ISSN (Print Version) 0975-3931
ISSN (On Line Version) 2278-1277

Cointegration of East Asian, Indian and European Markets– A Study of Impact on Indian Bourses

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1. Introduction

Economies like India, which offer relatively higher growth than the developed economies, have gained favour among Foreign Institutional Investors (FIIs) as attractive investment destinations. Investors are optimistic on India and sentiments are favourable following government's announcement of a series of economic reform measures from time to time since 1991. FII's net investments in Indian equities and debt have touched record highs in the past financial year, backed by expectations of an economic recovery, falling interest rates and improving earnings outlook. FIIs net investments in Indian equities and debt stood at US$ 7.46 billion in 2016-17 (up to April 14, 2017). Cumulative value of investments by FIIs during April 2000-December 2016 stood at US$ 183.69 billion. Table 1 depicts the flow from 2011 to 2017.Table 2 shows country-wise assets under custody till June 2017 which are approximately 450 billion.

Table 1. FII Investments during 2011-17.

Financial Year	IN MILLION USD		
	Equity	Debt	Total
2011-12	6626.97	7573.939	14200.91
2012-13	21217.12	4293.03	25510.15
2013-14	12077.12	-4251.52	7825.606
2014-15	16868.64	25170.76	42039.55
2015-16	-2147.27	-606.667	-2753.94
2016-17	8439.848	-1104.85	7335

Source: Author's calculation by conversion with mean Exchange rate. Data from NSDL

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With such huge investments from all over the world, it becomes pertinent for FIIs and DIIs (Domestic Institutional Investors), retail investors, investment advisors, brokers and portfolio consultants to keep abreast with latest research on fundamentals and technical of stock market movements. The association among equity markets of developed countries has long been a popular research area for researchers and investors across the globe with a view to discover the co- movement among the equity markets. The interest in stock market linkages has been motivated by a number of reasons, but most importantly, as an opportunity to minimize risks in international portfolio, the economic implications of such linkages for countries, and to explore better returns in portfolio of short time investors.

Table 2. Country-wise Assets under Custody by custodial agencies.

FPI/FII AUC Country-wise (top 10 countries) data				
Year 2017	Till June 2017 In USD Million			
		Equity	**Debt**	**Total**
1	UNITED STATES OF AMERICA	1,33,828	9,546	1,43,375
2	MAURITIUS	72,849	7,296	80,145
3	SINGAPORE	29,875	17,827	47,702
4	LUXEMBOURG	31,954	8,782	40,736
5	UNITED KINGDOM	20,277	615	20,891
6	JAPAN	10,765	2,545	13,310
7	IRELAND	11,370	749	12,119
8	CANADA	11,311	458	11,769
9	NORWAY	6,893	3,440	10,333
10	NETHERLANDS	7,593	2,229	9,822
11	Other	50,950	9,182	60,133
12	Total	3,87,664	62,669	4,50,333

Source: Calculated by author with exchange rate USD = 65 INR

During mid-twentieth century, the spotlight of study of co-movement between the markets was confined to the western markets and very few studies focused on Asian equity market inter-linkages. The focus of research literature started shifting to Asia in the late 1990's mainly on account of the South-East Asian crisis in 1997-98. With Asia gaining prominence in the global economy, many studies have now started analyzing the inter-linkages among the Asian markets and not just their cointegration with the US or UK equity markets. In Asia, apart from Japan and China, Asian Tiger countries- Hong Kong, Taiwan, Singapore and South Korea, have attracted the interest of international investors (Akhtar, 2001) from the point of view of both, investment in the real economy and the financial markets.

Indian investors, both retailer and institutional, keep an eye on East in the morning before trading starts at the stock exchanges to get a clue for short term movement of market. Investors perceive that East Asian markets have impact on the Indian market during morning sessions while they watch West (European markets) in the afternoon as these market openings have short-term impact on closing prices of Indian bourses.

This paper is an attempt to examine a) relationship of opening prices of a major Indian Stock Market index (Nifty) with opening prices of select Asian Stock Indices and b) relationship of closing prices of Nifty with opening prices of select major European Stock Indices. Section 2 reviews literature, section 3 discusses the data and methodology, sections 4 discusses the analysis and section 5 concludes the study.

2. Literature Review

The importance of the issue of financial market linkages, from the point of view of portfolio diversification and macroeconomics is well-recognized in literature (Shepherd, 1994). The economies in Asia are making technological progress and are attracting foreign capital inflows. Liberalization of financial markets since the late 1980s and increasing regionalization of economic activities have resulted in integration among the markets within the same region (Mukherjee and Mishra 2007). Integration among the Asian markets has become a topic of interest for researchers in recent times.

Johnson and Soenen (2002) examined the economic integration among Asian and other Pacific markets and found that stock market of Japan was cointegrated with the markets of Hong Kong, Australia, Malaysia, Singapore, New Zealand and China.

The economies of Hong Kong, Singapore, South Korea, and Taiwan achieved and sustained exceptionally high growth rates (nearly 7 percent a year) and rapid industrialization for a period spanning more than three decades between 1960s and 1990s, thereby earning them the coveted name of "*Asian Tigers*". Despite the setback suffered during the 1997 crisis, all these economies continue to flourish. Although the Asian Tigers were affected by the Asian financial crisis, with Korea quite severely and Singapore and Taiwan mildly, compared to other Asian countries, that have been the least affected; and most of all, have made the quickest recovery (Roger, 2001).

Sharma (2017) examines the relationship among oil prices, stock prices and exchange rate in Indian market. The results evidence that data is stationary at first difference order. Johansen co-integration suggests the possibility of at most one co-integrating equation. It indicates investors cannot benefit from arbitrage activities in the long run through diversifying the portfolio in these markets. Granger causality and Wald statistics evidenced the absence of Granger causality between Oil prices and Stock Prices as well as between Exchange Rate and Oil Prices. Unidirectional causality flowing from Stock Price to exchange rate was noticed but not vice versa. Since stock prices Granger cause the exchange rate, participants in the foreign exchange market can use information of stock prices to improve the forecast of exchange rates.

According to Shahzad et al (2016), the assessment of interdependence between stock markets is an important aspect of international portfolio management. Short-term dynamics are captured through vector error correction-based Granger causality. South Asian stock markets are closely linked with each other; similarly, developed/European markets are interlinked. US stock market not only impacts European stock markets, it also Granger cause South Asian stock markets.

Paskelian et al (2013) examine the characteristics and behaviour of stock market equity indices of several Middle East and North Africa (MENA) countries. Granger causality tests based on the VECM reveal strong bidirectional causalities between several of the MENA stock markets. The Granger causalities also indicate that stock market returns of Egypt, Jordan, Kuwait, Malta, Oman, Qatar, Saudi Arabia and Tunisia exhibit cointegrating behaviour. MENA stock markets tend to co-move with the U.S. stock market. Furthermore, markets within the MENA region are not yet fully integrated with the U.S. However, market imperfections may preclude U.S. investors from entering MENA markets to take advantage of possible diversification benefits. The increased level of integration of markets within the MENA region does not necessarily reduce the potential of risk diversification for international portfolios.

