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An Empirical Study on the Long-run and Short-run Integration between Select Asia-Pacific Countries and US with Reference to India

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Structured Abstract:

Purpose: To study the long-run and short-run integration between Asia-Pacific countries and US with special emphasis on India.

Design / Methodology / Approach: The study is based on secondary data of selected closing equity stock indices of Asia-Pacific countries and US. The data has been analyzed using various econometrics techniques and models.

Findings: The study reveals that India is integrated with most of the countries both in long-run and short-run. However the there exists slight diversification opportunity for the Indian investors. It also reveals that Engle-Granger is not appropriate in existence of multiple variables and more than one cointegrating equation.

Originality / Value: The study is very unique as it deals with a period during and after US financial crisis and it also considers lot of economic turmoil that took place in many countries. In addition the study considers many emerging economies of the world.

Keywords: Causality, Equity Indices, Integration, Long-run, Short-run, Unit Root, VAR, VECM.

Paper Type: Empirical Research Paper.

Introduction

Over the last three decades, the degree of integration among the stock markets around the globe had increased significantly. Out of several reasons for the apparent increased linkages and dependencies amongst international and national stock markets, the major influences are stepwise removal of the entry restrictions in financial market, relaxation of control over capital movements, emergence of new capital markets and instruments, rapid expansion of international markets, financial and economic crises, scams and their aftermath effects etc. Other important factors are improvement in the flow of information due to internet and telecommunication technology, reduction in transaction costs etc. Integration or more specifically financial integration lacks any universal definition. Financial openness, free

movement of capital and integration of financial services are part of a broad range of definition frequently cited in literature. Financial markets are said to be integrated when the law of one price holds (Yu, Fung and Tam, 2010). Discrepancies in prices or returns on identical (or comparable) assets would tend to be used as evidence to support that financial markets are not integrated.

Since long past, the developed international stock markets are influencing global economy and stock markets of major countries significantly. But very recently, they are also being influenced by many emerging and developing markets, although the effects may be very insignificant (Wong et al., 2004). Inspite of having many positive aspects of integration among the stock markets at regional, national and international level, there are umpteen evidences how some extraordinary incidents or scams such as US (United States) stock market crash in 1987, the breakdown of the European monetary system in 1992, bond market turmoil in 1994 and the Asia-Pacific crisis beginning in 1997, subprime crisis in US in 2007 etc. primarily churned out one stock market negatively, which had severe bad contagion effects over several stock markets. Studies found that the US stock market influences most of the European and Asian stock markets during the time of financial crisis (Huyghebaert and Wang, 2010; Iqbal, Khalid and Rafiq, 2011).

As world's main trading partner, US holds a significant amount of total capital investments in global stock markets, which gives birth to the notion when US sneezes, the other parts of the world gets flue. No one can deny that US has been influencing world economies since long ago. However over the passage of time, US supremacy as a global leader fades away, more specifically on economic standpoint and as an agent for spreading global financial contagion. Some recently occurred events have challenged the traditional concept of US supremacy in world economy. One burning instance is economic turmoil throughout the world due to unexpected devaluation of Chinese Yuan on 25th August, 2015, commonly referred to as Black Monday of 2015. The Chinese incident exerted the fading away of supremacy of US control to a great extent and the level of integration among the economies of many countries have also reached to such a level where traditional economic explanations have to either accept defeat or require all round modification. The Tsunami of Chinese economic pollution of August 2015 had first started devastating Asia, flooded across Europe and then slammed into the US, resulting in a single day loss of INR 7 lakh crores of market capitalisation of Indian investors. The US also could not get rid of the tide of this Tsunami, which resulted in

fall down of S&P 500 and NASDAQ Composite by 3.8% and 4.5% respectively (The Economic Times, 25th August 2015).

Another fact that attracts more attention is that some economies in Asia-Pacific region are growing at faster rate than US. Recent data of International Monetary Fund (IMF) and World Bank revealed that some Asian countries like China, Japan, India, Taiwan, Malaysia, Singapore etc. are among the fastest growing economies of the world. According to the recent Report of World Federation of Exchanges (WFE), domestic market capitalisation of equity markets of Asia-Pacific region has increased by 9.8% (expressed in USD millions) in 2015 over 2014, whereas in American region the same decreased by 7.7% (expressed in USD millions) during the same period. Equity markets of Asia-Pacific countries and America account for 36.91% and 44.57% respectively of the world domestic market capitalisation in 2015. The same was 33.20 and 47.67% for Asia-Pacific countries and America during 2014 (WFE Annual Statistics Guide V1, 2016). All these signify the growing concentration of economic power in this region.

