Research Study

On the Topic

Examining Associations between S&P CNX Nifty and selected Asian & US Stock Markets

Submitted to

National Stock Exchange of India Ltd

by

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(2009)

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1. Introduction

In a dynamic economic environment, knowledge of the international stock market structure is important for both investors and portfolio managers. Various theories in finance, suggest that individual and institutional investors should hold a well-diversified portfolio to reduce risk. From the perspective of an international investor who is willing to make portfolio investments in different stock markets, it is important to know if diversification can give some gain or not. International diversification is sought due to differences in the levels of economic growth and timing of business cycles among various countries. But, if the stock markets of different countries move together, then investing in different national stock markets would not generate any long-term gain to portfolio diversification.

Previously, International Portfolio Diversification was recommended on the assumption of low correlations/ integration among different national stock markets. But due to growing international trade, investment flows, deregulation of the financial systems and growth in international capital flows, national economies have become more closely linked. It has created a level of correlation among markets.

A comprehensive study on stock market integration carries a lot of importance in the present day situation when Asian economies are among fastest growing economies in the world. Policy-makers need to understand the emerging stock market interdependence. Such an understanding will provide a better grasp of the functioning of the Asian stock markets, and allow investors and policy makers to ask various questions regarding the actual trend (i.e., constant, increasing, or decreasing) of interdependence among them.

Present research considers a key issue that may interest investors, portfolio managers, corporate executives and policy makers. They are interested in understanding the intensity of stock market integration for diversification motives. Thus, it becomes essential to examine the interdependence between different Asian markets, including S&P CNX Nifty and its relation with other markets

2. Literature Review

Various studies undertaken in different parts of the world regarding linkages between the stock markets are mentioned as under:

Wheatley (1988) analyzed the data, of US and 17 other countries, by applying VAR and unit root tests, for the period 1960-1985, and supported the notion of equity-market integration. **Dwyer and Hafer (1988)** concluded that there were considerable interactions among stock market indexes, with one-way causality running from the US to other markets, including Hong Kong and Japan. **Eun and Shim (1989**) analyzed daily stock market returns of Australia, Hong Kong, Japan, France, Canada, Switzerland, Germany, US and the UK. They found existence of substantial interdependence among the national stock markets with US being the most influential market.
Using daily and intraday price and stock returns data, **Hamao, Masulis and Ng (1990)** find that there are significant spillover effects from the US and the UK stock markets to the Japanese market but not the other way round. **Rao & Naik (1990**) got same result when they attempted to examine the inter-relatedness of US, Japanese and Indian Stock Markets. Their findings pointed out that Japanese market acts like an independent factor in relation to the US and Indian stock markets. **Fischer and Palasvirta (1990)** also found a high level of interdependence between stock markets of 23 countries , they further concluded that US index prices lead almost every country index in the sample.**Becker et al. (1990)** too reported that the Japanese market has only a small impact on the U.S. return during the period of study. **Mathur and Subrahmanyam (1990)** used the concept of Granger causality to examine interdependencies among the stock market indices for four Nordic countries and the U.S. The results indicate that the Nordic stock markets are less than fully integrated. Further **Malkamäki (1992)** examines the interdependence of stock markets in Sweden, Finland and their biggest trading partners in the period 1974–89 and finds that the Scandinavian markets seem to be led by the German and the UK market. **Chan et al. (1992)** uses unit root and cointegration tests to examine the relationships among the stock markets in Hong Kong, South Korea, Singapore, Taiwan, Japan, and the United States. Their findings suggest that the stock prices in major Asian markets and the United States are weak-form efficient individually and collectively in the long run. **Cheung and Mak (1992)** concluded that The US market can be considered as a 'global factor' and is found to lead most of the Asian - Pacific emerging markets with the exception of three relatively closed markets: Korea, Taiwan and

Thailand. The Japanese market is found to have a less important influence on the Asian - Pacific emerging markets.

Confirming the previous study **Smith et al. (1993)** also find evidence of Granger unidirectional causality running from the US to the other countries immediately after the October 1987 worldwide crash. **Park and Fatemi (1993)** examine the linkages between the equity markets of the Pacific- Basin countries to those of the US, UK and Japan. It was again noticed that the US market is the most influential compared to that of UK and Japan. It was found that Australia is most sensitive to the US market. Singapore, Hong Kong and New Zealand form the next group and exhibit moderate linkages

Another study that confirms US dominated role is done by **Choudhury (1994),** he examine the relationship among the Asian Newly Industrialized Economies (NIEs), Japan and the US. By applying variance decomposition and impulse response functions, they found that the US led the NIEs and that there were significant linkages between the markets. **Blackman et al. (1994)** further suggests that, while such relationships were unlikely before 1980, markets are now expected to move together. **Arshanapalli, Doukas and Lang (1995)** examine the possible links between the US and six major Asian Stock Markets before and after October 1987.They concluded that the Asian equity markets were less integrated with Japanese equity market than they were with the US market. Working in the same direction **Arshanapalli et al. (1995**) documents the presence of a common stochastic trend between the U.S. and the Asian stock market movements during the post-October 1987 period. The evidence suggests a cointegrating structure. **Hassan and Naka (1996)** investigates the dynamic linkages among the U.S., Japan, U.K. and German stock market and found significant evidence in support of both short-run and long run relationships among these four stock market indices. **Sewell et al. (1996)** also examined five Pacific Rim countries and the US, documenting evidence of varying degrees of market co-movements.. **Karolyi and Stulz (1996)** study the daily return co-movements between the Japanese and U.S. stocks from 1988 to 1992 and find evidence that correlations are high when there are significant markets movements. **Markellos and Siriopoulos (1997)** too examined the diversification benefits available to U.S. and Japanese investors over the period 1974-94 in seven of the smaller European stock markets. Cointegration analysis found no significant common trend shared between the U.S. and Japanese markets. **Palac-McMiken (1997)** uses the monthly ASEAN market indices (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) between 1987 and 1995 and finds that with the exception of Indonesia, all the markets are linked with each other. **Kanas (1998**) discovered that the US stock market does not have pair wise co-integration with any of the European markets. These results imply that there are potential benefits from diversifying in US stocks as well as stocks in European markets. **Janakiramanan and Lamba (1998)** empirically examine the linkages between the Pacific-Basin stock markets. The influence of the US market on the Australasian markets has diminished over more recent years, and the emerging market of Indonesia is becoming more integrated with these markets. **Elyasiani et al. (1998)** found No significant interdependence between the Sri Lankan market and the equity markets of the US and the Asian markets considered. **Liu et al. (1998**) had tried to examine the stability of the interrelationship among the emerging and developed stock markets of Thailand, Taiwan, Japan, Singapore, Hong-Kong and the US. They found an increase in the general stock market interdependence. **Ramchand and Susmel (1998)** find that the correlations between the U.S. and other world markets are on average 2 to 3.5 times higher when the U.S. market is in a high variance state as compared to a low variance regime. They also find that, compared to a GARCH framework, the portfolio choices resulting from their SWARCH model lead to higher Sharpe ratios. In their paper, **Gerrits and Yuce (1999)** test the interdependence between stock prices in Germany, the UK, the Netherlands and the US. Results of the tests show that the US exerts a significant impact on European markets. Moreover, the three European markets influence each other in the short and long run. **Masih and Masih (1999)** also found high level of interdependence among markets in Thailand, Malaysia, the U.S., Japan, Hng Kong, and Singapore from 1992 to 1997.On the other hand **Christofi and Pericli (1999)** investigate the short turn dynamics between five major Latin American stock markets (Argentina, Brazil, Chile, Columbia, and Mexico) from 1992 to 1997. They find significant first and second moment time dependencies. Cross spectral analysis is applied by **Smith (1999)** to six of the G-7 markets to determine whether frequency domain correlations have increased post-crash relative to the pre-crash period. The results indicate that correlations have increased for most of the markets studied**. Sheng and Tu (2000)** use a cointegration and variance decomposition analysis to examine the linkages among the stock markets of 12 Asia–Pacific countries, before and during the period of the Asian financial crisis. In addition, Granger's causality test suggests that the US market still 'causes' some Asian countries during the period of crisis, reflecting the US market's persisting dominant role. **Ng (2000)** examines the magnitude and changing nature of volatility spillovers from Japan and the US to six