Menon et al (2009), examined the extent of cointegration between the Indian stock market and other leading stock markets using the NSE Nifty index along with other major stock indices of US, China, Singapore and Hong Kong. The study covers a period of ten years; from 1 April 1997 to 10 May 2007. The Engle Granger test of cointegration is used to check the level of dependence between the various capital markets. The results of the test show absence of cointegration between the two variables suggesting no interdependence between the Indian stock markets and the American Stock markets. This is also the case with Indian stock markets and Hong Kong stock market. The Indian stock markets and Hong Kong markets operate independently of each other. There is some amount of cointegration between the Indian stock markets and the Shanghai stock market. The markets in India and Shanghai are dependent to some extent. However, the results show the presence of strong cointegration between Indian and Singapore stock markets suggesting a strong inter-dependency. The test of cointegration reveals the absence of interdependence and long-term relationship between the Indian, American Stock Markets and Indian and Hong Kong stock markets. When studied with the SSE (China) index, and STI (Singapore) the results show that there is some amount of relationship between the Indian and Shanghai stock markets and a strong relationship between Indian and Singapore stock markets.

Nupur et al (2014) analysed cointegration among various East Asian Indices in US Dollar terms and observed that Cointegration test did not find any long term relationship among the markets. However the results of Vector Error Correction Mechanism found short term bidirectional relationship between the Singapore and Indian Markets; Short term impact of both Indian and Singapore markets on Hong Kong markets and South Korean markets. The short term movement in the Taiwanese and Thai markets were unaffected by the their own movements; movment of each other and movments of the other four markets – India, Singapore, Hong Kong and South Korea.

The influential work of Engle and Granger (1987) on ‘Cointegration’ has become the routine tool of time series econometrics. Cointegration has come into view as a dominant procedure for exploring common trends in multivariate time series and provides a robust methodology for depiction of both long and short run dynamics in a system. Cointegration and correlation are linked, but diverse concepts. High correlation does not essentially imply high cointegration in asset prices. Correlation is a signal of co-movements in returns, which may be accountable for great volatility over time. It is basically a short-run measure and correlation based portfolio diversification strategies frequently require rebalancing.

3. Data and Methodology

This paper is an attempt to observe short term and long-term impact of East Asian and European stock markets on Indian bourses especially National Stock Exchange Index (Popularly known as Nifty). Five indices from East Asian Economies viz HANG SENG (Hong Kong), STI (Singapore), TSEC (in short TW for the purpose of this study, Taiwan), SET (Thailand), and KOSPI (South Korea) were selected to observe their impact on Opening prices of Nifty. Five European Indices viz FTSE 100 (England), Euronext 100 (Europe), CAC 40 (France), DAX (German), Swiss Market Index (SMI, Switzerland) were selected to see their impact on Nifty closing price. Nifty opening and closing prices were downloaded from nseindia.com and data of other indices were downloaded from respective websites of stock exchanges, yahoo finance and investing.com. Daily data was downloaded from 1st January 2012 to 31st Dec 2016. Data was collated and adjusted for holidays in exchanges. Total 1149 entries of Asian indices data were found valid against Nifty opening data and total 1186 entries of European data were found valid against Nifty closing prices.

Data was subjected to following tests

3.1 Unit Root Test: Data for 12 series were subjected to Unit Root test. Augmented Dickey Fuller test was used to observe whether series have unit root. Data for three months (1st Oct 2016 to 31st Dec 2016), six months (1st July 2016 to 31st Dec 2016), one year (1st January 2016 to 31st Dec2016) and 5 years (1st Jan 2012 to 31st Dec 2016) were tested for Unit root. This paper shows results of one-year and five-year data.

3.2 Johansen Cointegration Test: Series were found to be stationary or having unit root. Stationary series were subjected to Johansen Cointegration test. If series were found to be cointegrated, using Vector Error Correction Method, short term and long-term relationship were observed and model was framed and tested with Wald test to observe the significance of each variable.

3.3 Granger Causality under VAR: If series were not cointegrated. Unrestricted VAR was estimated and Granger Causality Test under VAR was performed to observe how series affect each other.

3.4 Pair wise Granger Causality: Stationary series were subjected to Pairwise Granger Causality Test to get model on how series impact each other.

4. Analysis and Discussion

Short term and long-term impact on Indian bourses like National Stock Exchange Index (Popularly known as Nifty) is observed. Five indices from East Asian Economies viz HANG SENG (Hong Kong), STI (Singapore), TSEC (Taiwan), SET (Thailand), and

KOSPI (South Korea) were selected to observe their impact on Opening prices of Nifty. Five European Indices viz FTSE 100 (England), Euronext 100 (Europe), CAC 40 (France), DAX (German), Swiss market Index (Switzerland) were selected to see their impact on Nifty closing prices.

Table 3. Unit Rate Test (ADF)

Index	One Year Data 1st Jan 2016 to 31st Dec 2016				5 Year Data 1st Jan 2012 to 31st Dec 2016			
	At Level		First Difference		At Level		First Difference	
Index	ADF T stat	Prob	ADF T stat	Prob	ADF Tstat	Prob	ADF T stat	Prob
Nifty Open	-1.13980	0.6983	-15.0895	0.000	-1.9573	0.6233	-34.404	0.0000
Hang Sang	-1.55801	0.5009	-10.1950	0.00	-2.3574	0.4019	-30.257	0.0000
KOSPI (South Korea)	**-2.74492**	**0.0696**	-11.9585	0.00	**-4.508**	**0.0015**	NR	NR
SIT (Singapore)	**-2.76943**	**0.0658**	-10.0956	0.000	-2.4516	0.3525	-31.092	0.0000
SET (Thailand)	-2.49483	0.1193	-14.1079	0.000	-2.7464	0.2180	-32.914	0.0000
TSEC (Taiwan),	-2.22196	0.1997	-10.1628	0.000	-2.3491	0.4064	-30.906	0.0000
Nifty Close	-1.21504	0.6683	-14.4040	0.00	-1.9396	0.6329	-32.725	0.0000
FTSE 100 England),	-0.80948	0.8142	-14.3883	0.000	-2.8391	0.1834	-33.801	0.0000
Euronext 100 (PAN Europe),	**-2.70154**	**0.0753**	-14.4618	0.000	-2.5565	0.3007	-32.978	0.0000
CAC 40 (France),	-2.15169	0.2249	-14.5502	0.000	-2.7042	0.2350	-33.847	0.0000
DAX (German),	-1.37632	0.5936	-16.0567	0.00	-2.6599	0.2537	-34.351	0.0000
SMI (Switzerland)	**-4.00864**	**0.0016**	NR	NR	-1.9626	0.6205	-32.488	0.0000

Source: Calculations by author using Eviews.