The theories of stock market integration are not only required by international investors to have portfolio diversification benefits, but also government policy makers should also possess such knowledge in order to have an idea how a particular policy can impact the particular country's or global stock markets. Correlations among equity markets could be more important to the policy makers of East-Asia because of their implications in financial stability. Monetary policy strategy is often influenced by the international/ regional stock market developments due to the international or regional propagation of shocks channeled through equity markets, wealth channel and confidence effects (Wang L., 2014).

In India, the process of liberalization started in 1991 following the Balance of Payment crisis, devaluation of rupee in 1991, subsequent transition to the market based exchange rate regime, elimination of the quantitative restrictions on imports and the drastic reduction in custom duties. In addition to these, Indian government has taken policy to open up many areas for FIIs and foreign direct investment (FDI), which ignited the Indian linkages with global financial markets.

Closely knit economies have major conveniences from the perspective of economic development. Empowerment of the Asia-Pacific countries will have strong message to the world economy and will also reduce the US dependency in many ways. Formation of regional / international groups has become important issue for enhancing economic and other

cooperation. For instance, ASEAN (Association of Southeast Asian Nations), BRICS, G20 etc have added some momentum to the international level integration. In this backdrop, the present study aims at finding out empirically the linkages among stock markets of Asia-Pacific and US with special emphasis on India. The study period mainly starts from the beginning of 2007 in order to empirically establish the fact of increased integration during and after US subprime crisis. Moreover, it will also give an insight into the recent trends of integration among some emerging economies of Asia-Pacific and already developed economy US.

Review of Empirical Literature

Kansas (1998) considered US and six largest European equity markets and found that US market was not pairwise cointegrated with any of the European markets. Masih & Masih (2001) investigated the dynamic causal linkages amongst nine major international stock price indices. Click & Plummer (2003) studied the degree of correlation among stock markets of ASEAN-5 and its implications for portfolio investors. The empirical results suggested in favour of incomplete integration of ASEAN-5 stock markets. Narayan, Smyth & Nandha (2004) examined the linkages among the stock markets of Bangladesh, India, Pakistan and Sri Lanka and find that stock prices in Bangladesh, India and Sri Lanka Granger-cause stock prices in Pakistan in long run. Cotter (2004) examined the relationship between the Irish, German, U.K and US equity markets and found that Irish equity market depends heavily on trading activity in the other markets but not vise-versa. Study of Lamba (2005) explored that the Indian market is influenced by the US, UK and Japan and this influence has persisted following the September 11, 2001 terrorist attacks on the US. Mukherjee & Mishra (2007) studied major equity indices of 23 sample countries including India. The countries from same region were found to be more integrated than those from the different regions. Raj & Dhal (2008) studied the extent of integration of Indian market with regional (Singapore and Honk Kong) and global (US, UK and Japan) markets and supported international integration of Indian stock market. Aktan et al. (2009) examine the emerging market indices of BRICA and found that the US market has a significant effect on all BRICA countries in the same trading day. Iqbal, Khalid & Rafiq (2011) found out the dynamic linkages among the equity markets of USA, Pakistan and India. No co-integration was found among stock markets of USA, Pakistan and India, but evidence of unidirectional causality running from NYSE to Bombay and Karachi stock exchanges was observed. Saha & Bhunia (2012) studied the casual

relationship between US and Indian equity markets after Subprime Crisis and found long run equilibrium relation between the selected variables which suggested the evidence of feedback causality running between the six stock exchanges. Palamalai et al. (2013) examined stock market integration among major stock markets of emerging Asia-Pacific economies. Their results revealed that investors can gain feasible benefits from international portfolio diversification in the short run. They argued that although long-term diversification benefits from exposures to these markets might be limited, short-run benefits might exist due to substantial transitory fluctuations. Wang (2014) examined the integration and causality of interdependencies among six major Asian stock exchanges, while considering their interactions with USA before, during and after global financial crisis and revealed that East Asian markets are less responsive to the shocks in the USA after crisis.

Objectives of the Study

This empirical study aims to focus on the following aspects:

- To outline a statistical overview of the selected equity markets of Asia-Pacific region and US.
- To examine the existence of long-run and short-run linkages, if any, between the selected equity markets.
- To evaluate, analyse the empirical results and make necessary conclusions.