Pacific-Basin equity markets. The study finds that regional and world factors are important for market volatility in the Pacific-Basin region, though world market influence tends to be greater. **Roca and Selvanathan (2001)** analysed price linkages between the equity market of Australia and those of Hong Kong, Singapore and Taiwan, covering the period 1975-1995. The results show that the Australian market is not significantly linked with any of these markets. **Scheicher (2001)** studied the regional and global integration of stock markets in Hungary, Poland and the Czech Republic. The empirical result is the existence of limited interaction.

Johnson and Soenen (2002) find that the equity markets of Australia, China, Hong Kong, Malaysia, New Zealand, and Singapore are highly integrated with the stock market in Japan. **Kumar (2002),** in his study, confirmed that stock index of Indian stock market was not co-integrated with that of developed markets. **Mishra (2002)** investigated the international integration of Indian stock market. He found no co integrating vector between BSE and NASDAQ indices that signifies there was no long-run relationship between these two stock exchanges. **Darrat and Zhong (2002)** examined the linkages between eleven emerging Asia-Pacific markets with US and Japan. They argued that the effect of the movements in the Japan market on the Asia-Pacific region is only transitory. **Ng (2002)** found no evidence to indicate a long–run relationship among the South–East Asian stock markets. Correlation analyses also indicate that the South–East Asian stock markets are becoming more integrated. **Nath and Verma (2003)** analyzed the level of capital market integration by examining the transmission of market movements among three major stock markets in Asian region, viz., India, Singapore and Taiwan; they suggested that international investors could achieve long term gains by investing in the stock markets because of the independencies of the stock markets. **Bessler and Yang (2003)** concluded that The US market is highly influenced by its own historical innovations, but it is also influenced by market innovations from the UK, Switzerland, Hong Kong, France and Germany. **Darrat and Benkato (2003)** analyzed stock returns and volatility relations between the Istanbul Stock Exchange (ISE) and the stock markets in the US, the UK, Japan and Germany. They realized that the two matured markets of the US and the UK shoulder significant responsibility for the stability and financial health of smaller emerging markets like the ISE.

Wang et al. (2003) uniquely examined relationships among the five largest emerging African stock markets and the US market. There is evidence of both long-run relationships and short-run causal linkages between these markets. **Baharumshah et al. (2003)** examines the dynamic interrelationship among four Asian markets (Malaysia, Thailand, Taiwan and South Korea) The evidence shows that the degree of integration between the Asian emerging markets and the US increased following the deregulation period, and that the relationship has intensified since the onset of the Asian crisis. **Hatemi and Roca (2004)** examines the equity market price interaction between Australia and the European Union . they concluded that Australia also had no causal links with Germany and France but it had with the UK, with causality running from the UK to Australia but not vice-versa.

Working in line with above researches ,**Narayan et al. (2004)** examines the dynamic linkages between the stock markets of Bangladesh, India, Pakistan and Sri Lanka using Granger causality approach. In the short run there is unidirectional Granger causality running from stock prices in Pakistan to India, stock prices in Sri Lanka to India and from stock prices in Pakistan to Sri Lanka. Bangladesh is the most exogenous of the four markets.**Click and Plummer (2005)** concluded that ASEAN-5 stock markets are integrated in the economic sense, but that integration is far from complete. **Maghyereh (2006)** investigated the interdependence among the daily equity market returns for four major Middle Eastern and North African (MENA) emerging markets, Jordanian, Egyptian, Moroccan and Turkish markets. Evidence indicates that none of the MENA markets is completely isolated and independent. After analyzing markets of 23 different countries **Mukherjee and Mishra (2007)** identified increasing tendency of integration among the markets and discovered that countries of same region are found to be more integrated than others.

Present study contributes to the existing body of literature. Research studies on the issue of Stock Markets Integration, must be longitudinal rather than cross sectional. A continued research on the subject can help policy makers and practitioners. The present study takes a step ahead in the same direction. It is also an attempt to fill the time gap of researches on Asian and US markets. It also examines TA 100 of Israel for which earlier literature is scarce.

3. Methodology

3.1 Sample

The study is based on secondary data, which covers the recent period using daily closing figure from 01/06/1999 to 01/06/2009. For better understanding and to judge time varying results the time period is divided into two equal parts. Period-I starts from 01/06/2009 to 02/06/2004 and Period –II is ranged between 01/06/2004 to 01/06/1999

Table 1 shows the general stock indices of the countries, which make up the sample of the study. The data is taken from Yahoo Finance and nseindia.com.

The daily returns/ prices of the sample stock markets are matched by the calendar date, the timing of the trading sessions of the stock exchanges may not completely be related. The study is based on the daily closing price, rather than the intra day prices.

Table No.1: Stock Exchanges and Stock Indices

S. No	Country /Region	Index	Symbol
1	India	BSE 30	BSE
2	India	S&P CNX Nifty	NIFTY
3	China	Shanghai Composite	SC
4	Hong Kong	Hang Seng	HS
5	Indonesia	Jakarta Composite	JC
6	Malaysia	KLSE Composite	KLSE
7	Japan	Nikkei 225	NIKKEI
8	Singapore	Straits Times	ST
9	S. Korea	Seoul Composite	SEOUL
10	Taiwan	Taiwan Weighted	TAIWAN
11	Israel	TA-100	TA
12	USA	DJIA	DJIA
13	USA	S&P 500	S&P

3.2 Hypotheses

After the review of literature, it is evident that econometric methods are the most useful method to analyse and interpret data. For the purpose of the study, following hypotheses are put to trial.

H_{01} = NIFTY returns are not normally distributed in both periods understudy.

H_{02} = Volatility has increased in NIFTY in Period -II

H_{03} = No change in period wise correlation of NIFTY with all indices understudy

H_{04} = Existence of Unit Root (non stationarity) in NIFTY as well as other indices in both periods

H_{05} = No change in cointegration among stock indies in Period -II.

H_{06} = No change in Granger Causality found between NIFTY and other indices in Period-II

3.3 Methodology

Following methods are used to test correlation, stationarity of time series, co integration and causalities between the stock markets. The computations in the present study are aided by the use of Eviews 5.1. In this study, following test were undertaken:

- The Jarque-Bera Test is used to find out the normal distribution of returns of Markets
- Pearson correlation is used to find correlation between the stock markets returns.
- Testing for stationarity (unit root test) is done by using, both the Augmented Dickey-Fuller and the Phillips-Perron tests (fit for applying on non normal distribution).
- Johansen Cointegration test is used for pinpointing the long run relationships among the markets under study.
- For Causality Test, Gragner test is used, which identify that whether one series has significant explanatory power for another series

Return of the indexes are used to find out correlation among the stock markets, Daily return has been calculated as follows by taking the natural logarithm of the daily closing price relatives

$$r = \ln (P_t/P_{t-1})$$

It may further be noted that the price of the indexes are used to do Test for stationarity, Cointegration Test and Granger Causality Test.