4.1 Unit Root Test

The first step is to see whether series have unit root at level or at first difference. Table 3 shows results Augmented Dickey Fuller unit root test with intercept and trend for one-year data and five years data. Results show that SMI (Switzerland) did not have unit root at level during period 1st Jan to 31st Dec 2016. SMI was found to be stationary at level. KOSPI and Euronext 100 were found to be stationary at 10% significance level during the same one-year time. All other series were found to be stationary at first difference level. Five years data from 1st Jan 2012 to 31st Dec 2016 shows KOSPI is stationary at level. This compelled the researcher to exclude KOSPI, Euronext100 and SMI from further Johansen Cointegration Test and only to consider them during Granger Causality test under VAR or Granger Causality Test.

4.2 Johansen Cointegration Test with one-year data (1st Jan to 31st Dec 2016)

The 3 months, 6 months, one year and five years data were subjected to experiment whether series are cointegrated. It was observed that series are cointegrated at short term level but for longer period they are not cointegrated. This paper shows only one-year and five-years data analysis. Series are strongly cointegrated with three months and six months period but cointegration breaks with longer period. However, they Granger cause each one which can be seen at later stages of this paper.

4.2.1 Asian Data One year

Table 1A shows Johansen Cointegration Test with one year data. Both Trace and Maximum Eigenvalue tests show that there is no cointegration among NIFTY, HANG, SET, and TW (short for TSEC Taiwan). KOSPI and SIT were not considered for cointegration as they did not have Unit root at 10% level.

4.2.2 European One-Year Data

Table 2 A results show that there is one cointegration equation with series CAC, DAX and FTSE. Two indices – SMI and Euronext were not taken into consideration as they were stationary at level. An equation was constructed with Eviews system and coefficients were tested with Wald test. Equation (1) shows the long term cointegration and short-term adjustment. In the equation, figures in brackets and italics are long term cointegrating portion. It is statistically significant at 5% level. However, none of the short-term adjustments are statistically significant.

D(NIFTY) = **-0.032281***(***NIFTY(-1) + 7.243*CAC(-1) - 2.261 *DAX(-1) - 0.313*FTSE(-1) - 15006.8)*** + 0.1467*D(NIFTY(-1)) + -0.0814*D(CAC(-1)) - 0.021*D(DAX(-1)) .044*D(FTSE(-1)) + 1.866336….Equation (1)

In case of European indices only long-term relationship in a year works, as coefficient of cointegration is negative and statistically significant. Short term adjustments are not statistically significant.

4.3 Johansen Cointegration Test for Five years data

4.3.1 Cointegration of Asian Data

Five-year Asian data (Nifty-open, Hang Sang, SET, SIT, TW) from 1st Jan 2012 to 31st Dec 2016 was subjected to Johannsen Cointegration Test. KOSPI was not included in the test as its data was stationary at level. Two lags were used based on lag criteria test and selection of two lags are based on minimum AIC (Akaike Information Criteria). Table 3A shows that series are not cointegrated at 5% level either by Trace or Max Eigen Value methods. Now this needs to be tested whether series Granger Cause.

4.3.2 Cointegration of European Data

Five-year European data (Nifty Close, CAC, DAX, Euronext, FTSE, SMI) from 1st Jan 2012 to 31st Dec 2016 was subjected to Johannsen Cointegration Test. Three lags were used based on lag criteria test based on minimum AIC (Akaike Information Criteria). Table 4A shows that series are not cointegrated at 5% level either by Trace or Max Eigen Value methods. Now this needs to be tested whether series Granger Cause.

4.4 VAR (Unrestricted Vector Auto Regression) – Asian Data

As Asian series for five years period were not cointegrated, these series were treated with unrestricted VAR (Vector Auto regression). Table 5A shows the result for all indices as dependent variable and other indices as independent variables. It is observed that Nifty Open is effected by lag one and two of Nifty itself and lag one and two of KOSPI. R^2 is 0.99 in this model. Durbin Watson is 2.02 and overall the model is statistically significant at 1% level with high level of F.

4.4.1 VAR Granger Causality/Block Exogeneity Wald Tests (Asian Data)

Granger Causality under VAR was carried out as shown in Annexure Table no 6A. As VAR Granger Causality test takes all lags together, so clearly indicates how variables effect the depend variables. It is observed that Nifty is influenced by KOSPI and TW. Hang is also influenced by KOSPI. KOSPI is influenced by TW. SET, SIT and TW are also influenced by KOSPI. Models except SET are statistically significant at 1% level while SET is statistically significant at 5% level.

4.4.2 Pairwise Granger Causality Data

Pairwise Granger Causality Test was carried out using two lags as per minimum AIC lag criteria for stationary Asian indices at first difference level. Table 7A shows the results. It is observed that Hang, KOSPI, SET Granger Cause Nifty. TW Granger Cause Nifty at 10% level. Nifty Granger cause TW and SIT. KOSPI, and SET causes Hang. Hang causes TW and SIT. SET effects SIT and TW

Granger Causality under VAR is tested by Chi Square as test statistics while Pairwise Granger Causality uses F statistics.

4.5 VAR - European Data

As European series for five years period were not cointegrated, these series were treated with unrestricted VAR (Vector Auto regression) using three lags. Table 8A shows the result for all indices as dependent variable and other indices as independent variables. It is observed that Nifty closing prices are effected by lag one, two and three of Nifty itself and third lags of FTSE and SMI. R^2 is 0.99 in this model. Durbin Watson is 1.98 and overall the model is statistically significant at 1% level with high level of F, (Table 9A).

4.5. 1 VAR Granger Causality/Block Exogeneity Wald Tests (European Data)

Granger Causality under VAR was carried out as shown in Table no 10A. As VAR Granger Causality test takes all lags together, it clearly indicates how variables effect the dependent variable. It is observed that Nifty closing prices are not influenced by any of the European indices under VAR Granger Causality. However, all European indices CAC, FTSE, Euronext, DAX and SMI are influenced by Nifty closing prices which is opposite to common hypothesis that European indices influence Nifty. All models are statistically significant at 1% level.

4.5.2 Pairwise Granger Causality for European Data

Pairwise Granger Causality Test was carried out using three lags as per minimum AIC lag criteria for stationary European indices at first difference level. Table 11A shows the results. It is observed that Nifty closing price Granger Cause CAC, DAX, FTSE, Euronext and SMI. The results are same as depicted by VAR Granger Causality. DAX and NEXT and SMI have impact on FTSE. Euronext influences SMI.

Pairwise Granger Causality results can be summarised in Figure 1 and Figure 2.

