, that the long-term information contained in levels time series will be lost after the differencing. To avoid loss of long-term information, the majority of economists insisted on working with levels instead of differences.

Table 4: Augmented Dickey Fuller Test Statistic

Variable	In level form (with intercept and trend) ADF Statistic	First Difference (With intercept) ADF Statistic
Rbse	-1.9567	-32.65831
raex_e	-1.009637	-23.00168
rallord	0.101336	-47.44972
ratx_e	0.286237	-42.83707
rcac40_e	-0.954035	-22.27270
rdax_e	-2.136046	-47.39743
rdja_na	-0.615159	-26.25541
rftse_e	-1.125754	-21.69613
rhangseng	-2.434619	-46.78170
rmexico_la	-1.378196	-40.86398
rmibtel_e	-0.544494	-15.95365
rnasdaq_na	-2.360269	-35.94068
rshangai	-1.462871	-45.11517
rsp500_na	-0.459460	-26.70852
rsptx_na	-0.673454	-48.53236
rstaraits	-1.067458	-44.83061
rswiss_e	-0.574758	-21.71180

Critical values in level form -3.9625 at 1%, -3.4119 at 5%, and -3.1279 at 10%

Critical values in first difference -3.433 at 1%, -2.862 at 5%, and -2.567 at 10%

An augmented Dickey Fuller (ADF) test with 4 lags of the dependent variable in a regression equation on the return data series with a intercept and trend, results indicate that the test statistic less than the crucial values in the level form at least at 10% level. But, if I repeat the same process in the first difference with intercept not with trend, all series are exceeds the test statistic critical values. So the null hypothesis of a unit root in the all the series cannot be rejected. The test statistic is more negative than the critical value and hence the null hypothesis of a unit root in the returns is convincingly rejected. Since the dependent variable in this regression is non-stationary, it is not appropriate to examine the coefficient standard errors or their ratios. Unit roots can be obtained by estimating the shift dates running a properly augmented Dickey–Fuller (ADF) regression (Table 4); the critical values depend on the shift dates and the power of the tests declines as the maximum number of allowed shifts (which is assumed to be known) increases.

Table 5: Pair-wise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Probability
RAEX_E does not Granger Cause RBSE	2059	3.93588	0.01968
RBSE does not Granger Cause RAEX_E		2.12430	0.11978
RALLORD does not Granger Cause RBSE	2059	2.02515	0.13224
RBSE does not Granger Cause RALLORD		2.00149	0.13540
RATX_E does not Granger Cause RBSE	2059	5.13742	0.00595
RBSE does not Granger Cause RATX_E		0.20330	0.81605
RCAC40_E does not Granger Cause RBSE	2059	3.30472	0.03690
RBSE does not Granger Cause RCAC40_E		3.33658	0.03575
RDA_E does not Granger Cause RBSE	2059	2.40348	0.09066
RBSE does not Granger Cause RDA_E		5.67874	0.00347
RDJA_NA does not Granger Cause RBSE	2059	0.31500	0.72982
RBSE does not Granger Cause RDJA_NA		0.62320	0.53633
RFTSE_E does not Granger Cause RBSE	2059	0.77553	0.46059
RBSE does not Granger Cause RFTSE_E		1.48933	0.22577
RHANGSENG does not Granger Cause RBSE	2059	10.3530	3.4E-05
RBSE does not Granger Cause RHANGSENG		4.98209	0.00694

RMEXICO_LA does not Granger Cause RBSE	2059	11.6726	9.1E-06
RBSE does not Granger Cause RMEXICO_LA		9.18103	0.00011
RMIBTEL_E does not Granger Cause RBSE	2059	2.13096	0.11899
RBSE does not Granger Cause RMIBTEL_E		3.49238	0.03061
RNASDAQ_NA does not Granger Cause RBSE	2059	1.88499	0.15209
RBSE does not Granger Cause RNASDAQ_NA		2.24799	0.10587
RSHANGAI does not Granger Cause RBSE	2059	2.07382	0.12597
RBSE does not Granger Cause RSHANGAI		2.68248	0.06863
RSP500_NA does not Granger Cause RBSE	2059	0.46386	0.62892
RBSE does not Granger Cause RSP500_NA		0.10915	0.89661
RSPTX_NA does not Granger Cause RBSE	2059	1.77191	0.17027
RBSE does not Granger Cause RSPTX_NA		9.27591	9.8E-05
RSTARAITS does not Granger Cause RBSE	2059	0.49231	0.61129
RBSE does not Granger Cause RSTARAITS		8.81523	0.00015
RSWISS_E does not Granger Cause RBSE	2059	1.34510	0.26074
RBSE does not Granger Cause RSWISS_E		1.75901	0.17247

