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Integration of Stock Market – Evidence from India and Major Global Indices

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Abstract

In designing portfolio, diversification plays an important role and diversifying into international market is one of the important ingredient in it. High integration among the markets across the globe, however, also have its own risk of spillover effect of one country into another geography which will have cascading effect across the entire globe. This study has been done to identify interdependency among ten indices of market spread across Asia, Europe and America. The study has been done by measuring co-integration among various indices and also determining causality among the indices by Granger Causality. The study reveals to large extent presence of a strong dependency across various markets. Among the indices studies SHANGAI from China showed low dependency across various geographies.

Keywords: Market Integration, Unit Root, Causality, Co-integration Market

Introduction

Diversification has always been important aspect for developing portfolio for getting best-risk return reward and for that one of the options is diversifying investments in international market. Diversifying in international markets may yield of overcoming political, economic, and environmental risk specific to a country. It is quite widely believed that stock markets performance is an important economic barometer of any country. A diversified index of any stock market is supposed to capture the performance of an economy and is reflection of all economic activity in the country. For taking benefit of diversification among different economies it is imperative to understand the interlinkages among different markets through indices of those markets. Diversifying portfolio in international market can yield good results if there exist low correlation among these markets as through diversification maximum gain can be derived for creating portfolio of low risk and high return. However with easing of capital flows among many international markets and deregulations among various financial markets across globe economies are coupling together and there is possibility of high correlation among market movements which may thus nullify the advantage of diversification.

Over the last few years globalization and liberalization in markets have increased in last decade Global market cap has exceeded $80 trillion (Chart 1). Tehrani (2011) has pointed that innovation in technologies and deregulating of financial markets is leading to financial integration. Babcky (2013) also observed that financial integration has accelerated in last decade because of rapid changes and development happening across all financial markets especially with the advent of technology enables fast processing and financial innovation.

Development in multinational companies, liberation of flow of foreign exchange has impacted strong correlation among markets. This mobility of capital for more earnings and diversification has made way for integration of stock markets. However this integration has always lead to risks of ripple effect being observed in other countries as well and the events of 2008 subprime crises in USA its aftermath leading to global melt down is an evidence of strong co-integrations of markets.

It is in this context that this study has been done to identify the interrelationship among the stock indices across the globe. This study will help in understanding the interdependency and co-integration among the markets that will enable policy makers, portfolio managers, and investors in designing their strategies.

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Review of Literature

There have been various studies across the globe in identifying linkages among stock indices. Some of the earlier studies include by Wheatley (1988) in which data of USA and 17 other countries was analyzed for a period ranging from 1960 to 1985, and it concluded about integration of equity markets. The earlier studies by Hilliard (1979), Lessard (1976) and Ripley (1973) identified low correlation between various indices of international markets that is required for reaping benefit of diversification.

Dwyer and Hafer (1988) also concluded about interaction among indices of various stock markets and identified one-way causality between US with other markets. Eun and Shim (1989) also identified same relationship among US and other market. On the similar lines Smith et al. (1993) also identified relationship of one-way causality of USA to other countries. Park and Fatemi (1993) establish the influence of US market over United Kingdom and Japan. However Kanas (1998) identified that US markets have no co-integration between any of the European market and thus may yield higher benefits for diversification.

Lehkonen and Heimonen (2015) found that integration affected mostly openness in the financial system and institutional environment and there is slight variation between emerging and developed market.

Darrat and Zhong (2002) studied the relationship emerging in Asia-Pacific markets with USA and Japan. They pointed out that the Japanese market has only transitory effect on Asia-Pacific region.

Valadkhani and Chancharat (2008) had studied about Granger cause relationship between Asian market with developed geographies such as USA and UK and they concluded that US markets influence Asian markets. The study found that the developed geographies, particularly the US, influence Asian markets.

Fahami (2011) examined linkages and co-integration relationship among the world fastest emerging BRICS economies on developed countries and concluded that in all type of periods markets were co-integrated.

Menon, Subha, and Sagaran (2009) confirmed that Indian Stock indices are related to major stock markets such as USA, Singapore, Hong Kong, and China. Gupta and Agarwal (2011) studied about the relationships between the Indian stock market and five other major Asian markets (Korea, Japan, Hong Kong, Indonesia, and Malaysia) and found a weak correlation among the stock exchanges. This offers a diversification benefit to institutional and international investors.