Analysis of Empirical Results

Descriptive Statistics

Table 2a (for Period-I) and Table 2b (for Period-II) provide summary statistics about index return, namely means, minimums, maximums, medians, standard deviations(SD), skewness, kurtosis and the Jarque- Bera .

It is noted that during the Period-I SD was highest in SC (0.1987) followed by BSE (0.1432), JC (0.1151) and TA (0.0856). It is noted that NIFTY's SD is 0.0564 in Period-I which moved down to 0.3875 in Period-II. It is further observed that during the Period –II the SD reduced in all but US indices. In the same period highest SD is witnessed in BSE followed by SC,JC and TA. Fall in SD signifies falling volatility. The results show that the returns are not normally distributed, which may open the door to the issue of stationarity of the time series of returns under study.

Table 2a: Characteristics of Distributions of the Stock Indices (Period-I)

	BSE	NIFTY	SC	HS	JC	KLSE	NIKKEI	ST	SEOUL	TAIWAN	TA	DJIA	SP
Mean	-0.000044	-0.000120	-0.000221	0.000010	-0.000160	-0.000016	0.000218	0.000095	0.000010	0.000068	-0.000068	0.000049	0.000129
Median	-0.001115	-0.001334	0.000000	0.000306	-0.000569	-0.000007	0.000440	0.000315	-0.000794	0.000801	-0.000454	0.000038	0.000088
Maximum	2.241588	0.724564	1.232094	0.208593	1.128173	0.339572	0.337177	0.226339	0.450418	0.307914	0.332812	0.119070	0.216980
Minimum	-2.237298	-0.691149	-1.257755	-0.258194	-1.120575	-0.330826	-0.383294	-0.233133	-0.431818	-0.331426	-0.334309	-0.150448	-0.249641
Std. Dev.	0.143209	0.056428	0.198796	0.033849	0.115177	0.046990	0.034282	0.024390	0.057401	0.041144	0.085674	0.018200	0.020575
Skewness	0.044052	0.295415	0.272801	-0.390270	0.189343	0.006998	-0.397323	0.133441	0.246530	-0.229909	0.012976	-0.231340	-0.499671
Kurtosis	113.586100	64.999710	24.978180	17.807740	46.391500	23.164020	41.295420	24.205710	27.072310	24.285660	7.129440	12.328300	34.103590
Jarque-Bera	661400.50	208233.60	26180.81	11910.08	101837.00	22023.50	79471.74	24361.64	31401.45	24553.24	923.70	4725.03	52456.74
Probability	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	1300	1300	1300	1300	1298	1300	1300	1300	1300	1300	1300	1300	1300

Table 2b: Characteristics of Distributions of the Stock Indices (Period-II)

	BSE	NIFTY	SC	HS	JC	KLSE	NIKKEI	ST	SEOUL	TAIWAN	TA	DJIA	SP
Mean	-0.000874	-0.000845	-0.000418	-0.000342	-0.000773	-0.000218	0.000119	-0.00022	-0.000435	-0.000115	-0.00028	0.000121	0.000133
Median	-0.001617	-0.001567	-0.000162	-0.000732	-0.001435	-0.000463	-0.000195	-0.000653	-0.001423	-0.000558	-0.00038	-0.000415	-0.000709
Maximum	0.727019	0.365888	0.795718	0.198364	0.505186	0.376957	0.464172	0.286767	0.26113	0.321756	0.254411	0.256587	0.29624
Minimum	-0.651788	-0.345243	-0.914406	-0.202947	-0.515957	-0.376878	-0.518631	-0.324725	-0.251648	-0.405096	-0.32688	-0.268636	-0.327359
Std. Dev.	0.067612	0.038759	0.062282	0.02462	0.051918	0.042311	0.034025	0.023976	0.031224	0.037967	0.046304	0.024349	0.02339
Skewness	0.280952	0.058527	-1.692989	-0.364398	0.011913	0.12118	-0.78012	-0.691247	-0.34199	-0.209487	0.030631	-0.331719	-0.428599
Kurtosis	33.54466	23.60942	108.2987	19.34189	31.70212	36.93456	75.1393	48.9322	23.00704	39.70967	8.838718	45.82166	57.46394
Jarque-Bera	50592.22	23025.64	601673.8	14505.52	44657.49	62427.02	282236.4	114470.6	21723.96	73060.68	1848.199	99425.38	160839.1
Probability	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	1301	1301	1301	1301	1301	1301	1301	1301	1301	1301	1301	1301	1301

Correlation

Table 3a and 3b show the return correlations among the various indices under study.

Table 3a: Correlations of Returns of the Stock Indices (Period-I)

	BSE	NIFTY	SC	HS	JC	KLSE	Nikkei	ST	Seoul	Taiwan	TA	DJIA	SP
BSE	1.00												
NIFTY	0.70	1.00											
SC	0.00	0.02	1.00										
HS	0.11	0.22	0.02	1.00									
JC	0.07	0.37	0.02	0.14	1.00								
KLSE	0.00	0.07	0.00	0.16	0.21	1.00							
Nikkei	-0.01	-0.04	0.05	0.13	-0.07	-0.01	1.00						
ST	0.12	0.20	-0.01	0.25	0.19	0.24	0.26	1.00					
Seoul	0.09	0.11	0.04	0.07	0.06	0.15	0.07	0.22	1.00				
Taiwan	-0.01	-0.03	0.07	0.14	0.03	0.19	0.25	0.20	0.17	1.00			
TA	0.15	0.22	-0.57	0.11	0.22	0.18	0.05	0.17	0.08	-0.02	1.00		
DJIA	-0.05	-0.06	-0.03	0.13	-0.01	0.01	0.21	0.17	0.00	0.08	0.04	1.00	
SP	-0.06	-0.10	0.01	0.18	-0.04	0.00	0.35	0.24	-0.01	0.16	0.03	0.75	1.00

Table 3b: Correlations of Returns of the Stock Indices (Period-I) I)

	BSE	NIFTY	SC	HS	JC	KLSE	Nikkei	ST	Seoul	Taiwan	TA	DJIA	SP
BSE	1.00												
NIFTY	0.68	1.00											
SC	0.10	0.08	1.00										
HS	0.12	0.24	0.08	1.00									
JC	0.10	0.20	0.02	0.21	1.00								
KLSE	0.01	0.02	-0.01	0.21	0.44	1.00							
Nikkei	0.04	0.06	0.12	0.36	0.05	0.06	1.00						
ST	0.05	0.14	0.11	0.53	0.23	0.28	0.46	1.00					
Seoul	0.13	0.22	0.08	0.35	0.22	0.15	0.23	0.31	1.00				
Taiwan	0.08	0.04	0.10	0.26	0.15	0.17	0.34	0.31	0.17	1.00			
TA	0.13	0.17	-0.03	0.18	0.17	0.17	0.13	0.25	0.18	0.04	1.00		
DJIA	-0.04	0.01	0.01	0.37	0.03	0.15	0.25	0.44	0.14	0.16	0.15	1.00	
SP	-0.04	0.01	0.02	0.23	0.02	0.05	0.38	0.47	0.11	0.23	0.15	0.75	1.00

It can be clearly seen from the Table 3a and 3b that correlations among the returns of the indices under study has increased in 46 out of 78 possible correlations. It may be seen as first indication for the increasing interdependency among them.