Data Sources and Research Methodology

1. Sources and Nature of Data: As the study is empirical in nature, the secondary data had been obtained from various websites of stock markets including Yahoo Finance.

2. Variables Selected: Table 1 shows the proxy stock markets for the respective countries and their equity indices which have been selected as primary variables. Their selection is based on the review of literature and which can appropriately reflect the sense of the economic condition of the country.

3. Time Frame: The study has been conducted on daily closing indices of 10 countries considering period from 2nd January 2007 to 30th December, 2016.

4. Data Mining: Due to different stock exchange holidays, missing observations was the relevant difficulty. To overcome this problem, this study adopts a procedure to match the

daily data of the selected indices and finally reached at 2,602 observations. First the daily closing indices are converted into natural logarithm forms and daily returns have been calculated taking first difference of the logarithmic indices. Therefore Return (R_t) = ln (P_t / P_{t-1}) = ln P_t – ln P_{t-1}

5. Econometrics Models Used: Initially, Augmented Dicky-Fuller's (ADF) Test and Phillips Perron (PP) Test were conducted to test the stationarity of the data series. Depending on the outcome and other the diagnostic tests conducted, Engle Granger Cointegration Model and Johansen-Juselius Model were used. Thereafter, Granger Causality Test was conduted to identify the nature and direction of causality.

Empirical Analysis and Discussion

(a) Descriptive Statistics

Descriptive statistics of selected daily logarithmic stock returns are shown in Tables 2 and 3. Indonesia (0.0407%) and Singapore (-0.0014%) show the highest and lowest mean returns respectively. China poses high risk due to volatility as it has the highest standard deviation (SD), whereas Malaysia shows the lowest SD. High kurtosis values indicate that data of none of the countries are normally distributed. Probability values of Jarque-Bera test confirms that the null hypothesis of normality of the stock indices is rejected at 1 per cent level of significance.

(b) Unit Root Test Result:

Two or more non-stationary time series are said to be cointegrated if a linear combination of the variables is found stationery. In analysis of cointegration, test of non-stationarity of the time series data is considered as the precondition. The other condition is that all series should be integrated in the same order i.e. I (d), where d is the order of integration. For stationarity analysis, Augmented Dicky-Fuller (ADF) and Philip-Perron (PP) tests have been conducted.

Table 4 suggests that the null hypothesis of existence of a unit root cannot be rejected in respect of all the proxy stock indices in their natural log levels and hence indices are non-stationary in both models, with linear trend including both intercept and time trend. However they are all stationary in first difference forms as the test statistics in both ADF and PP tests are significant at 1 per cent level. Therefore, all the indices and the respective countries are found to be integrated of order one, i.e. I (1).

❒ ***Long-run Cointegration Test-***

(c) Residual Based Engle-Granger (E-G) Cointegration Test:

According to Engle and Granger (1987), if two variables (say, Y_t and X_t) are individually I(1) and the residual ($\hat{e}_t$) obtained from the long-run Ordinary Least Square (OLS) equation (formed using Y_t and X_t) is I(0), then it can be concluded that Y_t and X_t are cointegrated in long-run. However, if $\hat{e}_t$ is not I(0), then it can be concluded that they are not cointegrated. In Panel A of Table 5, E-G test shows that India is integrated in long-run with all the selected Asia-Pacific countries and US, as the null hypothesis of no cointegration is rejected at 10 per cent level of significance. Therefore it exhibits that all the selected countries move together in long-run or share common economic and financial shocks. In Panel B of Table 5, bi-variate cointegration has been shown. Individually, India is cointegrated with China, Hong Kong, Taiwan. However the result is not consistent with the reality, as it shows that India is not cointegrated with US in long-run. There are some limitations of this model which provokes us to test the above results further using more robust model.