Gupta (2017) has used Granger causality and correlation as a tool to study interdependency of sectoral indices on each other.

Nath Mukherjee and Mishra (2010) studies about integration of NASDAQ and BSE and observed that there has been no long-term relationship between the indices of these market.

This study will add more to the existing literature on the subject which can help researchers, policy makers, and practitioners in the current context and this study takes a step ahead in the same direction. It is also an attempt to fill the time gap of researches on Asian, Europe, and US markets simultaneously.

Data

The study uses daily closing data of 10 stock market indices across the globe for the period of September 2001 to April 2018. One of the limitations of the data set has been that in some part of series there are long gaps as the markets are being closed for those days at stretch. To capture the global impact Shanghai, Hang sheng Nikkie225, Kospi, FTSE Singapore were taken from Asia. CAC, DAX and FTSE100 were taken from Europe and NASDAQ were taken from USA.

Table 1

Indices	*Stock Exchange*	*Country*
NIFTY	National Stock Exchange	India
CAC	Paris Stock Exchange	France
DAX	Frankfurt Stock Exchange	Germany
FTSE100	London Stock Exchange	United Kingdom
FTSE Singapore	Singapore Stock Exchange	Singapore
Shanghai	Shanghai Stock Exchange	China
Kospi	Korea Stock Exchange	Korea
Nasdaq	New York Stock Exchange	USA
Nikkie225	Tokyo Stock Exchange	Japan
Hangsheng	Hongkong Stock Exchange	China

In the study daily log return of closing indices were taken which can be presented as following:

Daily returns are calculated as the difference in the natural logarithm of the closing index value for the two consecutive trading days. It can be presented as:

$$R_t = \ln \frac{P_t}{P_{t-1}} \qquad \text{(i)}$$

R_t is logarithmic daily return at time t. P_{t-1} and P_t are daily prices of index of two consecutive days.

Descriptive Analysis

As observed from the table all indices have shown positive daily average return and NIFTY in this period has given highest daily average return of 0.06%. However Nikkie225 (1.495%) and Nasdaq (1.492%) have shown maximum variability measured through Standard deviation All indices returns were showing non-normality as measured by Jarque-Bera (JB) test. It is the most common test to identify presence of normality in the time series data and thus stationarity of series need to be checked for studying further.

To test the normality of data for return Jarque-Bera test was applied (ii)

$$JB = \frac{n-k+1}{6}\left(S^2 + \frac{1}{4}\left(C-3\right)^2\right) \qquad \text{(ii)}$$

n = no. of observations k = no. of variables

S = Skewness C = Kurtosis

As observed from Correlation Matrix on returns (Table 2) of indices all value are positive indicating a positive interdependence of all markets over each other. Nifty has shown low correlation with NASDAQ (0.20) and SHANGAI (0.20) and is showing relatively high correlation with FTSESingapore (0.54) and HANSHENG (0.54). SHANGAI has reflected lowest correlation with all indices.

The tests results depicted by correlation matrix need to be further substantiated for identifying direction of influence by using Granger causality test and also need to be tested for long-term movements of indices, by co-integration as these tests will authenticate for more robust results.

Unit Root Test

Augmented Dickey and Fuller (ADF) test is used to check the validation of market integration hypothesis. It is a test for identifying the unit problem in the series or stationarity of data. If the variables in the regression model are not stationary, then it can be shown that the standard assumptions for testing hypothesis through t-test will not be valid. Stationarity in time series implies that mean, variance, and covariance remain constant with the change in time as if the series is not stationary then study can be done only for particular time period and cannot be generalize for other time periods Besides that Granger and Newbold (1974) observed results, non-stationary series will be spurious. To perform Granger causality it was necessary to check whether all the time series variables are stationary and have no Unit Root problem.

$$\Delta y_t = a + \beta y_{t-1} + \sum_{i=1}^{n} \gamma \Delta y_t - i + u_i \qquad \text{(iii)}$$

On checking with augmented Dicky Fuller test for Unit Root where the null hypothesis is

H0: There exists Unit Root.

As seen from the Table 4, p-value for all logarithmic returns is less than 0.05 and hence null hypothesis cannot be accepted which implies log returns of all indices are stationary. Even though at log level all the indices were non-stationery.