It is noted that correlation of return of NIFTY with SC, Seoul and HS has increased in Period-II. It decreased in case of JC, KLSE, ST and TA. It is observed that correlation of NIFTY with Nikkei, Taiwan DJIA and SP has reversed in Period-II. It is also seen that correlation between NIFTY and BSE has gone down slightly in the same period. BSE's correlation with other indices like SC, HS, JC, KLSE and Seoul has also increased, but reduced in the case of ST, TA, DJIA and SP. It reversed for Nikkei and Taiwan. It is worth mentioning that correlation of returns between SC and KLSE , SC and ST , KLSE and Nikkei , JC and Nikkei, JC with US indices has reversed. Correlation of HS with all other has gone up in Period – II. As mentioned earlier that correlation of NIFTY with US indices has changed marginally, it may have have long term policy implication for investors too.

The correlations need to be further verified for the direction of influence by the Granger causality test and for long-term movements among the returns of stock markets, by the co-integration. All these tests will provide more robust results if the underlying are stationary over time and therefore, there is a need of a stationarity test for the time series under study which is done below.

Unit Root Test

A unit root test is used to test a time series for stationarity. The most appropriate and widely used test is the Augmented Dickey-Fuller (ADF), which uses the existence of a unit root as the null hypothesis.

Augmented Dickey-Fuller (ADF Test)

Results of the Unit Root Test is contained in Table 4a (for Period-I) and 4b (for Period-II)

Table 4a: Augmented Dickey-Fuller (ADF Test) Period-I

Symbol	Level			First Difference		
	Lag Length	ADF Statistic	P-value	Lag Length	ADF Statistic	P-value
BSE	8	- 1.8000	.3805	7	-19.6979	0.00
NIFTY	5	-1.8580	.3560	4	-21.9594	0.00
SC	16	-2.7024	.0738	15	-08.7148	0.00
HS	4	-1.5610	.5023	3	-24.7273	0.00
JC	6	- 2.3823	.1470	5	-22.2372	0.00
KLSE	4	-2.1964	.2078	3	-26.1313	0.00
NIKKEI	3	-0.9228	.7813	2	-29.5752	0.00
ST	2	- 1.5565	.5046	1	-34.0801	0.00
SEOUL	6	- 2.1364	.2305	5	-21.2046	0.00
TAIWAN	2	- 1.6255	.4691	3	-22.9182	0.00
TA	9	- 1.6792	.4417	8	-17.0110	0.00
DJIA	2	- 2.2083	.2035	1	-32.3507	0.00

Table 4b: Augmented Dickey-Fuller (ADF Test) Period-II

Symbol	Level			First Difference		
	Lag Length	ADF Statistic	P-value	Lag Length	ADF Statistic	P-value
BSE	3	-1.0061	.7530	2	-29.2137	0.00
NIFTY	3	-0.7699	.8266	2	-25.9050	0.00
SC	3	-1.0465	.7383	2	-30.7276	0.00
HS	1	-1.2221	.7090	0	-46.1164	0.00
JC	3	-0.8285	.8102	2	-28.1885	0.00
KLSE	8	-0.7184	.8401	7	-19.1222	0.00
NIKKEI	3	-1.5090	.5289	2	-28.5814	0.00
ST	2	-0.7660	.8277	1	-34.5530	0.00
SEOUL	4	-0.5869	.8709	3	-24.2235	0.00
TAIWAN	4	-1.6713	.4457	3	-24.5560	0.00
TA	5	-0.6609	.8542	4	-21.4584	0.00
DJIA	4	-1.8017	.3799	3	-24.7530	0.00

Exogenous: Constant
Lag Length: Automatic based on SIC, MAXLAG=25
*MacKinnon (1996) one-sided p-values.
Deterministic terms: Intercept

The critical values from MacKinnon (1996) for rejection of H0: intercept	1% level	-3.433291
	5% level	**-2.862726**
	10% level	-2.567447

Inferring from table 4a and 4b, one can conclude that the null hypothesis about the existence of a unit root cannot be rejected for all the variables using intercept terms in the test equation at the level form for both the periods. However, for the first differences of all the variables the null hypothesis of a unit root is strongly rejected for both the periods. So it can be said that all the variables contain a unit root, that is, non-stationary in their level forms, but stationary in their first differenced forms. Result remains same in both periods under study.

Co-integration Test

Co-integration is a property of two or more variables moving together through time, and despite following their own individual trends will not drift too far apart since they are linked together in some sense. The results of the unit root test show that the time series of indices of share prices related to various stock exchanges under study are I (1). Therefore, co-integration will be a suitable means for correctly testing hypotheses concerning the long-term relationship among the time series under the study. It tests a set of null hypothesis that there exist no co-integrating equations among variables.

For Period- I, first part of the co-integration results (table 6a), the trace test, indicate that there exist four co-integrating vectors at 5% level. Second part of the co-integration results (table 6b), the Maximum Eigenvalue test, also indicates the same result, but cointegration equation is one.

For the Period-II, it is revealed that cointegration equation has increased to five. In case Maximum Eigen Value Test the equation have increased to three from one (in Period –I),which shows increasing cointegration in Period –II.

It is important to note that co-integration reflects only co-movements between two time series over a period of time among variable under study but does not represent the correlation among them. Hence, through the co-integration tests, one can conclude that by and large stock price indices across the world move together.

Table 6a: Co-integration Tests (Period-I)

A: Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.15222	636.51320	NA	NA
At most 1 *	0.06988	422.50620	334.98370	0.00
At most 2 *	0.05070	328.61790	285.14250	0.00
At most 3 *	0.04163	261.19330	239.23540	0.00
At most 4 *	0.04039	206.08630	197.37090	0.02
At most 5	0.03336	152.64850	159.52970	0.11
At most 6	0.02489	108.67610	125.61540	0.34
At most 7	0.02121	76.00526	95.75366	0.51
At most 8	0.01633	48.22227	69.81889	0.71
At most 9	0.00875	26.89082	47.85613	0.86
At most 10	0.00679	15.50449	29.79707	0.75
At most 11	0.00405	6.67633	15.49471	0.62
At most 12	0.00109	1.41570	3.84147	0.23

Trace test indicates 4 co-integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Trend assumption: Linear deterministic trend
Lags interval (in first differences): 1 to 4

B: Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.152216	214.007	NA	NA
At most 1 *	0.069883	93.88833	76.57843	0.0007
At most 2	0.050695	67.42457	70.53513	0.0945
At most 3	0.04163	55.10706	64.50472	0.2919
At most 4	0.040394	53.43776	58.43354	0.1432
At most 5	0.03336	43.97235	52.36261	0.277
At most 6	0.024894	32.67089	46.23142	0.6132
At most 7	0.021209	27.78299	40.07757	0.5773
At most 8	0.016325	21.33145	33.87687	0.6591
At most 9	0.008747	11.38633	27.58434	0.9545
At most 10	0.006789	8.828161	21.13162	0.846
At most 11	0.004051	5.260639	14.2646	0.7087
At most 12	0.001092	1.415695	3.841466	0.2341

Max-eigenvalue test indicates 1 co-integrating eqn (s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 6b: Co-integration Tests (Period-II)

A: Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.118885	665.836	NA	NA
At most 1 *	0.089361	501.6779	334.9837	0
At most 2 *	0.059401	380.2667	285.1425	0
At most 3 *	0.052391	300.8412	239.2354	0
At most 4 *	0.043253	231.0452	197.3709	0.0003
At most 5 *	0.038758	173.6965	159.5297	0.0067
At most 6	0.031048	122.4276	125.6154	0.077
At most 7	0.020546	81.51965	95.75366	0.3157
At most 8	0.0161	54.59342	69.81889	0.4361
At most 9	0.010723	33.54125	47.85613	0.527
At most 10	0.008848	19.55889	29.79707	0.4533
At most 11	0.004076	8.031684	15.49471	0.462
At most 12	0.002106	2.733879	3.841466	0.0982