Causality between any pair of variables there is a possibility of unidirectional causality or bidirectional causality or none. The primary-condition for applying Granger Causality test is to ascertain the stationarity of the variables in the pair. The second requirement for the Granger Causality test is to find out the appropriate lag length for each pair of variables.

For this purpose, we used the vector auto regression (VAR) lag order selection. Finally, the result of Granger causality test is reported in table 5. There is a unidirectional causal influence between Indian stock indices and AEX, ATX_E, Hangseng, Mexico_LA, Mibtel, Shangai, Staraits. There is no causal relationship between Indian stock indices and Allord, DJA_NA, FTSE_E, SP500_NA. But there is bi-directional causal relationship between CAC40_E, DAX_E, NASDAQ_NA, SPTX_NA and SWISS_E. The present study found that direction of causality is from at 1 and 5% level of significance.

Co-integration test results:

The valuable contribution of the concepts of unit root, co-integration, etc., is to force us to find out if the regression residuals are stationary. In the language of co-integration theory, a regression known as co-integration regression and the parameter is known as the co-integrating parameter. As the unit root tests try to examine the presence of stochastic trend of time series, co integration tests search for the presence of a common stochastic trend among the variables from the unit root test results, the required condition for co integration test that given series are not I (O) is satisfied. At levels all the variables are non-stationary, where as first differenced stationary. Majority of the cases, if two variables that are I(1) are linearly combined, then the combination will also be I(1). In general, if variables with difference orders of integration are combined, the combination will have an order of integration equal to the largest.

A set of variables is defined as co-integrated if a linear combination of them is stationary. Many time series are non-stationary but 'move together' over time – that is, there exist some influences on the series, which imply that the series are bound by some relationship in the long run. A co-integration relationship may also be seen as a long-term or equilibrium phenomenon, since it is possible that co-integrating variables may deviate from their relationship in the short run, but their association would return in the long run (Chris Brooks, 1995).

To analyze long run relationship between Indian stock Market and other stock markets, Johansen co-integration model has adopted. For testing co-integration, there are two test statistics to use. First, trace statistics and other is Maximum Eigen value statistics. The results are shown in table 5. An empirical result of trace statistic indicates that the rejection of null hypothesis at 0.05 critical values i.e. there are no co-integration vector. In other words, Indian stock market has long relationship with other markets. Trace test also indicates that four co-integration equations at 1% level and one co-integration equation at 5 % level of significance, tells about long run equilibrium between Bombay stock exchange and other markets.

Table 6: Multivariate co-integration Unrestricted Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.113150	1371.519	NA	NA
At most 1	0.104365	1124.635	NA	NA
At most 2	0.083718	898.0177	NA	NA
At most 3	0.067779	718.2603	NA	NA
At most 4	0.053064	573.9602	NA	NA
At most 5 *	0.046007	461.8589	334.9837	0.0000
At most 6 *	0.041605	365.0233	285.1425	0.0000
At most 7 *	0.030684	277.6538	239.2354	0.0003
At most 8 *	0.026532	213.5790	197.3709	0.0060
At most 9	0.019171	158.2935	159.5297	0.0583
At most 10	0.017531	118.4960	125.6154	0.1251
At most 11	0.013125	82.13194	95.75366	0.2969
At most 12	0.012402	54.96791	69.81889	0.4204
At most 13	0.006529	29.30985	47.85613	0.7534
At most 14	0.004036	15.84192	29.79707	0.7234
At most 15	0.003645	7.526611	15.49471	0.5173
At most 16	9.04E-06	0.018596	3.841466	0.8914

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

Similarly, the empirical results of Maximum Eigen value are shown in the table 6. The empirical result indicates that the rejection of null hypothesis at 0.05 critical value i.e. no-co integration vector. It also tells that Bombay stock exchange have long run equilibrium with other markets. Maximum Eigen value indicates that two co-integration equations at 1% and one co-integration at 5 % level of significance.