Co-integration Test

By testing for co-integration over different indices we have tried to identify movement of these indices together over time and even though each indices have their own individual trend, these are still linked together by some relationship. The result of unit root shows that at log level all indices were non-stationary but on taking their logarithmic return which is at first difference all series were stationary and thus co-integration will be suitable test for testing their long-term relationship in which null hypothesis states that there do not exists any co-integrating equation among different indices.

For applying Johnson co-integration, the series need to be non-stationary at level and stationary at first order which is applicable in this case, where at level and at log level all indices were non stationary but by taking first difference and taking log returns the series were stationary. For testing Johnson co-integration the data was taken at level and thus co-integration was tested at log values which are at level. As seen from Table 5 and checking from both Co-integration Rank at Trace test and also from Maximum Eigen Value test it is observed there exists nine co-integration vectors at 5% level.

It need to be observed that co-integration reflects co-movement among different time series over long period of time and it thus can be concluded that to large extent indices across the globe move together.

Granger Causality

The Granger causality test has been used to test the relationship between various stock indices and to establish relationship that return of one market can help in forecasting in returns in another market for testing the Granger causality relationship following relationship has been used

$$y_t = a_0 + a_1 y_{t-1} + a_2 y_{t-2} + \ldots a_p y_{t-p} + b_1 x_{t-1} + b_2 x_{t-2} + \ldots b_p x_{t-p} + \in_t \quad \text{(iv)}$$

$$x_t = c_0 + c_1 x_{t-1} + c_2 x_{t-2} + \ldots c_p x_{t-p} + d_1 y_{t-1} + d_2 y_{t-2} + \ldots d_p y_{t-p} + \cup_t \quad \text{(v)}$$

If in the first equation of y above all the coefficients of xb_i for i=1......l are significant then the null hypothesis that x does not cause y is rejected. Similarly in the second equation of 'x' all the coefficient of d_i for i=1…l are significant then the null hypothesis that y does not cause x is rejected. Depending upon this the relationship can be concluded whether there do exist any relationship which can be Univariate if only in one equation the hypothesis is rejected or bivariate if in both the equation null hypothesis is rejected or no relationship if relationship is not rejected.

Table 6 presents a statement of pair-wise Granger causality tests for different indices. By observing the table there exists very few indices where there do not exist any causality among them as represented by 'x'. As regard Nifty is concerned it shows no relationship between CAC and DAX whereas it depicted bidirectional relationship with FTSE100, KOSPI, NASDAQ and SHANGAI. Nifty unidirectional Granger cause FTSESingapore, Nikkie225 and HANGSHENG. Corroborating the results of correlation SHANGAI has showed no relationship with most of the indices.

Conclusion

This study is in continuation of research on the issue of increasing interdependency among the capital market across the globe. This interdependency among indices has been studied primarily through correlation of returns among stock indices. The results are further tested through co-integration and the Granger causality. It has been quite evident from these tools that there is strong interdependency of indices across major indices. Positive correlation among all indices has reflected the same. Even existence of high co-integrating relationship among all indices also justifies the same interdependence. For further understanding the relationship among different indices Granger causality test have been used in which most of the indices have shown bi-variate relationship among them. Among all indices which were studied SHANGAI is indices in which low interdependence was observed. The study was done for exploring option for portfolio diversification by investing across the globe. Diversification benefits are high by investing in low correlation assets and for this the study has identified options for building portfolio Therefore, it is hoped that the findings of the present study would be useful for individual and institutional investors and for managing investments by portfolio managers.