Trace test indicates 5 co-integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Trend assumption: Linear deterministic trend
Lags interval (in first differences): 1 to 4

B: Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.118885	164.1581	NA	NA
At most 1 *	0.089361	121.4112	76.57843	0
At most 2 *	0.059401	79.42552	70.53513	0.0062
At most 3 *	0.052391	69.79603	64.50472	0.0144
At most 4	0.043253	57.34868	58.43354	0.0637
At most 5	0.038758	51.26886	52.36261	0.0644
At most 6	0.031048	40.90796	46.23142	0.1666
At most 7	0.020546	26.92623	40.07757	0.6382
At most 8	0.0161	21.05217	33.87687	0.6802
At most 9	0.010723	13.98236	27.58434	0.8238
At most 10	0.008848	11.5272	21.13162	0.5947
At most 11	0.004076	5.297806	14.2646	0.7039
At most 12	0.002106	2.733879	3.841466	0.0982

Trace test indicates 3 co-integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Trend assumption: Linear deterministic trend
Lags interval (in first differences): 1 to 4

Pair-wise Granger Causality Tests

Having done the co-integration test, there is a need to capture the degree and the direction of correlation among the stock price indices under study pair-wise Granger Causality Tests are conducted. These tests involve examining whether lagged values of one series have significant explanatory power for another series. They have null hypotheses of no granger causality. The results of these tests summarized in table 7 and it indicates whether there exists significant Granger Causality and if it exists, then in which direction such causality exists among various stock markets. The table presents a comparative statement of Pair wise Granger Causality Tests for both period under study.

By viewing the table it is clear that *Both Ways Causality* (◄►) has decreased tremendously in Period-II in all indices under study, but SC. Apart from this *No Causality Both Side* (**0**) has shown numerous changes, KLSE and SC are worth mentioning. Due to decrease in *Both Ways Causality, No Causality one-side* incidences have increased.

NIFTY has witnessed noticeable changes. Firstly *Both Ways Causality* with other indices under study has decreased from eight to three. NIFTY maintained it with JC and TA, but initiated with HS. The same is lost with KLSE, Nikkei, ST and Taiwan. Relationship of NIFTY is also changed with BSE. In Period –I, NIFTY caused BSE, but did not get caused. In Period-II, *Both Ways Causality* started to begin. Earlier in Period –I, NIFTY shared *Both Ways Causality* with US indices, now they are failing to cause NIFTY. BSE still has *Both Ways Causality with* SP in Period –I. In this period, NIFTY shared No *Causality Both Side* with KLSE and SC. US indices seem to suffer the most in terms of loosing *Both Ways Causality.* Table

Table 7: Summary of Pair-wise Granger Causality Tests (Period-I and II)

	BSE		NIFTY		SC		HS		JC		KLSE		NIKKEI		ST		SEOUL		TAIWAN		TA		DJIA		S&P	
Symbol	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
BSE	--	--	0 ↑	↔	0	↔	↔	↔	↔	↑	↔	0 ↑	↔	↔	↔	0 ↑	↔	0 ↑	↑	0 ↑	↔	0 ↑	↔	↑	↔	↔
NIFTY	↑	↔	--	--	↑	0	↑	↔	↔	↔	↔	0	↔	↑	↔	↑	↑	↑	↔	↑	↔	↔	↔	↑	↔	↑
SC	0	↔	0 ↑	0	--	--	↑	0 ↑	↔	0	↔	0	↑	↔	↑	↔	↑	0 ↑	↑	0 ↑	↔	↔	↑	0	↑	0 ↑
HS	↔	↔	0 ↑	↔	0 ↑	↑	--	--	↔	↔	0 ↑	0	↔	0 ↑	↔	0 ↑	↔	↔	↔	↔	↔	0	↔	↑	↑	↑
JC	↔	0 ↑	↔	↔	↔	0	↔	↔	--	--	↑	0 ↑	↔	↑	↔	0 ↑	↔	0 ↑	↔	0	↔	↔	↔	0 ↑	↔	0 ↑
KLSE	↔	↑	↔	0	↔	0	↑	0	0 ↑	↑	--	--	↔	0	↔	↑	↔	↑	↔	↑	↔	↔	↑	0 ↑	↑	0
NIKKEI	↔	↔	↔	0 ↑	0 ↑	↔	↔	↑	↔	0 ↑	↔	0	--	--	↔	0 ↑	↔	↔	0 ↑	↑	↔	↑	↑	↑	↑	↑
ST	↔	↑	↔	0 ↑	0 ↑	↔	↔	↑	↔	↑	↔	0 ↑	↔	↑	--	--	↔	0	↔	↑	↔	0 ↑	↔	↑	↑	↑
SEOUL	↔	↑	0 ↑	0 ↑	0 ↑	↑	↔	↔	↔	↑	↔	0 ↑	↔	↔	↔	0	--	--	↔	0	↔	0 ↑	↔	↑	↔	↑
TAIWAN	0 ↑	↑	↔	0 ↑	0 ↑	↑	↔	↔	↔	0	↔	0 ↑	↑	0 ↑	↔	0 ↑	↔	0	--	--	↔	0 ↑	↔	↑	↑	0 ↑
TA	↔	↑	↔	↔	↔	↔	↔	0	↔	↔	↔	↔	↔	↑	↔	0 ↑	↔	↔	↔	↑	------	--	↔	0	↔	↑
DJIA	↔	0 ↑	↔	0 ↑	0 ↑	0	↔	0 ↑	↔	↑	0 ↑	0 ↑	0 ↑	0 ↑	↔	0 ↑	↔	0 ↑	↔	0 ↑	↔	0	--	--	0 ↑	↑
S&P	↔	↔	↔	0 ↑	0 ↑	↑	0 ↑	0 ↑	↔	↑	0 ↑	0	0 ↑	0 ↑	0 ↑	0 ↑	↔	0 ↑	0 ↑	0 ↑	↔	0 ↑	↑	0 ↑	--	--

Note 1: Table contained comparative analysis for Period I and II

Note. 2: ↑ denotes Granger Causality, running from one side to another, whereas ↔ means Causality from both side and **O** is put for no causality both side. 0 ↑ is put for no causality one side to another.

Note 3: The precise table is formed from the analysis of Granger Causality between the indexes. Complete analysis is attached as Annexure

SUMMARY AND CONCLUSION

The study is a continuation of research on the issue of growing interdependency among the stock markets and indices. Interdependency among global stock markets is studied primarily through correlation of returns, Co-integration and the Granger Causality. It is observed that a significant change took place in results derived from the analysis of data of Period- I and II. Results of hypotheses testing is presented

H_{01} = Accepted, H_{02} = Rejected' H_{03} = Rejected, H_{04} = Accepted, H_{05} = Rejected,H_{06} = Rejected

It is seen that the returns are not normally distributed. It is also concluded that volatility has gone down in Period-II. Change in correlation between the indices is also widespread in Period-II. It can further be derived that the interdependencies among the indices understudy has increased in Period-II. No very clear direction of relationships exists in the sense of Granger Causality indicating the fact that influence of few markets, especially that of the US, has eroded over a period of time.

Both the US markets are unable to cause impacts in various Asian markets. If the results of this study, regarding the influence of the US markets on other markets, are extended and contrasted with the previous studies included in the literature, it can be concluded that stock market integration and causation between different markets and indices have changed.