(d) Vector Auto regression Based Johansen's Cointegration Test:

As all the selected variables are integrated of the same order i.e. I(1), hence Vector Autoregressive (VAR) approach based Johansen & Juselius (J-J) (1988, 1990) cointegration test has been carried out to find out whether there exists any long-run cointegrating relationship between the variables. It is to be mentioned here that the efficiency of an ideal VAR model depends on the ideal number of lags selected. After several trial and error process lag 5 has been considered as ideal according to AIC (Akaike Information Criteria) and FPE (Final Prediction Error) criteria. In the selected lags, the level VAR model also passes the diagnostic test like autocorrelation LM test and stability test which are considered as pre-condition before running the VAR. Both Trace statistic and Max-Eigen value statistic of Johansen-Juselius test (Table 6) indicate that null hypothesis of no cointegration is rejected at 5 per cent level of significance. Since both the tests are giving the same result, the Johansen Model tested here is the ideal one. Table 6 shows that there exists one cointegrating equation among the variables. In the presence of at least one cointegrating relationship among the variables, there exists a long-run cointegrating relationship among India, other Asia-Pacific countries and US or in long-run they share the common shock. There exists also long-run causality running from all selected countries to India as the value of error correction term (ECT) is negative (i.e. -0.010) and significant at 1 per cent level of significance. It implies that in case of any deviation from the above long-run cointegrating relationship, it will tend to revert back to long-run relationship with the speed of adjustment of 1 per cent.

❑ ***Short-run Causal Relationship Test-***

(e) Vector Error Correction Model (VECM) Based Block Exogeneity Test:

As all the countries are integrated in long-run, it is also required to test the existence of any short-run causality among them. In presence of long-run cointegration, the short-run causal relationship has been tested using Vector Error Correction Model (VECM) based Granger Causality/ Block Exogeneity Test. Table 7 shows that India granger causes Japan, Hong Kong, Singapore, Indonesia, Taiwan, Malaysia, Korea (South) and US. On the other hand, India is granger caused by Japan, China Hong Kong, Indonesia, Korea (South) and US. Therefore it can be concluded that in short-run India influences the most of the countries and conversely India is also sharing short-run dynamic shock from most of the Asia-Pacific countries and US.

Conclusion

The study shows that India has long-run cointegrating relationship with Asia-Pacific countries and US during the sample period. US financial crisis of 2007 had also contaminated all most all the economies of the world. The study has considered the period that began with the year of US financial crisis of 2007. US financial crisis has indirectly bound the most of the stock markets. Both the models show that India has long-run integration with Asia-Pacific countries and US. However, India possesses low power in terms of creation of long-term cointegrating relationship as India has bi-variate long-run cointegration with only China, Hong Kong and Taiwan as shown by E-G test. Scope of long-run diversification benefit is very meagre for the investors of India, although some countries like Singapore, Indonesia, Malaysia, South Korea and obviously US remain opened for Indian investors. In short-run, India is impacted by maximum Asia-Pacific countries and US except Singapore, Taiwan and Malaysia. India has also influenced most of selected countries except China.

Econometrics models are not consistent so far as the results are concerned. Many claim that Engel & Granger model is not very efficient model. Such claim is proved here as it shows inconsistency with other models regarding outcome. The main reason of such deviation in Engel & Granger model is that it is a single equation and residual based model. Single equation has lower power than multivariate vector based models like VAR and Johansen models. Engel & Granger model will be ineffective when there exist more than one

cointegrating relations. Therefore it can be concluded that in case of heavy volatility in relationship, this E-G model has lower power.

Overall it can be concluded India is integrated in long-run with most of the countries not individually. Power of India increased when it acts with other economies of the world to create long-run equilibrium relationship and thus it pinpoints the need to the formation of powerful groups of countries of Asia-Pacific region in which India should take a lead position.

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Table 1: List of the Countries and Their Equity Indices (Variables)

Region	*Country*	*Equity Stock Markets*	*Equity Indices*
Asia-Pacific	India	National Stock Exchange (NSE)	NSE NIFTY (50)
	Japan	Tokyo Stock Exchange	NIKKEI 225
	China	Shanghai Stock Exchange	SSE Composite Index
	Hong Kong	Hong Kong Stock Exchange	Hang Seng Index
	Singapore	Singapore Exchange	FTSE Straits Times Index (30)
	Indonesia	Jakarta Stock Exchange	JSX Composite Index
	Taiwan	Taiwan Stock Exchange	Taiwan Weighted
	Malaysia	Kuala Lampur Stock Exchange	FTSE Bursa Malaysia KLCI
	Korea (South)	Korea Stock Exchange	Korea Composite Stock Price Index (KOSPI)
US	USA	New York Stock Exchange	S & P 500

Table 2: Descriptive Statistics of Stock Returns (%) (at natural log first difference)