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Annexures

Chart 1

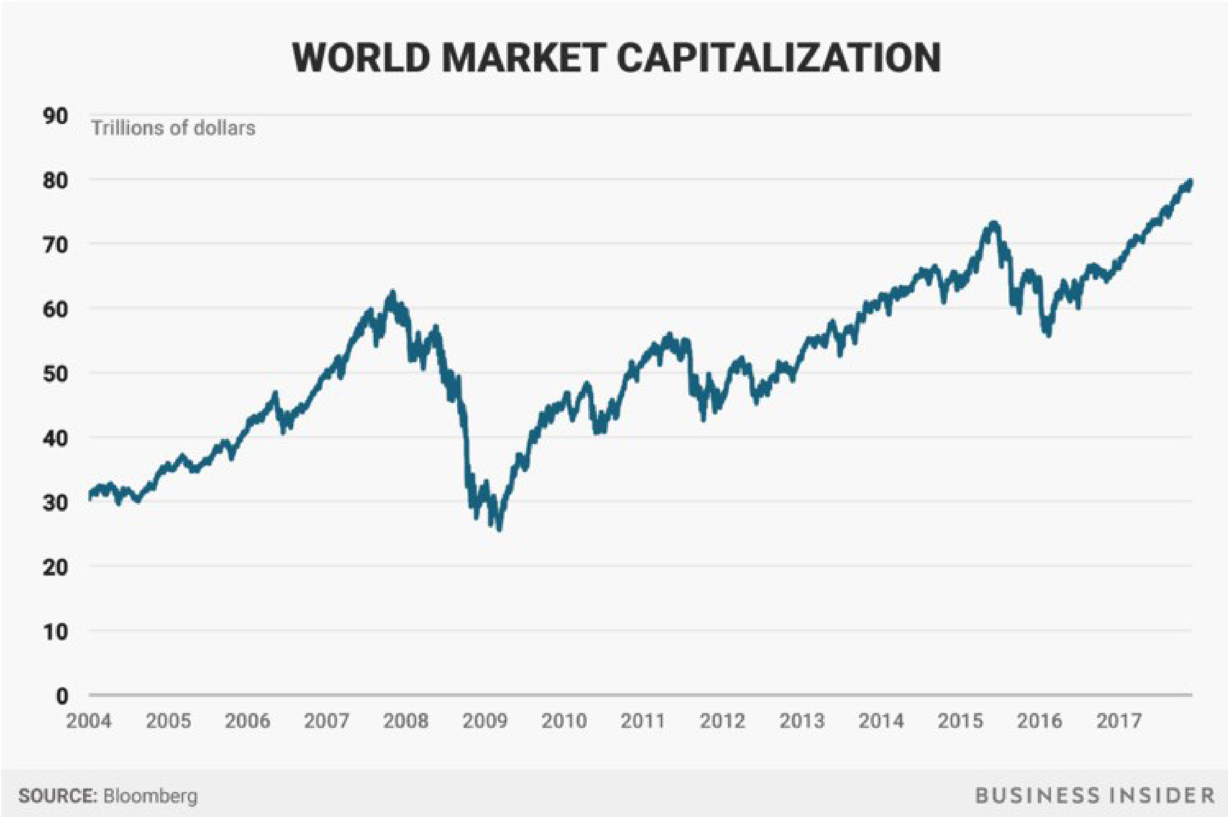

Table 2: Descriptive Analysis of returns of Indices

	LNNIFTY	*LNCAC*	*LNDAX*	*LNFTSE100*	*LNFTSE_SIN*	*LNHANGSHENG*	*LNKOSPI*	*LNNASDAQ*	*LNNIKKIE225*	*LNSHANGAI*
Mean	0.06%	0.01%	0.02%	0.01%	0.02%	0.02%	0.04%	0.04%	0.02%	0.01%
Media	0.09%	0.04%	0.06%	0.01%	0.03%	0.00%	0.02%	0.05%	0.00%	0.00%
Max	16.33%	10.50%	10.80%	9.38%	9.76%	13.41%	13.86%	11.85%	13.23%	9.40%
Min	-13.05%	-9.40%	-9.83%	-10.48%	-9.39%	-13.58%	-12.80%	-11.11%	-12.11%	-9.26%
Std. D	0.01427	0.01339	0.01516	0.011967	0.011501	0.01439	0.01385	0.01492	0.01495	0.016
Skew	-0.29201	-0.0718	-0.06033	-0.19454	-0.02837	0.00762	-0.4373	0.03799	-0.4345	-0.29863
Kurt	13.4907	9.2637	8.1384	10.5898	10.5593	12.462	11.93595	9.3546	10.18027	7.986
J-B Test	18988.2	6751.84	4543.89	9924.52	9829.36	15394.18	13842.53	6946.52	8975.79	4327.95
Prob	0	0	0	0	0	0	0	0	0	0