These developments in the international stock markets will pose great challenges before the investors to look for the markets with low correlation (study suggest that correlation of returns has increased in most of the cases in Period –II) with that of the domestic markets so as to exploit the gains of diversification as well as before policy makers because these growing interdependencies will infuse crisis in the domestic economy from other economies.

Therefore, it is hoped that the results of the present paper would be useful for individual and institutional investors for the management of their assets portfolios and policy makers.

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Annexure

PERIOD-I

Null Hypothesis:	Obs	F-Statistic	Probability
NIFTY does not Granger Cause BSE	1297	35.4749	0.0000*
BSE does not Granger Cause NIFTY		1.64868	0.1442
SC does not Granger Cause BSE	1297	1.38356	0.2276
BSE does not Granger Cause SC		1.25873	0.2794
HS does not Granger Cause BSE	1297	3.13033	0.0082*
BSE does not Granger Cause HS		21.2079	0.0000*
JC does not Granger Cause BSE	1297	6.17305	0.0000*
BSE does not Granger Cause JC		11.6284	0.0000*
KLSE does not Granger Cause BSE	1297	2.47776	0.0304*
BSE does not Granger Cause KLSE		8.76797	0.0000*
NIKKEI does not Granger Cause BSE	1297	2.23965	0.0483*
BSE does not Granger Cause NIKKEI		18.7385	0.0000*
ST does not Granger Cause BSE	1297	6.05768	0.0000*
BSE does not Granger Cause ST		21.9318	0.0000*
SEOUL does not Granger Cause BSE	1297	2.68662	0.0201*
BSE does not Granger Cause SEOUL		9.24802	0.0000*
TAIWAN does not Granger Cause BSE	1297	1.5603	0.1684
BSE does not Granger Cause TAIWAN		12.0878	0.0000*
TA does not Granger Cause BSE	1297	2.1605	0.0561
BSE does not Granger Cause TA		12.5461	0.0000*
DJIA does not Granger Cause BSE	1297	2.82172	0.0153*
BSE does not Granger Cause DJIA		17.204	0.0000*
SP does not Granger Cause BSE	1297	4.82724	0.0002*
BSE does not Granger Cause SP		24.5037	0.0000*
SC does not Granger Cause NIFTY	1297	2.16613	0.0555
NIFTY does not Granger Cause SC		3.27079	0.0061*
HS does not Granger Cause NIFTY	1297	0.96686	0.4369

NIFTY does not Granger Cause HS		22.312	0.0000*
JC does not Granger Cause NIFTY	1297	3.08388	0.0090*
NIFTY does not Granger Cause JC		12.5478	0.0000*
KLSE does not Granger Cause NIFTY	1297	2.37368	0.0372*
NIFTY does not Granger Cause KLSE		10.1225	0.0000*
NIKKEI does not Granger Cause NIFTY	1297	4.13792	0.0010*
NIFTY does not Granger Cause NIKKEI		17.9286	0.0000*
ST does not Granger Cause NIFTY	1297	4.83607	0.0002*
NIFTY does not Granger Cause ST		19.1383	0.0000*
SEOUL does not Granger Cause NIFTY	1297	1.3765	0.2303
NIFTY does not Granger Cause SEOUL		12.6098	0.0000*
TAIWAN does not Granger Cause NIFTY	1297	2.33835	0.0399
NIFTY does not Granger Cause TAIWAN		13.2909	0.0000*
TA does not Granger Cause NIFTY	1297	2.53825	0.0270*
NIFTY does not Granger Cause TA		19.9623	0.0000*
DJIA does not Granger Cause NIFTY	1297	3.60778	0.0030*
NIFTY does not Granger Cause DJIA		15.3232	0.0000*
SP does not Granger Cause NIFTY	1297	3.72095	0.0024*
NIFTY does not Granger Cause SP		18.9262	0.0000*
HS does not Granger Cause SC	1297	1.50588	0.1850
SC does not Granger Cause HS		5.97083	0.0000*
JC does not Granger Cause SC	1297	3.61599	0.0030*
SC does not Granger Cause JC		2.94256	0.0120*
KLSE does not Granger Cause SC	1297	5.51548	0.0000*
SC does not Granger Cause KLSE		2.58123	0.0248*
NIKKEI does not Granger Cause SC	1297	1.19993	0.3069
SC does not Granger Cause NIKKEI		4.53942	0.0004*
ST does not Granger Cause SC	1297	0.85715	0.5093
SC does not Granger Cause ST		4.4433	0.0005*
SEOUL does not Granger Cause SC	1297	1.04464	0.3898
SC does not Granger Cause SEOUL		3.35035	0.0052*
TAIWAN does not Granger Cause SC	1297	0.26244	0.9336
SC does not Granger Cause TAIWAN		2.70723	0.0193*

TA does not Granger Cause SC	1297	3.36231	0.0051*
SC does not Granger Cause TA		6.01236	0.0000*
DJIA does not Granger Cause SC	1297	1.64559	0.1450
SC does not Granger Cause DJIA		14.4772	0.0000*
SP does not Granger Cause SC	1297	1.14182	0.3362
SC does not Granger Cause SP		10.3928	0.0000*
JC does not Granger Cause HS	1297	4.93136	0.0002*
HS does not Granger Cause JC		9.87966	0.0000*
KLSE does not Granger Cause HS	1297	6.19734	0.0000*
HS does not Granger Cause KLSE		1.51518	0.1821
NIKKEI does not Granger Cause HS	1297	3.35606	0.0051*
HS does not Granger Cause NIKKEI		8.93093	0.0000*
ST does not Granger Cause HS	1297	4.85999	0.0002*
HS does not Granger Cause ST		9.43536	0.0000*
SEOUL does not Granger Cause HS	1297	7.9228	0.0000*
HS does not Granger Cause SEOUL		5.50583	0.0001*
TAIWAN does not Granger Cause HS	1297	6.67323	0.0000*
HS does not Granger Cause TAIWAN		7.31245	0.0000*
TA does not Granger Cause HS	1297	3.72658	0.0024*
HS does not Granger Cause TA		10.2444	0.0000*
DJIA does not Granger Cause HS	1297	6.7222	0.0000*
HS does not Granger Cause DJIA		27.4117	0.0000*
SP does not Granger Cause HS	1297	3.30764	0.0057
HS does not Granger Cause SP		44.1306	0.0000*
KLSE does not Granger Cause JC	1297	1.62712	0.1498
JC does not Granger Cause KLSE		4.77294	0.0003*
NIKKEI does not Granger Cause JC	1297	14.9392	0.0000*
JC does not Granger Cause NIKKEI		7.4663	0.0000*
ST does not Granger Cause JC	1297	8.20322	0.0000*
JC does not Granger Cause ST		4.47168	0.0005*
SEOUL does not Granger Cause JC	1297	4.70175	0.0003*
JC does not Granger Cause SEOUL		8.09522	0.0000*