Figure 1. Impact of Asian Indices on each other and Nifty Opening prices

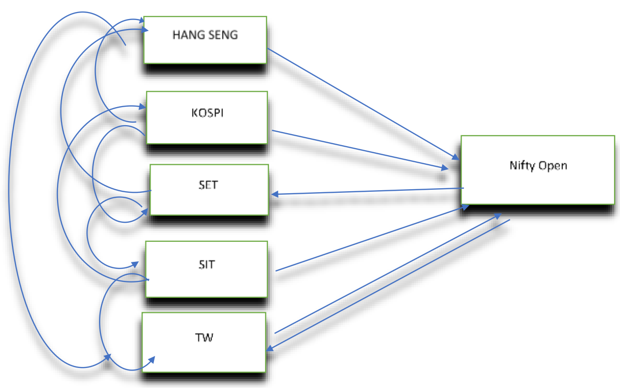
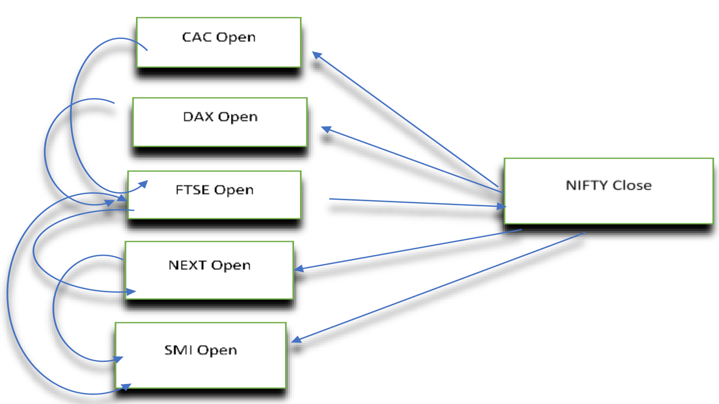


Figure 2. Impact of European Indices on each other and Nifty closing prices



5. Conclusion

With huge investments flowing from all over the world to India, FIIs (Foreign Institutional Investors) and DIIs (Domestic Institutional Investors), retail investors, investment advisors, brokers and portfolio consultants keep abreast with latest research on fundamentals and technicals. Interdependence between stock markets is an important aspect of international portfolio management. In this paper, impact of Asian Indices like Hang Sang, KOSPI, SET SIT and TSEC on opening prices of Indian index Nifty was studied with various tools like Johansen Cointegration Test, VAR Granger Causality and Pairwise Granger Causality test. Similarly impact of European indices like CAC, FTSE, Euronext, DAX and SMI on Nifty closing prices were studied with same tools. The 3 months, 6 months, one year and 5 year data were subjected to experiment whether series are cointegrated. It was observed that series are cointegrated at very short-term level but for longer period they are not cointegrated, however, they influence others. VAR Granger Causality Test and Pairwise Granger Causality reveal that Hang Sang, KOSPI, SIT and TW (TSEC of Taiwan) impact Nifty Open prices. Nifty influences only TW. KOSPI influences Hang Sang and SET. SET influences KOSPI and TW. Similarly, VAR Granger Causality Test and Pairwise Granger Causality also reveal Nifty closing prices influence CAC, DAX, FTSE, Euronext and SMI against the common hypothesis that Nifty closing prices are influenced by these indices. Further FTSE is influenced by CAC, DAX and SMI. SMI is influenced by Euronext and FTSE. To generalise, markets are integrated and impact each other. Asian markets influence Nifty and Nifty influences European markets. Study will help both domestic and foreign investors to decide their strategies for better returns and arbitrage.

Annexure Tables

Table no 1A (Johansen Cointegration Test without KOSPI and SIT)

Sample (adjusted): 1/07/2016 12/29/2016
Included observations: 199 after adjustments
Trend assumption: Linear deterministic trend
Series: NIFTY HANG SET TW
Lags interval (in first differences): 1 to 2
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.069685	36.96872	47.85613	0.3490
At most 1	0.059676	22.59460	29.79707	0.2666
At most 2	0.038875	10.34999	15.49471	0.2548
At most 3	0.012283	2.459464	3.841466	0.1168

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.069685	14.37412	27.58434	0.7960
At most 1	0.059676	12.24462	21.13162	0.5237
At most 2	0.038875	7.890521	14.26460	0.3899
At most 3	0.012283	2.459464	3.841466	0.1168

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 2 A (Johansen Cointegration Test on One Year European data without SMI and Euronext)

Sample (adjusted): 1/06/2016 12/30/2016
Included observations: 232 after adjustments
Trend assumption: Linear deterministic trend
Series: NIFTY CAC DAX FTSE
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.131690	54.23967	47.85613	0.0112
At most 1	0.077948	21.47989	29.79707	0.3284
At most 2	0.006384	2.652213	15.49471	0.9804
At most 3	0.005014	1.166261	3.841466	0.2802

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 No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.131690	32.75978	27.58434	0.0099
At most 1	0.077948	18.82768	21.13162	0.1019

At most 2	0.006384	1.485952	14.26460	0.9981
At most 3	0.005014	1.166261	3.841466	0.2802

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 3 A (Johansen Cointegration Test of Asian Data without KOSPI)

Date: 08/12/17 Time: 18:18
Sample (adjusted): 1/09/2012 12/29/2016
Included observations: 1046 after adjustments
Trend assumption: Linear deterministic trend
Series: NIFTY HANG SET SIT TW
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.016241	46.36217	69.81889	0.7845
At most 1	0.012185	29.23469	47.85613	0.7571
At most 2	0.008412	16.41087	29.79707	0.6831
At most 3	0.006906	7.575087	15.49471	0.5119
At most 4	0.000312	0.326016	3.841466	0.5680

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.016241	17.12748	33.87687	0.9168
At most 1	0.012185	12.82382	27.58434	0.8944
At most 2	0.008412	8.835783	21.13162	0.8455
At most 3	0.006906	7.249071	14.26460	0.4601
At most 4	0.000312	0.326016	3.841466	0.5680

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 4 A (Johansen Cointegration Test of European Data)

Sample (adjusted): 1/09/2012 12/30/2016
Included observations: 1182 after adjustments
Trend assumption: Linear deterministic trend
Series: NIFTY CAC DAX FTSE NEXT SMI
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.032313	82.63394	95.75366	0.2820
At most 1	0.015358	43.80900	69.81889	0.8664
At most 2	0.008944	25.51465	47.85613	0.9042
At most 3	0.006022	14.89569	29.79707	0.7868
At most 4	0.003920	7.755844	15.49471	0.4919
At most 5	0.002630	3.113166	3.841466	0.0777

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.032313	38.82495	40.07757	0.0687
At most 1	0.015358	18.29435	33.87687	0.8624
At most 2	0.008944	10.61895	27.58434	0.9742
At most 3	0.006022	7.139851	21.13162	0.9482
At most 4	0.003920	4.642678	14.26460	0.7861
At most 5	0.002630	3.113166	3.841466	0.0777