Table 3: Correlation Matrix

	LNNIFTYRET	LNCACRET	LNDAXRET	LNFTSE100RET	LNFTSE_ SINGAPORERET	LNHANGSHENGRET	LNKOSPIRET	LNNASDAQRET	LNNIKKIE225RET	LNSHANGAIRE
LNNIFTYRET	1.000	0.387	0.343	0.379	0.545	0.540	0.432	0.208	0.352	0.202
LNCACRET	0.387	1.000	0.902	0.888	0.449	0.407	0.333	0.505	0.330	0.131
LNDAXRET	0.343	0.902	1.000	0.810	0.392	0.355	0.311	0.563	0.278	0.113
LNFTSE100RET	0.379	0.888	0.810	1.000	0.432	0.400	0.328	0.464	0.319	0.133
LNFTSE_SINGAPORERET	0.545	0.449	0.392	0.432	1.000	0.711	0.590	0.242	0.510	0.260
LNHANGSHENGRET	0.540	0.407	0.355	0.400	0.711	1.000	0.621	0.218	0.555	0.396
LNKOSPIRET	0.432	0.333	0.311	0.328	0.590	0.621	1.000	0.187	0.570	0.219
LNNASDAQRET	0.208	0.505	0.563	0.464	0.242	0.218	0.187	1.000	0.136	0.071
LNNIKKIE225RET	0.352	0.330	0.278	0.319	0.510	0.555	0.570	0.136	1.000	0.219
LNSHANGAIRE	0.202	0.131	0.113	0.133	0.260	0.396	0.219	0.071	0.219	1.000

Table 4: Unit Root – ADF Test

	LNNIFTYRET	LNCACRET	LNDAXRET	LNFTSE100RET	LNFTSE_ SINGAPORERET	LNHANGSHENGRET	LNKOSPIRET	LNNASDAQRET	LNNIKKIE225RET	LNSHANGAIRE
T-Val	-59.86	-47.38	-64.75	-49.55	-61.62	-63.69	-63.06	-49.26	-59.86	-63.29
P Val	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Table 5: Co-integration Test

Trend assumption: Linear deterministic trend Series: LNIFTY LCAC LDAX LFTSE100 LFTSE_SINGAPORE LHANGSHENG LKOSPI LNASDAQ LSHANGAI LNIKKIE225 Lags interval (in first differences): 1 to 4 Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		*Trace*	*0.05*	
No. of CE(s)	*Eigenvalue*	*Statistic*	*Critical Value*	*Prob.***
None *	0.017171	261.3859	239.2354	0.0033
At most 1	0.013248	189.9573	197.3709	0.1095
At most 2	0.008852	134.9589	159.5297	0.4805
At most 3	0.006910	98.29211	125.6154	0.6550
At most 4	0.005832	69.69625	95.75366	0.7326
At most 5	0.004114	45.57449	69.81889	0.8120
At most 6	0.003272	28.57295	47.85613	0.7882
At most 7	0.001818	15.05868	29.79707	0.7763

At most 8	0.001634	7.553389	15.49471	0.5143
At most 9	0.000196	0.807632	3.841466	0.3688
Trace test indicates 1 cointegrating eqn(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		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.017171	71.42863	64.50472	0.0096
At most 1	0.013248	54.99837	58.43354	0.1051
At most 2	0.008852	36.66683	52.36261	0.7020
At most 3	0.006910	28.59586	46.23142	0.8527
At most 4	0.005832	24.12176	40.07757	0.8195
At most 5	0.004114	17.00154	33.87687	0.9217
At most 6	0.003272	13.51427	27.58434	0.8546
At most 7	0.001818	7.505288	21.13162	0.9313
At most 8	0.001634	6.745757	14.26460	0.5196
At most 9	0.000196	0.807632	3.841466	0.3688
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Table 6

	Pairwise Granger Causality Between Return of Indices									
	NIFTYRET	*CACRET*	*DAXRET*	*FTSE 100RET*	*FTSE_ SINGAPORERET*	*HANGSHENG RET*	*KOSPIRET*	*NASDAQRET*	*NIKKIE225RET*	*SHANGAIRE*
NIFTYRET		x	x	↔	→	→	↔	↔	→	↔
CACRET	→		↔	x	→	↔	→	x	↔	↔
DAXRET	→	↔		→	→		↔	↔	↔	↔
FTSE100RET	↔	x	x		↔	↔	→	x	↔	→
FTSE_SINGAPORERET	x	x	x	↔		↔	→	↔	→	↔
HANGSHENGRET	x	↔	↔	↔	↔		↔	↔	↔	↔
KOSPIRET	↔	x	↔	x	x	↔		↔	→	x
NASDAQRET	↔	→	↔	→	↔	↔	↔		→	→
NIKKIE225RET	x	↔	↔	↔	x	↔	x	x		x
SHANGAIRE	↔	x	x	x	↔	↔	x	x	x	