	India	**Japan**	**China**	**Hong Kong**	**Singapore**
Mean	0.027461	0.004000	0.005707	0.003074	-0.001377
Maximum	16.33432	13.23458	9.034251	13.40681	7.530528
Minimum	-13.01419	-12.11103	-9.256154	-13.58202	-8.695982
Std. Dev.	1.471025	1.628232	1.736050	1.609405	1.165257
Skewness	0.069902	-0.457334	-0.594338	0.044624	-0.173999
Kurtosis	14.06715	11.54372	7.282565	11.81757	9.535544
Jarque-Bera	13276.08	8001.516	2140.766	8426.967	4642.182
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	2601	2601	2601	2601	2601

Table 3: Descriptive Statistics of Stock Returns (%) (at natural log first difference)

	Indonesia	**Taiwan**	**Malaysia**	**Korea (S)**	**US**
Mean	0.040723	0.005979	0.015527	0.013262	0.017729
Maximum	7.623376	6.524620	16.02038	11.28435	10.95720
Minimum	-10.95387	-6.735079	-15.56824	-11.17200	-9.469514
Std. Dev.	1.369484	1.210957	0.945694	1.291952	1.298447
Skewness	-0.632911	-0.389240	-0.501861	-0.587667	-0.330903

	Indonesia	Taiwan	Malaysia	Korea (S)	US
Kurtosis	10.99670	6.909539	93.96273	12.96644	13.34837
Jarque-Bera	7103.923	1722.136	896827.7	10914.60	11653.21
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	2601	2601	2601	2601	2601

Table 4: Unit Root Test

Country	At Levels				At First Differences			
	ADF		PP		ADF		PP	
	Intercept	Intercept + Trend	Intercept	Intercept + Trend	Intercept	Intercept +Trend	Intercept	Intercept +Trend
India	-1.360611 [14] (0.6030)	-2.678247 [14] (0.2458)	-1.305397 [8] (0.6292)	-2.521103 [6] (0.3177)	-12.82205* [13] (0.0000)	-12.81973* [13] (0.0000)	-49.07348* [10] (0.0001)	-49.06380* [10] (0.0000)
Japan	-1.107363 [3] (0.7151)	-1.941871 [3] (0.6230)	-1.142965 [11] (0.7007)	-1.964436 [12] (0.6199)	-31.59658* [2] (0.0000)	-31.65085* [2] (0.0000)	-53.72734* [11] (0.0001)	-53.80081* [12] (0.0000)
China	-2.064970 [20] (0.2592)	-2.056791 [20] (0.5692)	-1.802251 [9] (0.3798)	-1.817471 [9] (0.6962)	-10.24499* [19] (0.0000)	-10.24641* [19] (0.0000)	-50.41818* [8] (0.0001)	-50.40901* [8] (0.0000)
Hong Kong	-2.585528 [14] (0.0961)	-2.662953 [14] (0.2523)	-2.690991 [8] (0.0757)	-2.761774 [8] (0.2118)	-13.88431* [13] (0.0000)	-13.88138* [13] (0.0000)	-52.64069* [5] (0.0001)	-52.63045* [5] (0.0000)
Singapore	-2.260504 [17] (0.1852)	-2.323062 [17] (0.4206)	-1.937495 [8] (0.3152)	-1.970429 [8] (0.6166)	-10.93794* [18] (0.0000)	-10.93612* [16] (0.0000)	-49.58334* [6] (0.0001)	-49.57381* [6] (0.0000)
Indonesia	-1.311502 [14] (0.6264)	-1.797398 [14] (0.7060)	-1.242617 [17] (0.6580)	-1.780534 [16] (0.7142)	-13.19924* [13] (0.0000)	-13.20707* [13] (0.0000)	-45.75628* [19] (0.0001)	-45.74919* [19] (0.0000)
Taiwan	-2.405954 [27] (0.1401)	-2.814102 [27] (0.1922)	-1.857241 [6] (0.3530)	-2.277657 [5] (0.4455)	-8.206839* [26] (0.0000)	-8.210871* [26] (0.0000)	-48.8711* [9] (0.0001)	-48.88061* [9] (0.0000)
Malaysia	-1.509130 [1] (0.5290)	-1.543543 [1] (0.8145)	-1.588718 [3] (0.4882)	-1.655347 [1] (0.7706)	-56.68333* [0] (0.0001)	-56.68150* [0] (0.0000)	-56.68458* [1] (0.0001)	-56.68275* [1] (0.0000)
Korea (S)	-2.371851 [27] (0.1499)	-2.748720 [27] (0.2169)	-2,320262 [11] (0.1656)	-2.725371 [9] (0.2262)	-9.480052* [26] (0.0000)	-9.485237* [26] (0.0000)	-50.31813* [13] (0.0001)	-50.31134* [13] (0.0000)
US	-0.343665 [18] (0.9160)	-2.092096 [18] (0,5494)	-0.432156 [9] (0.9013)	-2.117180 [8] (0.5354)	-12.33384* [17] (0.0000)	-12.40617* [17] (0.0000)	-57.23999* [9] (0.0001)	-57.31000* [10] (0.0000)