Table 7: Multivariate Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.113150	246.8843	NA	NA
At most 1	0.104365	226.6174	NA	NA
At most 2	0.083718	179.7574	NA	NA
At most 3	0.067779	144.3001	NA	NA
At most 4	0.053064	112.1012	NA	NA
At most 5 *	0.046007	96.83559	76.57843	0.0003
At most 6 *	0.041605	87.36951	70.53513	0.0007
At most 7	0.030684	64.07480	64.50472	0.0549
At most 8	0.026532	55.28551	58.43354	0.0991
At most 9	0.019171	39.79754	52.36261	0.5079
At most 10	0.017531	36.36404	46.23142	0.3765
At most 11	0.013125	27.16403	40.07757	0.6214
At most 12	0.012402	25.65806	33.87687	0.3420
At most 13	0.006529	13.46793	27.58434	0.8575
At most 14	0.004036	8.315304	21.13162	0.8834
At most 15	0.003645	7.508015	14.26460	0.4309
At most 16	9.04E-06	0.018596	3.841466	0.8914

Empirical analysis Error Correction Mechanism:

From the above analysis, it has explained that, Indian capital market has long run relationship with other developing markets. But that does not mean they have short run equilibrium. There may exists short run dynamics among capital markets. For taking care of short run equilibrium Error Correction Mechanism (ECM) has been adopted. ECM empirical results have shown in the table (6). Indian capital market and Australian capital market has taken into consideration. Empirical result shows that coefficient of difference closing price ATX-100 is non-zero that means difference closing price Sensex is out of equilibrium. Since co-efficient of lagged residual is negative, the term θut-1is negative. Therefore, the dependent variable ΔX is also negative to restore equilibrium. That means dependent variable ΔX is above its equilibrium value, it starts falling in the next period to correct the equilibrium error. Empirical result also finds that Indian capital market adjusts to change in Australian capital market have a positive impact on short-run changes. Similarly, in case of UK, Japan and France, short run changes in the capital market has positive impact on short-run changes in Indian capital market except USA capital market which has shown negative impact on short run changes in Indian capital market.

Vector Error Correction estimates

Cointegrating Eq:	CointEq1
RBSE(-1)	1.000000
RAEX_E(-1)	0.055373
	(0.02067)
	[2.67931]
RALLORD(-1)	-1.091942
	(0.21132)
	[-5.16732]
RATX_E(-1)	-0.035879
	(0.05483)
	[-0.65437]
RCAC40_E(-1)	1.890385
	(0.38265)
	[4.94027]
RDA_E(-1)	0.121756
	(0.19005)
	[0.64063]
RDJA_NA(-1)	1.606171
	(1.40853)
	[1.14032]
RFTSE_E(-1)	0.842189
	(0.35916)
	[2.34490]
RHANGSENG(-1)	-2.511124
	(0.46817)
	[-5.36375]
RMEXICO_LA(-1)	0.008306
	(0.40725)
	[0.02039]
RMIBTEL_E(-1)	2.219601
	(1.07268)
	[2.06921]
RNASDAQ_NA(-1)	-0.297622
	(0.05803)

	[-5.12900]
RSHANGAI(-1)	0.044028
	(0.02170)
	[2.02881]
RSP500_NA(-1)	-0.192976
	(0.16733)
	[-1.15324]
RSPTX_NA(-1)	1.558806
	(0.45090)
	[3.45713]
RSTARAITS(-1)	-0.010596
	(0.08544)
	[-0.12402]
RSWISS_E(-1)	-4.050963
	(0.35075)
	[-11.5495]
C	0.008051