↔ Bivariate Causality x – No Causality → Univariate Causality

Table 7

Pairwise Granger Causality Test				
Null Hypothesis:	*Obs*	*F-Statistic*	*Prob.*	*Relationship*
LNDAXRET does not Granger Cause LNCACRET	4126	28.3878	6.00E-13	Bi directional Causality
LNCACRET does not Granger Cause LNDAXRET		4.15085	0.0158	Bi directional Causality
LNFTSE100RET does not Granger Cause LNCACRET	4118	1.68248	0.186	No Causality
LNCACRET does not Granger Cause LNFTSE100RET		1.43436	0.2384	No Causality
LNFTSE_SINGAPORERET does not Granger Cause LNCACRET	4126	1.52909	0.2169	No Causality
LNCACRET does not Granger Cause LNFTSE_SINGAPORERET		108.834	9.00E-47	Unidirectional Causality
LNHANGSHENGRET does not Granger Cause LNCACRET	4122	6.02108	0.0024	Bi directional Causality
LNCACRET does not Granger Cause LNHANGSHENGRET		221.806	3.00E-92	Bi directional Causality
LNKOSPIRET does not Granger Cause LNCACRET	4113	2.02329	0.1324	No Causality
LNCACRET does not Granger Cause LNKOSPIRET		237.459	3.00E-98	Unidirectional Causality
LNNASDAQRET does not Granger Cause LNCACRET	4126	182.776	9.00E-77	Unidirectional Causality
LNCACRET does not Granger Cause LNNASDAQRET		0.45634	0.6336	No Causality
LNNIFTYRET does not Granger Cause LNCACRET	4126	1.9972	0.1358	No Causality
LNCACRET does not Granger Cause LNNIFTYRET		36.5027	2.00E-16	Unidirectional Causality
LNNIKKIE225RET does not Granger Cause LNCACRET	4108	5.02544	0.0066	Bi directional Causality
LNCACRET does not Granger Cause LNNIKKIE225RET		437.613	5.00E-173	Bi directional Causality
LNSHANGAIRE does not Granger Cause LNCACRET	4111	1.69881	0.183	No Causality
LNCACRET does not Granger Cause LNSHANGAIRE		28.2276	7.00E-13	Unidirectional Causality
LNFTSE100RET does not Granger Cause LNDAXRET	4118	2.06399	0.1271	No Causality
LNDAXRET does not Granger Cause LNFTSE100RET		17.8658	2.00E-08	Unidirectional Causality
LNFTSE_SINGAPORERET does not Granger Cause LNDAXRET	4126	2.09628	0.123	No Causality
LNDAXRET does not Granger Cause LNFTSE_SINGAPORERET		129.186	4.00E-55	Unidirectional Causality
LNHANGSHENGRET does not Granger Cause LNDAXRET	4122	2.61776	0.0731	Bi directional Causality
LNDAXRET does not Granger Cause LNHANGSHENGRET		228.959	5.00E-95	Bi directional Causality
LNKOSPIRET does not Granger Cause LNDAXRET	4113	2.34486	0.096	Bi directional Causality
LNDAXRET does not Granger Cause LNKOSPIRET		265.359	4.00E-109	Bi directional Causality
LNNASDAQRET does not Granger Cause LNDAXRET	4126	87.6773	5.00E-38	Bi directional Causality
LNDAXRET does not Granger Cause LNNASDAQRET		4.89722	0.0075	Bi directional Causality
LNNIFTYRET does not Granger Cause LNDAXRET	4126	2.20115	0.1108	No Causality
LNDAXRET does not Granger Cause LNNIFTYRET		42.6286	5.00E-19	Unidirectional Causality
LNNIKKIE225RET does not Granger Cause LNDAXRET	4108	4.38651	0.0125	Bi directional Causality
LNDAXRET does not Granger Cause LNNIKKIE225RET		452.472	3.00E-178	Bi directional Causality
LNSHANGAIRE does not Granger Cause LNDAXRET	4111	1.04489	0.3518	No Causality
LNDAXRET does not Granger Cause LNSHANGAIRE		24.903	2.00E-11	Unidirectional Causality
LNFTSE_SINGAPORERET does not Granger Cause LNFTSE100RET	4118	3.17618	0.0418	Bi directional Causality
LNFTSE100RET does not Granger Cause LNFTSE_SINGAPORERET		106.402	9.00E-46	Bi directional Causality
LNHANGSHENGRET does not Granger Cause LNFTSE100RET	4118	7.27413	0.0007	Bi directional Causality
LNFTSE100RET does not Granger Cause LNHANGSHENGRET		214.952	2.00E-89	Bi directional Causality
LNKOSPIRET does not Granger Cause LNFTSE100RET	4105	1.24075	0.2893	No Causality
LNFTSE100RET does not Granger Cause LNKOSPIRET		179.392	2.00E-75	Unidirectional Causality
LNNASDAQRET does not Granger Cause LNFTSE100RET	4118	181.218	4.00E-76	Unidirectional Causality
LNFTSE100RET does not Granger Cause LNNASDAQRET		1.66217	0.1899	No Causality