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 4A Unrestricted Vector Auto Regression with Asian Data

Vector Autoregression Estimates
Sample (adjusted): 1/06/2012 12/29/2016
Included observations: 1047 after adjustments
Standard errors in ( )& t-statistics in [ ]

	NIFTY	HANG	KOSPI	SET	SIT	TW
NIFTY(-1)	0.850023	-0.092383	-0.011712	0.003366	-0.002461	0.037291
	(0.03607)	(0.11811)	(0.00774)	(0.00730)	(0.01122)	(0.03168)

	[23.5679]	[-0.78217]	[-1.51344]	[0.46121]	[-0.21941]	[1.17717]
NIFTY(-2)	0.140650	0.096581	0.010794	-0.003624	-0.000998	-0.037681
	(0.03605)	(0.11807)	(0.00774)	(0.00730)	(0.01121)	(0.03167)
	[3.90104]	[0.81800]	[1.39527]	[-0.49676]	[-0.08901]	[-1.18990]
HANG(-1)	0.011235	0.944064	0.005620	-0.003572	0.000550	-0.001690
	(0.01336)	(0.04375)	(0.00287)	(0.00270)	(0.00415)	(0.01173)
	[0.84106]	**[21.5808]**	**[1.96094]**	[-1.32129]	[0.13228]	[-0.14403]
HANG(-2)	-0.012754	0.024294	-0.004936	0.003419	-0.000426	0.001308
	(0.01328)	(0.04348)	(0.00285)	(0.00269)	(0.00413)	(0.01166)
	[-0.96049]	[0.55869]	[-1.73241]	[1.27241]	[-0.10326]	[0.11213]
KOSPI(-1)	0.430016	4.162566	0.929340	0.100004	0.332883	1.670892
	(0.17041)	(0.55805)	(0.03656)	(0.03448)	(0.05300)	(0.14967)
	[2.52344]	**[7.45912]**	**[25.4173]**	**[2.90006]**	**[6.28034]**	**[11.1636]**
KOSPI(-2)	-0.510897	-4.105818	0.011197	-0.114413	-0.366504	-1.723164
	(0.17022)	(0.55742)	(0.03652)	(0.03444)	(0.05294)	(0.14950)
	[-3.00144]	**[-7.36571]**	[0.30658]	**[-3.32162]**	**[-6.92242]**	**[-11.5258]**
SET(-1)	0.279210	0.529886	0.058664	0.973381	0.114308	0.015747
	(0.17805)	(0.58307)	(0.03820)	(0.03603)	(0.05538)	(0.15638)
	[1.56816]	[0.90878]	[1.53559]	**[27.0160]**	**[2.06405]**	[0.10070]
SET(-2)	-0.280374	-0.542818	-0.060637	0.013514	-0.103952	0.018386
	(0.17822)	(0.58365)	(0.03824)	(0.03607)	(0.05544)	(0.15654)
	[-1.57315]	[-0.93005]	[-1.58568]	[0.37471]	[-1.87520]	[0.11745]
SIT(-1)	-0.061688	-0.061612	0.026829	-0.059157	0.893215	-0.025546
	(0.13309)	(0.43583)	(0.02856)	(0.02693)	(0.04140)	(0.11689)
	[-0.46352]	[-0.14137]	[0.93955]	**[-2.19659]**	**[21.5775]**	[-0.21855]
SIT(-2)	0.049757	0.200428	-0.032144	0.059318	0.092195	0.007126
	(0.13297)	(0.43545)	(0.02853)	(0.02691)	(0.04136)	(0.11679)
	[0.37420]	[0.46028]	[-1.12664]	**[2.20448]**	**[2.22911]**	[0.06101]
TW(-1)	0.046265	-0.046884	-0.009795	0.011426	0.014299	0.924221
	(0.04142)	(0.13563)	(0.00889)	(0.00838)	(0.01288)	(0.03638)
	[1.11711]	[-0.34569]	[-1.10233]	[1.36340]	[1.10999]	[25.4077]
TW(-2)	-0.024837	0.073930	0.013715	-0.009033	-0.008207	0.071872
	(0.04152)	(0.13597)	(0.00891)	(0.00840)	(0.01291)	(0.03647)
	[-0.59821]	[0.54374]	[1.53957]	[-1.07513]	[-0.63554]	[1.97088]

C	119.7062	-69.38186	94.70419	31.80941	66.97879	158.2835
	(95.7314)	(313.499)	(20.5403)	(19.3721)	(29.7764)	(84.0826)
	[1.25044]	[-0.22131]	[4.61064]	[1.64202]	[2.24940]	[1.88248]
R-squared	0.996383	0.983321	0.938186	0.986527	0.987987	0.991270
Adj. R-squared	0.996341	0.983128	0.937469	0.986370	0.987847	0.991168
Sum sq. resids	6098564.	65402149	280759.3	249730.4	590013.4	4704689.
S.E. equation	76.79864	251.4987	16.47809	15.54087	23.88750	67.45361
F-statistic	23738.23	5080.143	1307.798	6309.127	7086.564	9783.467
Log likelihood	-6024.311	-7266.315	-4412.815	-4351.505	-4801.591	-5888.466
Akaike AIC	11.53259	13.90509	8.454279	8.337163	9.196926	11.27310
Schwarz SC	11.59410	13.96660	8.515786	8.398670	9.258433	11.33460
Mean dependent	6996.971	22428.19	1973.956	1405.928	3094.912	8452.725
S.D. dependent	1269.665	1936.202	65.89577	133.1161	216.6894	717.7621

Determinant resid covariance (dof adj.)	1.15E+19
Determinant resid covariance	1.06E+19
Log likelihood	-31848.32
Akaike information criterion	60.98629
Schwarz criterion	61.35533

Table 5A (Significance of Coefficient of other Asian Indices on Nifty Open)

Dependent Variable: NIFTY
Method: Least Squares

Sample (adjusted): 1/06/2012 12/29/2016
Included observations: 1047 after adjustments
NIFTY = C(1)*NIFTY(-1) + C(2)*NIFTY(-2) + C(3)*HANG(-1) + C(4)*HANG(-2)
+ C(5)*KOSPI(-1) + C(6)*KOSPI(-2) + C(7)*SET(-1) + C(8)*SET(-2) +
C(9)*SIT(-1) + C(10)*SIT(-2) + C(11)*TW(-1) + C(12)*TW(-2) + C(13)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.850023	0.036067	23.56788	0.0000
C(2)	0.140650	0.036054	3.901038	0.0001
C(3)	0.011235	0.013358	0.841059	0.4005
C(4)	-0.012754	0.013279	-0.960492	0.3370
C(5)	0.430016	0.170408	2.523444	0.0118
C(6)	-0.510897	0.170217	-3.001443	0.0028
C(7)	0.279210	0.178049	1.568164	0.1171
C(8)	-0.280374	0.178225	-1.573145	0.1160
C(9)	-0.061688	0.133088	-0.463517	0.6431
C(10)	0.049757	0.132971	0.374196	0.7083
C(11)	0.046265	0.041415	1.117113	0.2642
C(12)	-0.024837	0.041519	-0.598211	0.5498
C(13)	119.7062	95.73138	1.250438	0.2114