Figure 1: Return values of different stock indices

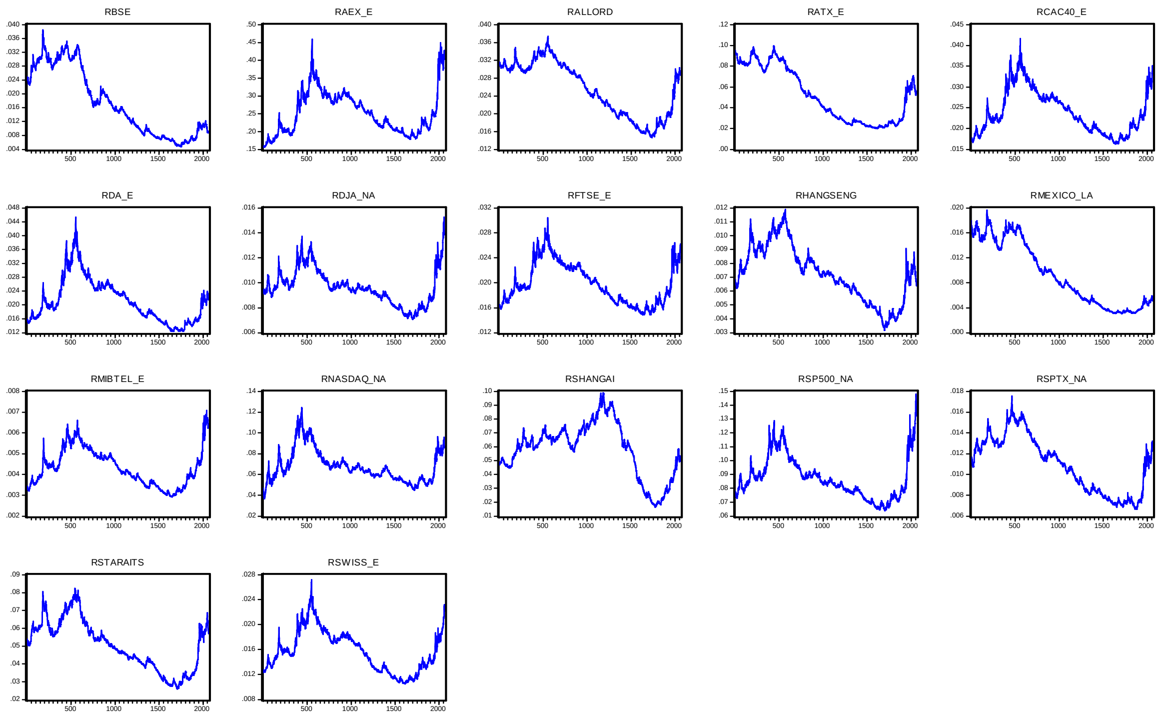


Figure 2: Residual series of stock indices

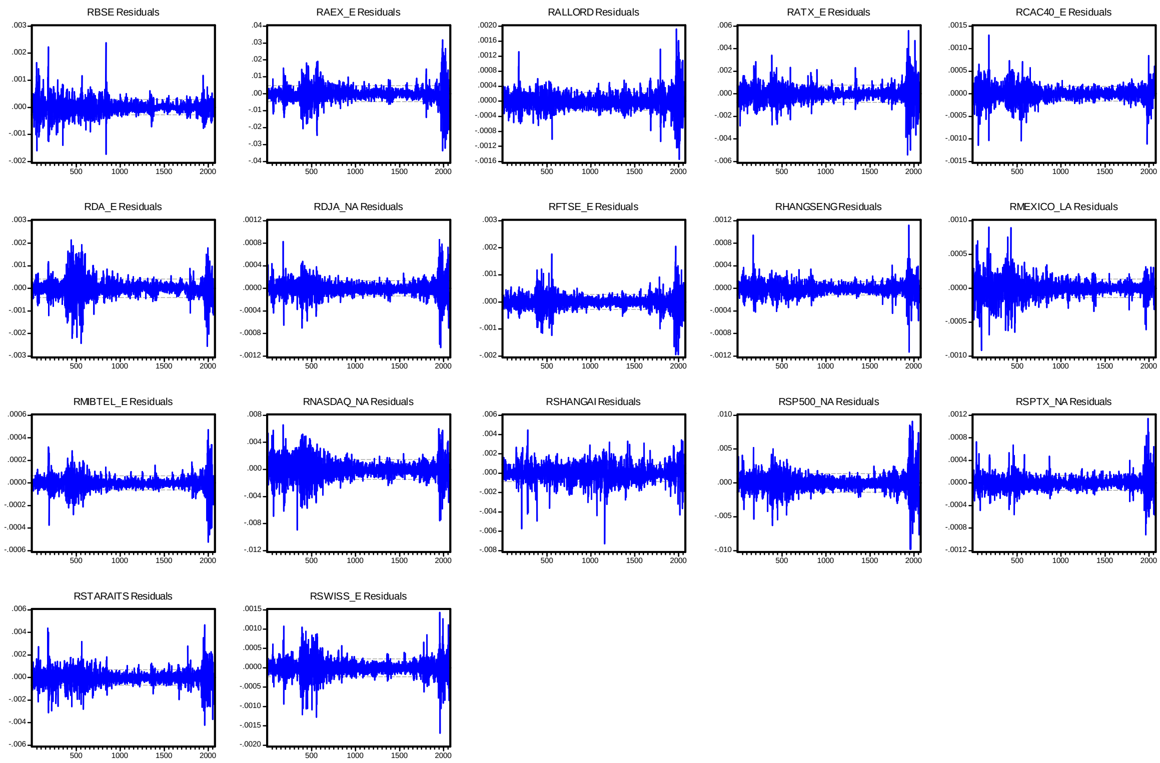
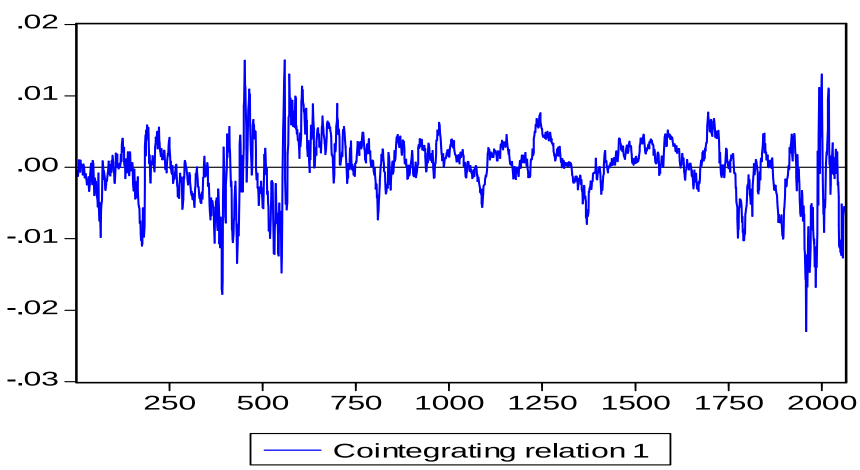


Figure 3: Co-integration analysis for the above said equation



Concluding Remarks:

This paper empirically investigates the long run equilibrium relationship between the Indian stock market and the stock market indices of five developed countries as a using the multivariate co integration. The multivariate co integration technique is used to investigate the long run relationship. To assess the short run influence of one market on the other and to assess how many days each market takes to factor out the influence Indian market, we have used the granger causality test with two days.

The study concludes, that India and other countries markets highly co integrating during the period of the study. Financial integration is key to delivering competitiveness, efficiency and growth. But Is integration brings financial stability? Not necessarily. As it indicates that, the integration of markets may also have positive impact of financial crisis which happened all over the world.

References:

Bekaert G. and Harvey C.R. (1995): Time Varying World Market Integration*: Journal of Finance*. 50. pp 403-414.

Chowdhry, T, Lin Lu and Ke Peng (2007): “Common stochastic trends among Far astern stock prices: effects of Asian financial crisis”, *International Review of Financial Analysis,* vol 16.

Cournot, Augustin (1927): *Researches into the Mathematical Principles of the Theory of Wealth*, Nathaniel T Bacon (trans), Macmillan.

Hassan, M K and A Naka (1996): “Short-run and long-run dynamic linkages among international stock markets”, *International Review of Economics and Finance*, vol 5, no 1.

Kasa, K (1992): “Common stochastic trends in international stock markets”, *Journal of Monetary Economics*, vol 29, pp 95–124.

Kim, E Han and V Singhal (2000): “Stock market opening: experience of emerging economies”, *Journal of Business*, vol 73, pp 25–66.

Taylor, M P and I Tonks (1989): “The internationalization of stock markets and abolition of UK exchange control”, *Review of Economics and Statistics*, vol 71, pp 332–6.