Pairwise Granger Causality Test				
Null Hypothesis:	*Obs*	*F-Statistic*	*Prob.*	*Relationship*
LNNIFTYRET does not Granger Cause LNFTSE100RET	4118	3.39728	0.0336	Bi directional Causality
LNFTSE100RET does not Granger Cause LNNIFTYRET		31.3733	3.00E-14	Bi directional Causality
LNNIKKIE225RET does not Granger Cause LNFTSE100RET	4100	4.06797	0.0172	Bi directional Causality
LNFTSE100RET does not Granger Cause LNNIKKIE225RET		372.667	2.00E-149	Bi directional Causality
LNSHANGAIRE does not Granger Cause LNFTSE100RET	4103	0.86983	0.4191	No Causality
LNFTSE100RET does not Granger Cause LNSHANGAIRE		34.2494	2.00E-15	Unidirectional Causality
LNHANGSHENGRET does not Granger Cause LNFTSE_SINGAPORER-ET	4122	4.09957	0.0166	Bi directional Causality
LNFTSE_SINGAPORERET does not Granger Cause LNHANGSHEN-GRET		41.621	1.00E-18	Bi directional Causality
LNKOSPIRET does not Granger Cause LNFTSE_SINGAPORERET	4113	0.53841	0.5837	No Causality
LNFTSE_SINGAPORERET does not Granger Cause LNKOSPIRET		27.1101	2.00E-12	Unidirectional Causality
LNNASDAQRET does not Granger Cause LNFTSE_SINGAPORERET	4126	242.814	2.00E-100	Bi directional Causality
LNFTSE_SINGAPORERET does not Granger Cause LNNASDAQRET		3.97308	0.0189	Bi directional Causality
LNNIFTYRET does not Granger Cause LNFTSE_SINGAPORERET	4126	10.9113	2.00E-05	Unidirectional Causality
LNFTSE_SINGAPORERET does not Granger Cause LNNIFTYRET		2.03449	0.1309	No Causality
LNNIKKIE225RET does not Granger Cause LNFTSE_SINGAPORERET	4108	1.22448	0.294	No Causality
LNFTSE_SINGAPORERET does not Granger Cause LNNIKKIE225RET		95.1506	4.00E-41	Unidirectional Causality
LNSHANGAIRE does not Granger Cause LNFTSE_SINGAPORERET	4111	5.78512	0.0031	Bi directional Causality
LNFTSE_SINGAPORERET does not Granger Cause LNSHANGAIRE		8.05598	0.0003	Bi directional Causality
LNKOSPIRET does not Granger Cause LNHANGSHENGRET	4109	9.5635	7.00E-05	Bi directional Causality
LNHANGSHENGRET does not Granger Cause LNKOSPIRET		12.2669	5.00E-06	Bi directional Causality
LNNASDAQRET does not Granger Cause LNHANGSHENGRET	4122	341.604	6.00E-138	Bi directional Causality
LNHANGSHENGRET does not Granger Cause LNNASDAQRET		4.17307	0.0155	Bi directional Causality
LNNIFTYRET does not Granger Cause LNHANGSHENGRET	4122	35.8973	4.00E-16	Unidirectional Causality
LNHANGSHENGRET does not Granger Cause LNNIFTYRET		2.86072	0.0573	No Causality
LNNIKKIE225RET does not Granger Cause LNHANGSHENGRET	4104	4.21819	0.0148	Bi directional Causality
LNHANGSHENGRET does not Granger Cause LNNIKKIE225RET		42.3005	7.00E-19	Bi directional Causality
LNSHANGAIRE does not Granger Cause LNHANGSHENGRET	4107	7.94546	0.0004	Bi directional Causality
LNHANGSHENGRET does not Granger Cause LNSHANGAIRE		3.35308	0.0351	Bi directional Causality
LNNASDAQRET does not Granger Cause LNKOSPIRET	4113	275.405	6.00E-113	Bi directional Causality
LNKOSPIRET does not Granger Cause LNNASDAQRET		11.9214	7.00E-06	Bi directional Causality
LNNIFTYRET does not Granger Cause LNKOSPIRET	4113	40.2151	5.00E-18	Bi directional Causality
LNKOSPIRET does not Granger Cause LNNIFTYRET		5.22414	0.0054	Bi directional Causality
LNNIKKIE225RET does not Granger Cause LNKOSPIRET	4098	1.28585	0.2765	No Causality
LNKOSPIRET does not Granger Cause LNNIKKIE225RET		17.8056	2.00E-08	Unidirectional Causality
LNSHANGAIRE does not Granger Cause LNKOSPIRET	4098	2.34325	0.0961	No Causality
LNKOSPIRET does not Granger Cause LNSHANGAIRE		1.33995	0.262	No Causality
LNNIFTYRET does not Granger Cause LNNASDAQRET	4126	3.40708	0.0332	Bi directional Causality
LNNASDAQRET does not Granger Cause LNNIFTYRET		92.4446	5.00E-40	Bi directional Causality
LNNIKKIE225RET does not Granger Cause LNNASDAQRET	4108	2.13055	0.1189	No Causality
LNNASDAQRET does not Granger Cause LNNIKKIE225RET		480.201	4.00E-188	Unidirectional Causality
LNSHANGAIRE does not Granger Cause LNNASDAQRET	4111	0.84378	0.4302	No Causality