R-squared	0.996383	Mean dependent var	6996.971
Adjusted R-squared	0.996341	S.D. dependent var	1269.665
S.E. of regression	76.79864	Akaike info criterion	11.53259
Sum squared resid	6098564.	Schwarz criterion	11.59410
Log likelihood	-6024.311	Hannan-Quinn criter.	11.55591
F-statistic	23738.23	Durbin-Watson stat	2.029436
Prob(F-statistic)	0.000000		

Table 6AVAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1/04/2012 12/29/2016
Included observations: 1047

Dependent variable: NIFTY

Excluded	Chi-sq	df	Prob.
HANG	1.065782	2	0.5869
KOSPI	9.781194	2	0.0075
SET	2.488323	2	0.2882
SIT	0.403383	2	0.8173
TW	7.285974	2	0.0262
All	29.68069	10	0.0010

Dependent variable: HANG

Excluded	Chi-sq	df	Prob.
NIFTY	0.718452	2	0.6982
KOSPI	56.70583	2	0.0000
SET	0.866024	2	0.6486
SIT	2.977223	2	0.2257
TW	1.152922	2	0.5619
All	70.57463	10	0.0000

Dependent variable: KOSPI

Excluded	Chi-sq	df	Prob.
NIFTY	2.946300	2	0.2292
HANG	4.348173	2	0.1137
SET	2.531608	2	0.2820
SIT	2.070029	2	0.3552
TW	6.408618	2	0.0406

All	20.17159	10	0.0277

Dependent variable: SET

Excluded	Chi-sq	df	Prob.
NIFTY	0.304789	2	0.8586
HANG	1.747512	2	0.4174
KOSPI	11.46465	2	0.0032
SIT	4.887158	2	0.0868
TW	3.521350	2	0.1719
All	20.50233	10	0.0248

Dependent variable: SIT

Excluded	Chi-sq	df	Prob.
NIFTY	5.604899	2	0.0607
HANG	0.028372	2	0.9859
KOSPI	48.37408	2	0.0000
SET	4.987596	2	0.0826
TW	6.239427	2	0.0442
All	79.20305	10	0.0000

Dependent variable: TW

Excluded	Chi-sq	df	Prob.
NIFTY	1.416279	2	0.4926
HANG	0.033935	2	0.9832
KOSPI	133.7584	2	0.0000
SET	1.435439	2	0.4879
SIT	0.723891	2	0.6963
All	185.1309	10	0.0000

Table 7A Pair wise Granger Causality Test for Asian Data

Pairwise Granger Causality Tests

Sample: 1/04/2012 12/29/2016

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
D(HANG) does not Granger Cause D(NIFTY)	1046	5.90324	0.0028
D(NIFTY) does not Granger Cause D(HANG)		0.90996	0.4029
D(KOSPI) does not Granger Cause D(NIFTY)	1046	15.6568	2.E-07
D(NIFTY) does not Granger Cause D(KOSPI)		0.11559	0.8909
D(SET) does not Granger Cause D(NIFTY)	1046	4.70527	0.0092
D(NIFTY) does not Granger Cause D(SET)		0.48536	0.6156
D(SIT) does not Granger Cause D(NIFTY)	1046	1.91127	0.1484
D(NIFTY) does not Granger Cause D(SIT)		3.81364	0.0224
D(TW) does not Granger Cause D(NIFTY)	1046	2.88573	0.0563
D(NIFTY) does not Granger Cause D(TW)		13.5793	2.E-06
D(KOSPI) does not Granger Cause D(HANG)	1046	36.6554	4.E-16
D(HANG) does not Granger Cause D(KOSPI)		1.71162	0.1811
D(SET) does not Granger Cause D(HANG)	1046	3.96972	0.0192
D(HANG) does not Granger Cause D(SET)		2.97860	0.0513
D(SIT) does not Granger Cause D(HANG)	1046	0.30846	0.7346
D(HANG) does not Granger Cause D(SIT)		6.36691	0.0018
D(TW) does not Granger Cause D(HANG)	1046	1.43141	0.2394
D(HANG) does not Granger Cause D(TW)		11.6665	1.E-05
D(SET) does not Granger Cause D(KOSPI)	1046	1.84402	0.1587
D(KOSPI) does not Granger Cause D(SET)		4.78411	0.0085
D(SIT) does not Granger Cause D(KOSPI)	1046	1.86211	0.1559
D(KOSPI) does not Granger Cause D(SIT)		34.1864	4.E-15
D(TW) does not Granger Cause D(KOSPI)	1046	0.06635	0.9358
D(KOSPI) does not Granger Cause D(TW)		95.3848	9.E-39
D(SIT) does not Granger Cause D(SET)	1046	2.10947	0.1218

ISSN (Print Version) 0975-3931
ISSN (On Line Version) 2278-1277

D(SET) does not Granger Cause D(SIT)		8.37637	0.0002
D(TW) does not Granger Cause D(SET)	1046	0.35654	0.7002
D(SET) does not Granger Cause D(TW)		10.9360	2.E-05
D(TW) does not Granger Cause D(SIT)	1046	2.11887	0.1207
D(SIT) does not Granger Cause D(TW)		7.15453	0.0008

Table 8 A VAR for European Data

Vector Autoregression Estimates

Sample (adjusted): 1/06/2012 12/30/2016
Included observations: 1183 after adjustments
Standard errors in ( )& t-statistics in [ ]