TAIWAN does not Granger Cause JC	1297	7.61899	0.0000*
JC does not Granger Cause TAIWAN		3.46093	0.0041*
TA does not Granger Cause JC	1297	11.3628	0.0000*
JC does not Granger Cause TA		10.7175	0.0000*
DJIA does not Granger Cause JC	1297	3.06789	0.0093
JC does not Granger Cause DJIA		9.57904	0.0000*
SP does not Granger Cause JC	1297	3.60424	0.0031*
JC does not Granger Cause SP		14.2545	0.0000*
NIKKEI does not Granger Cause KLSE	1297	4.06591	0.0012*
KLSE does not Granger Cause NIKKEI		5.83877	0.0000*
ST does not Granger Cause KLSE	1297	3.72638	0.0024*
KLSE does not Granger Cause ST		7.56029	0.0000*
SEOUL does not Granger Cause KLSE	1297	2.45392	0.0318*
KLSE does not Granger Cause SEOUL		4.02938	0.0012*
TAIWAN does not Granger Cause KLSE	1297	12.4597	0.0000*
KLSE does not Granger Cause TAIWAN		4.36958	0.0006*
TA does not Granger Cause KLSE	1297	7.88747	0.0000*
KLSE does not Granger Cause TA		6.26347	0.0000*
DJIA does not Granger Cause KLSE	1297	1.58114	0.1624
KLSE does not Granger Cause DJIA		4.31798	0.0007*
SP does not Granger Cause KLSE	1297	0.868	0.5019
KLSE does not Granger Cause SP		8.36681	0.0000*
ST does not Granger Cause NIKKEI	1297	8.8376	0.0000*
NIKKEI does not Granger Cause ST		3.15237	0.0078
SEOUL does not Granger Cause NIKKEI	1297	8.54485	0.0000*
NIKKEI does not Granger Cause SEOUL		8.02055	0.0000*
TAIWAN does not Granger Cause NIKKEI	1297	5.05682	0.0001*
NIKKEI does not Granger Cause TAIWAN		1.08908	0.3646
TA does not Granger Cause NIKKEI	1297	7.92383	0.0000*
NIKKEI does not Granger Cause TA		10.0018	0.0000*
DJIA does not Granger Cause NIKKEI	1297	1.75351	0.1196
NIKKEI does not Granger Cause DJIA		18.7335	0.0000*

SP does not Granger Cause NIKKEI	1297	1.89013	0.0932
NIKKEI does not Granger Cause SP		20.6889	0.0000*
SEOUL does not Granger Cause ST	1297	10.9873	0.0000*
ST does not Granger Cause SEOUL		6.10623	0.0000*
TAIWAN does not Granger Cause ST	1297	10.3831	0.0000*
ST does not Granger Cause TAIWAN		10.7543	0.0000*
TA does not Granger Cause ST	1297	3.89954	0.0016*
ST does not Granger Cause TA		10.6449	0.0000*
DJIA does not Granger Cause ST	1297	2.84511	0.0146
ST does not Granger Cause DJIA		19.5501	0.0000*
SP does not Granger Cause ST	1297	1.66324	0.1405
ST does not Granger Cause SP		24.1577	0.0000*
TAIWAN does not Granger Cause SEOUL	1297	4.21272	0.0008*
SEOUL does not Granger Cause TAIWAN		7.22938	0.0000*
TA does not Granger Cause SEOUL	1297	2.75624	0.0175*
SEOUL does not Granger Cause TA		13.4831	0.0000*
DJIA does not Granger Cause SEOUL	1297	3.62022	0.0030*
SEOUL does not Granger Cause DJIA		18.8459	0.0000*
SP does not Granger Cause SEOUL	1297	3.37657	0.0049*
SEOUL does not Granger Cause SP		21.0242	0.0000*
TA does not Granger Cause TAIWAN	1297	8.47563	0.0000*
TAIWAN does not Granger Cause TA		11.5374	0.0000*
DJIA does not Granger Cause TAIWAN	1297	2.29087	0.0437*
TAIWAN does not Granger Cause DJIA		10.9798	0.0000*
SP does not Granger Cause TAIWAN	1297	1.2589	0.2793
TAIWAN does not Granger Cause SP		11.6593	0.0000*
DJIA does not Granger Cause TA	1297	3.60438	0.0031*
TA does not Granger Cause DJIA		11.7249	0.0000*
SP does not Granger Cause TA	1297	5.45004	0.0001*
TA does not Granger Cause SP		10.5962	0.0000*
SP does not Granger Cause DJIA	1297	6.13804	0.0000*
DJIA does not Granger Cause SP		1.91347	0.0893

(*) Rejection of the null hypothesis at 5% and therefore there is Granger causality

Period-II

Null Hypothesis:	Obs	F-Statistic	Probability
NIFTY does not Granger Cause BSE	1296	24.5739	0.0000*
BSE does not Granger Cause NIFTY		9.7552	0.0000*
SC does not Granger Cause BSE	1296	5.77416	0.0000*
BSE does not Granger Cause SC		3.26408	0.0062*
HS does not Granger Cause BSE	1296	2.8258	0.0152*
BSE does not Granger Cause HS		3.14831	0.0079*
JC does not Granger Cause BSE	1296	0.8717	0.4994
BSE does not Granger Cause JC		3.56746	0.0033*
KLSE does not Granger Cause BSE	1296	2.98109	0.0111*
BSE does not Granger Cause KLSE		0.51508	0.7650
NIKKEI does not Granger Cause BSE	1296	14.4899	0.0000*
BSE does not Granger Cause NIKKEI		2.40738	0.0349*
ST does not Granger Cause BSE	1296	4.13302	0.0010*
BSE does not Granger Cause ST		0.65515	0.6576
SEOUL does not Granger Cause BSE	1296	3.83252	0.0019*
BSE does not Granger Cause SEOUL		1.06366	0.3788
TAIWAN does not Granger Cause BSE	1296	6.63513	0.0000*
BSE does not Granger Cause TAIWAN		0.68103	0.6379
TA does not Granger Cause BSE	1296	7.13452	0.0000*
BSE does not Granger Cause TA		1.52203	0.1799
DJIA does not Granger Cause BSE	1296	1.47722	0.1943
BSE does not Granger Cause DJIA		4.29225	0.0007*
SP does not Granger Cause BSE	1296	3.49689	0.0038*
BSE does not Granger Cause SP		4.30339	0.0007*
SC does not Granger Cause NIFTY	1296	0.63097	0.6762
NIFTY does not Granger Cause SC		0.65167	0.6603
HS does not Granger Cause NIFTY	1296	2.42271	0.0338*
NIFTY does not Granger Cause HS		5.56388	0.0000*
JC does not Granger Cause NIFTY	1296	4.62223	0.0004*
NIFTY does not Granger Cause JC		2.52893	0.0275*

KLSE does not Granger Cause NIFTY	1296	1.96414	0.0813
NIFTY does not Granger Cause KLSE		0.35802	0.8773
NIKKEI does not Granger Cause NIFTY	1296	1.34623	0.2422
NIFTY does not Granger Cause NIKKEI		7.15934	0.0000*
ST does not Granger Cause NIFTY	1296	0.3558	0.8787
NIFTY does not Granger Cause ST		3.91845	0.0016*
SEOUL does not Granger Cause NIFTY	1296	0.97886	0.4294
NIFTY does not Granger Cause SEOUL		2.49647	0.0293*
TAIWAN does not Granger Cause NIFTY	1296	1.27636	0.2716
NIFTY does not Granger Cause TAIWAN		2.64746	0.0217*
TA does not Granger Cause NIFTY	1296	3.4212	0.0045*
NIFTY does not Granger Cause TA		5.02088	0.0002*
DJIA does not Granger Cause NIFTY	1296	1.497	0.1878
NIFTY does not Granger Cause DJIA		3.40104	0.0047*
SP does not Granger Cause NIFTY	1296	1.54363	0.1733
NIFTY does not Granger Cause SP		2.91314	0.0127*
HS does not Granger Cause SC	1296	3.48093	0.0040*
SC does not Granger Cause HS		0.51142	0.7678
JC does not Granger Cause SC	1296	0.87119	0.4997
SC does not Granger Cause JC		1.94946	0.0835
KLSE does not Granger Cause SC	1296	1.33501	0.2467
SC does not Granger Cause KLSE		1.21831	0.2981
NIKKEI does not Granger Cause SC	1296	9.65186	0.0000*
SC does not Granger Cause NIKKEI		3.19321	0.0072*
ST does not Granger Cause SC	1296	5.6469	0.0000*
SC does not Granger Cause ST		2.3612	0.0381*
SEOUL does not Granger Cause SC	1296	5.8733	0.0000*
SC does not Granger Cause SEOUL		0.17594	0.9716
TAIWAN does not Granger Cause SC	1296	2.59095	0.0243*
SC does not Granger Cause TAIWAN		1.56546	0.1669
TA does not Granger Cause SC	1296	5.93298	0.0000*
SC does not Granger Cause TA		6.42683	0.0000*