Pairwise Granger Causality Test				
Null Hypothesis:	*Obs*	*F-Statistic*	*Prob.*	*Relationship*
LNNASDAQRET does not Granger Cause LNSHANGAIRE		29.1262	3.00E-13	Unidirectional Causality
LNNIKKIE225RET does not Granger Cause LNNIFTYRET	4108	0.06794	0.9343	No Causality
LNNIFTYRET does not Granger Cause LNNIKKIE225RET		77.0794	1.00E-33	Unidirectional Causality
LNSHANGAIRE does not Granger Cause LNNIFTYRET	4111	3.78191	0.0229	Bi directional Causality
LNNIFTYRET does not Granger Cause LNSHANGAIRE		7.93366	0.0004	Bi directional Causality
LNSHANGAIRE does not Granger Cause LNNIKKIE225RET	4093	0.41442	0.6607	No Causality
LNNIKKIE225RET does not Granger Cause LNSHANGAIRE		0.65567	0.5191	No Causality

Lag	*LogL*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	116925.4491270596	NA	1.82e-36	-56.75556	-56.74174	-56.75067
1	118032.4032773984	2208.535	1.10e-36	-57.25359	-57.11546*	-57.20470*
2	118185.8441715446	305.4666	1.07e-36	-57.28876	-57.02630	-57.19586
3	118304.3500810053	235.4011	1.05e-36	-57.30697	-56.92018	-57.17007
4	118387.5497629876	164.9050	1.05e-36	-57.30803	-56.79693	-57.12713
5	118475.2779490293	173.4974	1.04e-36*	-57.31130*	-56.67587	-57.08639
6	118540.5374849025	128.7767	1.05e-36	-57.30366	-56.54391	-57.03475
7	118612.2785898975	141.2534	1.05e-36	-57.29916	-56.41509	-56.98625
8	118696.5124853125	165.4828*	1.05e-36	-57.30073	-56.29233	-56.94382

* 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