	NIFTY	CAC	DAX	FTSE	NEXT	SMI
NIFTY(-1)	1.022546	0.136579	0.298332	0.269390	0.026596	0.183101
	(0.03194)	(0.02201)	(0.05153)	(0.02304)	(0.00390)	(0.03560)
	[32.0106]	**[6.20542]**	**[5.78956]**	**[11.6909]**	**[6.82480]**	**[5.14356]**
NIFTY(-2)	-0.099756	-0.169455	-0.371662	-0.291044	-0.032887	-0.231076
	(0.04560)	(0.03142)	(0.07356)	(0.03289)	(0.00556)	(0.05082)
	[-2.18766]	**[-5.39348]**	[-5.05268]	**[-8.84818]**	**[-5.91191]**	**[-4.54732]**
NIFTY(-3)	0.074848	0.034891	0.088212	0.026622	0.006903	0.055791
	(0.03401)	(0.02343)	(0.05486)	(0.02453)	(0.00415)	(0.03790)
	[2.20084]	[1.48899]	[1.60793]	[1.08516]	[1.66377]	[1.47207]
CAC(-1)	-0.350404	0.756757	-0.323881	0.126231	-0.022436	-0.342048
	(0.24832)	(0.17109)	(0.40056)	(0.17912)	(0.03029)	(0.27672)
	[-1.41113]	**[4.42311]**	[-0.80857]	[0.70472]	[-0.74066]	[-1.23608]
CAC(-2)	-0.135654	0.182974	0.631478	-0.104294	0.017389	0.428785
	(0.32734)	(0.22554)	(0.52804)	(0.23613)	(0.03993)	(0.36479)
	[-0.41441]	[0.81127]	[1.19589]	[-0.44168]	[0.43544]	[1.17544]
CAC(-3)	0.459701	0.023695	-0.321641	0.005806	0.002412	-0.021653
	(0.24601)	(0.16950)	(0.39684)	(0.17746)	(0.03001)	(0.27415)
	[1.86866]	[0.13980]	[-0.81051]	[0.03272]	[0.08037]	[-0.07898]
DAX(-1)	0.016910	0.037458	0.886358	-0.021088	0.006823	0.044366
	(0.04041)	(0.02785)	(0.06519)	(0.02915)	(0.00493)	(0.04504)
	[0.41842]	[1.34519]	**[13.5959]**	[-0.72336]	[1.38391]	[0.98509]
DAX(-2)	0.033348	-0.043853	0.043910	0.000272	-0.007913	-0.077190

	(0.05162)	(0.03556)	(0.08326)	(0.03723)	(0.00630)	(0.05752)
	[0.64607]	[-1.23308]	[0.52737]	[0.00731]	[-1.25664]	[-1.34196]
DAX(-3)	-0.044016	0.014563	0.052715	0.040935	0.003073	0.039498
	(0.04039)	(0.02783)	(0.06515)	(0.02913)	(0.00493)	(0.04501)
	[-1.08987]	[0.52336]	[0.80916]	[1.40513]	[0.62381]	[0.87760]
FTSE(-1)	0.019320	-0.027665	-0.009949	0.717031	-0.001324	0.135845
	(0.04880)	(0.03362)	(0.07872)	(0.03520)	(0.00595)	(0.05438)
	[0.39589]	[-0.82277]	[-0.12638]	[20.3688]	[-0.22233]	[2.49791]
FTSE(-2)	0.063213	0.056475	0.098073	0.158557	0.006759	-0.034797
	(0.05705)	(0.03931)	(0.09203)	(0.04116)	(0.00696)	(0.06358)
	[1.10797]	[1.43665]	[1.06562]	[3.85267]	[0.97108]	[-0.54729]
FTSE(-3)	-0.090008	-0.027148	-0.071489	0.104198	-0.005722	-0.101110
	(0.04358)	(0.03003)	(0.07030)	(0.03144)	(0.00532)	(0.04856)
	[-2.06543]	[-0.90414]	[-1.01695]	[3.31469]	[-1.07632]	**[-2.08201]**
NEXT(-1)	2.263457	1.090256	3.669576	1.899040	1.073360	1.137570
	(1.47939)	(1.01931)	(2.38643)	(1.06715)	(0.18047)	(1.64862)
	[1.52999]	[1.06960]	[1.53769]	[1.77954]	[5.94746]	[0.69001]
NEXT(-2)	0.353567	-0.514645	-4.145207	-1.009090	-0.013647	-1.073668
	(1.94322)	(1.33890)	(3.13464)	(1.40174)	(0.23706)	(2.16551)
	[0.18195]	[-0.38438]	[-1.32239]	[-0.71989]	[-0.05757]	[-0.49580]
NEXT(-3)	-2.621420	-0.576738	0.574038	-1.335678	-0.087593	-0.498821
	(1.46749)	(1.01112)	(2.36724)	(1.05857)	(0.17902)	(1.63537)
	[-1.78633]	[-0.57040]	[0.24249]	[-1.26177]	[-0.48929]	[-0.30502]
SMI(-1)	-0.025884	-0.057009	-0.159477	0.007385	-0.009894	0.979827
	(0.03921)	(0.02702)	(0.06326)	(0.02829)	(0.00478)	(0.04370)
	[-0.66006]	**[-2.10994]**	**[-2.52107]**	[0.26107]	[-2.06821]	[22.4215]
SMI(-2)	-0.046298	0.050911	0.110597	0.031384	0.008544	-0.095501
	(0.05657)	(0.03897)	(0.09125)	(0.04080)	(0.00690)	(0.06304)
	[-0.81848]	[1.30627]	[1.21206]	[0.76915]	[1.23819]	[-1.51501]
SMI(-3)	0.079489	0.008527	0.043302	-0.035225	0.001902	0.105655
	(0.03903)	(0.02689)	(0.06296)	(0.02815)	(0.00476)	(0.04349)
	[2.03668]	[0.31710]	[0.68780]	[-1.25118]	[0.39953]	**[2.42922]**
C	65.11826	35.71408	-26.38609	123.7859	8.567885	42.75966
	(48.0400)	(33.1000)	(77.4941)	(34.6535)	(5.86049)	(53.5354)
	[1.35550]	[1.07898]	[-0.34049]	**[3.57210]**	[1.46197]	[0.79872]
R-squared	0.997042	0.992142	0.994811	0.986382	0.994342	0.993417
Adj. R-squared	0.996996	0.992020	0.994731	0.986171	0.994254	0.993315

Sum sq. resids	5597700.	2657421.	14566029	2912719.	83305.14	6951636.
S.E. equation	69.34710	47.78083	111.8650	50.02335	8.459787	77.27998
F-statistic	21795.39	8164.718	12398.08	4683.811	11364.34	9757.965
Log likelihood	-6683.911	-6243.244	-7249.584	-6297.503	-4195.115	-6812.043
Akaike AIC	11.33206	10.58706	12.28839	10.67879	7.124455	11.54868
Schwarz SC	11.41358	10.66858	12.36991	10.76031	7.205977	11.63020
Mean dependent	6986.573	4171.479	9155.444	6387.145	801.6039	7939.501
S.D. dependent	1265.265	534.8905	1541.092	425.3805	111.6069	945.1668

Determinant resid covariance (dof adj.)	2.23E+17
Determinant resid covariance	2.02E+17
Log likelihood	-33642.46
Akaike information criterion	57.06925
Schwarz criterion	57.55839

Table 9A (significance of Coefficients of European indices on Nifty Closing prices)