Figures in [ ] represent Lag Lengths based on AIC in case of ADF Test and Bandwidth based on Newey-West,

* Indicates the statistical significance level of 1 %; Figures ( ) represent MacKinnon (1996) one sided *p* values.

Table 5: Engle & Granger Cointegration Test

Dependent Variable	No. of Lags	Tua statistic	Prob.	Z Statistic	Prob.
Panel A- Multivariate Cointegration Test: India Vs. Other Asia-Pacific Countries and US					
India	4	-5.645105	0.0996***	-66.96432	0.0600***
Panel B- Bi-variate Cointegration Test:					
India Vs. Japan					
India	0	-2.819127	0.3501	-15.83774	0.3238
India Vs. China					
India	0	-3.422682	0.1185	-23.38464	0.0986***
India Vs. Hong Kong					
India	4	-4.109489	0.0201**	-34.26084	0.0131**
India Vs. Singapore					
India	1	-3.117623	0.2165	-19.48112	0.1877
India Vs. Indonesia					
India	0	-2.860907	0.3294	-16.22677	0.3064
India Vs. Taiwan					
India	1	-4.345687	0.0096*	-38.04115	0.0062*
India Vs. Malaysia					
India	1	-2.841424	0.3390	-16.17369	0.3088
India Vs. Korea (South)					
India	1	-3.019676	0.2565	-17.41627	0.2576
India Vs. US					
India	1	-2.887768	0.3164	-16.36064	0.3006

The equation consists deterministic trends and constant; Lag selection is automatic based on Schwarz Criteria. Prob. represents MacKinnon (1996) *p* values. All variables are at their level forms and *,**, *** represent significance at 1%, 5% and 10% level respectively

Table 6: Johansen's Multivariate Cointegration Test

Hypothesized No. of CE (s)	Eigen value	Trace Statistics	Critical Value	Prob.	Max-Eigen Statistic	Critical Value	Prob.
None, r = 0	0.026582	250.9780	239.2354	0.0133**	69.94061	64.50472	0.0139**
At most 1, r ≤ 1	0.019771	181.0374	197.3709	0.2380	51.83947	58.43354	0.1926

Both Trace Test and Max-Eigen value Test indicate 1 cointegrating equ (s), at the 0.05 level. * indicates rejection of null hypothesis of no cointegration at 0.05 level;
p-values are MacKinnon- Haug-Michelis (1999) *p*- values.

Table 7: VECM Granger Causality / Block Exogeneity Test

Variables	χ^2	df	Probability
India does not granger cause Japan	46.64542	4	0.0000*
Japan does not granger cause India	11.85977	4	0.0184**
India does not granger cause China	6.195836	4	0.1850
China does not granger cause India	11.42825	4	0.0222**
India does not granger cause Hong Kong	36.01094	4	0.0000*
Hong Kong does not granger cause India	12.67278	4	0.0130**
India does not granger cause Singapore	19.05001	4	0.0008*
Singapore does not granger cause India	5.015644	4	0.2857
India does not granger cause Indonesia	34.69384	4	0.0000*
Indonesia does not granger cause India	11.22802	4	0.0241**
India does not granger cause Taiwan	47.90125	4	0.0000*
Taiwan does not granger cause India	2.067976	4	0.7233
India does not granger cause Malaysia	22.84427	4	0.0001*
Malaysia does not granger cause India	1.495470	4	0.8274
India does not granger cause Korea (S)	46.56579	4	0.0000*
Korea (S) does not granger cause India	18.01444	4	0.0012*
India does not granger cause US	57.62920	4	0.0000*
US does not granger cause India	16.67544	4	0.0022*

The above variables are at their logarithmic first difference form. * and ** Indicate rejection of null hypothesis of no causality at 1 and 5 per cent level of significance respectively.