DJIA does not Granger Cause SC	1296	2.10994	0.0618
SC does not Granger Cause DJIA		0.2112	0.9579
SP does not Granger Cause SC	1296	3.18459	0.0073*
SC does not Granger Cause SP		0.43923	0.8213
JC does not Granger Cause HS	1296	2.25166	0.0472*
HS does not Granger Cause JC		3.45052	0.0042*
KLSE does not Granger Cause HS	1296	1.67755	0.1370
HS does not Granger Cause KLSE		1.67973	0.1365
NIKKEI does not Granger Cause HS	1296	4.53782	0.0004*
HS does not Granger Cause NIKKEI		1.27334	0.2729
ST does not Granger Cause HS	1296	16.6033	0.0000*
HS does not Granger Cause ST		0.73544	0.5969
SEOUL does not Granger Cause HS	1296	6.7405	0.0000*
HS does not Granger Cause SEOUL		2.28875	0.0439*
TAIWAN does not Granger Cause HS	1296	4.72217	0.0003*
HS does not Granger Cause TAIWAN		2.77386	0.0169*
TA does not Granger Cause HS	1296	1.25703	0.2802
HS does not Granger Cause TA		0.74885	0.5870
DJIA does not Granger Cause HS	1296	0.56383	0.7278
HS does not Granger Cause DJIA		6.07117	0.0000*
SP does not Granger Cause HS	1296	1.12357	0.3458
HS does not Granger Cause SP		8.62229	0.0000*
KLSE does not Granger Cause JC	1296	3.07265	0.0092*
JC does not Granger Cause KLSE		1.13602	0.3392
NIKKEI does not Granger Cause JC	1296	1.98276	0.0785
JC does not Granger Cause NIKKEI		2.75185	0.0176*
ST does not Granger Cause JC	1296	3.19743	0.0071*
JC does not Granger Cause ST		0.5349	0.7500
SEOUL does not Granger Cause JC	1296	4.07874	0.0011*
JC does not Granger Cause SEOUL		2.00692	0.0750
TAIWAN does not Granger Cause JC	1296	2.01624	0.0737
JC does not Granger Cause TAIWAN		0.08561	0.9945

TA does not Granger Cause JC	1296	2.88484	0.0135*
JC does not Granger Cause TA		5.42937	0.0001*
DJIA does not Granger Cause JC	1296	3.42403	0.0045*
JC does not Granger Cause DJIA		1.42908	0.2109
SP does not Granger Cause JC	1296	3.5571	0.0034*
JC does not Granger Cause SP		1.49931	0.1871
NIKKEI does not Granger Cause KLSE	1296	1.62916	0.1492
KLSE does not Granger Cause NIKKEI		1.90118	0.0913
ST does not Granger Cause KLSE	1296	0.75425	0.5830
KLSE does not Granger Cause ST		3.35126	0.0052*
SEOUL does not Granger Cause KLSE	1296	0.28539	0.9213
KLSE does not Granger Cause SEOUL		3.53325	0.0035*
TAIWAN does not Granger Cause KLSE	1296	0.78511	0.5604
KLSE does not Granger Cause TAIWAN		2.26012	0.0464*
TA does not Granger Cause KLSE	1296	4.04757	0.0012*
KLSE does not Granger Cause TA		5.54633	0.0000*
DJIA does not Granger Cause KLSE	1296	0.41244	0.8404
KLSE does not Granger Cause DJIA		1.32072	0.2526
SP does not Granger Cause KLSE	1296	1.43438	0.2090
KLSE does not Granger Cause SP		0.62527	0.6805
ST does not Granger Cause NIKKEI	1296	4.53348	0.0004*
NIKKEI does not Granger Cause ST		2.09537	0.0635
SEOUL does not Granger Cause NIKKEI	1296	4.60044	0.0004*
NIKKEI does not Granger Cause SEOUL		2.30428	0.0426*
TAIWAN does not Granger Cause NIKKEI	1296	1.26232	0.2778
NIKKEI does not Granger Cause TAIWAN		2.6378	0.0221*
TA does not Granger Cause NIKKEI	1296	3.04561	0.0097*
NIKKEI does not Granger Cause TA		2.25585	0.0468*
DJIA does not Granger Cause NIKKEI	1296	0.47141	0.7978
NIKKEI does not Granger Cause DJIA		3.28932	0.0059*
SP does not Granger Cause NIKKEI	1296	1.42587	0.2120
NIKKEI does not Granger Cause SP		4.10732	0.0011*

SEOUL does not Granger Cause ST	1296	1.7902	0.1119
ST does not Granger Cause SEOUL		1.07947	0.3699
TAIWAN does not Granger Cause ST	1296	0.83353	0.5258
ST does not Granger Cause TAIWAN		3.72109	0.0024*
TA does not Granger Cause ST	1296	4.1154	0.0010*
ST does not Granger Cause TA		1.51945	0.1807
DJIA does not Granger Cause ST	1296	0.96609	0.4374
ST does not Granger Cause DJIA		12.1178	0.0000*
SP does not Granger Cause ST	1296	1.8084	0.1082
ST does not Granger Cause SP		14.3651	0.0000*
TAIWAN does not Granger Cause SEOUL	1296	3.32737	0.0054
SEOUL does not Granger Cause TAIWAN		1.47046	0.1966
TA does not Granger Cause SEOUL	1296	2.37202	0.0374*
SEOUL does not Granger Cause TA		5.3422	0.0001*
DJIA does not Granger Cause SEOUL	1296	0.53203	0.7522
SEOUL does not Granger Cause DJIA		3.43499	0.0044*
SP does not Granger Cause SEOUL	1296	0.21257	0.9573
SEOUL does not Granger Cause SP		6.32323	0.0000*
TA does not Granger Cause TAIWAN	1296	2.81619	0.0155*
TAIWAN does not Granger Cause TA		1.00691	0.4122
DJIA does not Granger Cause TAIWAN	1296	0.39025	0.8557
TAIWAN does not Granger Cause DJIA		4.50663	0.0005*
SP does not Granger Cause TAIWAN	1296	0.77251	0.5696
TAIWAN does not Granger Cause SP		1.71186	0.1288
DJIA does not Granger Cause TA	1296	0.52565	0.7570
TA does not Granger Cause DJIA		1.66421	0.1403
SP does not Granger Cause TA	1296	1.07511	0.3723
TA does not Granger Cause SP		2.27047	0.0455*
SP does not Granger Cause DJIA	1296	1.68394	0.1354
DJIA does not Granger Cause SP		2.41073	0.0346*

(*) Rejection of the null hypothesis at 5% and therefore there is Granger causality