Dependent Variable: NIFTY
Method: Least Squares

Sample (adjusted): 1/06/2012 12/30/2016
Included observations: 1183 after adjustments
NIFTY = C(1)*NIFTY(-1) + C(2)*NIFTY(-2) + C(3)*NIFTY(-3) + C(4)*CAC(-1) + C(5)*CAC(-2) + C(6)*CAC(-3) + C(7)*DAX(-1) + C(8)*DAX(-2) + C(9) *DAX(-3) + C(10)*FTSE(-1) + C(11)*FTSE(-2) + C(12)*FTSE(-3) + C(13) *NEXT(-1) + C(14)*NEXT(-2) + C(15)*NEXT(-3) + C(16)*SMI(-1) + C(17) *SMI(-2) + C(18)*SMI(-3) + C(19)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.022546	0.031944	32.01060	0.0000
C(2)	-0.099756	0.045599	-2.187665	0.0289
C(3)	0.074848	0.034009	2.200837	0.0279
C(4)	-0.350404	0.248315	-1.411125	0.1585
C(5)	-0.135654	0.327342	-0.414411	0.6786
C(6)	0.459701	0.246006	1.868661	0.0619
C(7)	0.016910	0.040414	0.418422	0.6757
C(8)	0.033348	0.051616	0.646073	0.5184
C(9)	-0.044016	0.040386	-1.089871	0.2760
C(10)	0.019320	0.048801	0.395888	0.6923
C(11)	0.063213	0.057053	1.107966	0.2681
C(12)	-0.090008	0.043578	-2.065426	0.0391
C(13)	2.263457	1.479390	1.529994	0.1263
C(14)	0.353567	1.943218	0.181949	0.8557
C(15)	-2.621420	1.467493	-1.786325	0.0743
C(16)	-0.025884	0.039214	-0.660059	0.5093
C(17)	-0.046298	0.056566	-0.818480	0.4133
C(18)	0.079489	0.039029	2.036678	0.0419

C(19)	65.11826	48.03997	1.355502	0.1755

R-squared	0.997042	Mean dependent var	6986.573
Adjusted R-squared	0.996996	S.D. dependent var	1265.265
S.E. of regression	69.34710	Akaike info criterion	11.33206
Sum squared resid	5597700.	Schwarz criterion	11.41358
Log likelihood	-6683.911	Hannan-Quinn criter.	11.36279
F-statistic	21795.39	Durbin-Watson stat	1.989340
Prob(F-statistic)	0.000000		

Table 10A VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1/03/2012 12/30/2016
Included observations: 1183

Dependent variable: NIFTY

Excluded	Chi-sq	df	Prob.
CAC	5.273750	3	0.1528
DAX	1.653237	3	0.6474
FTSE	4.542284	3	0.2085
NEXT	4.986205	3	0.1728
SMI	5.929315	3	0.1151
All	21.30510	15	0.1274

Dependent variable: CAC

Excluded	Chi-sq	df	Prob.
NIFTY	41.48592	3	0.0000
DAX	2.885097	3	0.4097
FTSE	2.139214	3	0.5440
NEXT	1.356847	3	0.7157
SMI	5.157444	3	0.1606
All	61.08257	15	0.0000

Dependent variable: DAX

Excluded	Chi-sq	df	Prob.
NIFTY	38.86437	3	0.0000

CAC	1.465461	3	0.6903
FTSE	2.580360	3	0.4609
NEXT	2.538062	3	0.4685
SMI	7.209218	3	0.0655
All	58.65531	15	0.0000

Dependent variable: FTSE

Excluded	Chi-sq	df	Prob.
NIFTY	139.5844	3	0.0000
CAC	0.947426	3	0.8140
DAX	7.512714	3	0.0572
NEXT	8.501494	3	0.0367
SMI	2.402831	3	0.4931
All	421.3970	15	0.0000

Dependent variable: NEXT

Excluded	Chi-sq	df	Prob.
NIFTY	50.54627	3	0.0000
CAC	0.666685	3	0.8810
DAX	3.809182	3	0.2828
FTSE	1.383115	3	0.7095
SMI	5.299631	3	0.1511
All	67.12669	15	0.0000

Dependent variable: SMI

Excluded	Chi-sq	df	Prob.
NIFTY	30.27542	3	0.0000
CAC	3.203225	3	0.3613
DAX	2.104790	3	0.5509
FTSE	8.713241	3	0.0334
NEXT	2.188517	3	0.5342
All	48.00770	15	0.0000

Table 11A Pairwise Granger Causality Tests

Sample: 1/03/2012 12/30/2016
Lags: 3

Null Hypothesis:	Obs	F-Statistic	Prob.
D(CAC) does not Granger Cause D(NIFTY)	1182	1.24950	0.2905
D(NIFTY) does not Granger Cause D(CAC)		15.5362	6.E-10
D(DAX) does not Granger Cause D(NIFTY)	1182	1.51573	0.2087
D(NIFTY) does not Granger Cause D(DAX)		12.9625	2.E-08
D(FTSE) does not Granger Cause D(NIFTY)	1182	4.28288	0.0051
D(NIFTY) does not Granger Cause D(FTSE)		87.7134	3.E-51
D(NEXT) does not Granger Cause D(NIFTY)	1182	1.82750	0.1403
D(NIFTY) does not Granger Cause D(NEXT)		17.5305	4.E-11
D(SMI) does not Granger Cause D(NIFTY)	1182	0.43009	0.7315
D(NIFTY) does not Granger Cause D(SMI)		9.35887	4.E-06
D(DAX) does not Granger Cause D(CAC)	1182	1.68461	0.1685
D(CAC) does not Granger Cause D(DAX)		1.70125	0.1650
D(FTSE) does not Granger Cause D(CAC)	1182	1.75101	0.1548
D(CAC) does not Granger Cause D(FTSE)		75.1094	2.E-44
D(NEXT) does not Granger Cause D(CAC)	1182	0.87907	0.4513
D(CAC) does not Granger Cause D(NEXT)		0.33920	0.7970
D(SMI) does not Granger Cause D(CAC)	1182	1.63071	0.1805
D(CAC) does not Granger Cause D(SMI)		2.22367	0.0837
D(FTSE) does not Granger Cause D(DAX)	1182	1.35081	0.2564
D(DAX) does not Granger Cause D(FTSE)		50.7588	8.E-31
D(NEXT) does not Granger Cause D(DAX)	1182	2.07708	0.1015
D(DAX) does not Granger Cause D(NEXT)		1.97859	0.1154
D(SMI) does not Granger Cause D(DAX)	1182	1.20132	0.3080
D(DAX) does not Granger Cause D(SMI)		1.48192	0.2178
D(NEXT) does not Granger Cause D(FTSE)	1182	80.5112	2.E-47
D(FTSE) does not Granger Cause D(NEXT)		1.36935	0.2506
D(SMI) does not Granger Cause D(FTSE)	1182	34.9719	1.E-21
D(FTSE) does not Granger Cause D(SMI)		4.80307	0.0025
D(SMI) does not Granger Cause D(NEXT)	1182	2.25140	0.0807

D(NEXT) does not Granger Cause D(SMI)	2.83024	0.0373

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