

## Direction of Causality among Japan, China and Indian Stock Markets

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**Abstract:** This research work investigates the relationship in terms of direction of causality among Japan, China and Indian stock market based on daily time series data between January 4, 2010 to September 7, 2016 using pairwise correlation and pairwise Granger causality tests. Correlation statistics indicated that three stock markets associated positively. Granger causality test results demonstrated that there existed a unidirectional causality between Indian stock market and Japanese stock market as well as Chinese stock market and Japanese stock market.

**Keywords:** Stock markets, India, China, Japan, correlation, causality test

### INTRODUCTION

Generally, investors cautiously measure the stock market performance by surveillance the combined market indices prior to investing funds. The stock market indices provide a past performance of stock market and the benchmark for assessing the individual portfolios performance and furthermore provide investors the capability to predict future trends in the market [1, 2]. In the last few years, India and China have reached a fast growth and development by the investors to more investing in the two country's stock market [3]. For the same, Japanese stock market has also safe investment place for the investors as Japanese currency is considered a safe haven currency. Japanese investors have possession of more foreign capital than its own assets for the reason that Japan is the biggest creditor in the global world. China is the second largest creditor after United States of America for its healthy surplus [4, 5]. For investing in India, China and Japan will make available better advantages of diversification in a very important manner for its investors. Then a question may arise, whether three countries stock markets associated or not?

### LITERATURE REVIEW

Various past studies examined the empirical association between Indian stock market and selected Asian countries' stock markets. Out of which, Nath and Verma, 2003; Lamba, 2005; Raj and Dhal, 2008; Auzairy and Ahmed, 2009; Chittedi, 2009; Abas, 2009; Aktan, Mandaci, Kopurla and Ersener, 2009 are most important. Chaitanya [6] illustrated that the comparative analysis between Indian stock market and international stock markets. He selected the major international stock indices, that is, S&P 500, Hang Seng, Shanghai Composite Index and Nikkei-225 in this study. After

the analysis, it was found that the Bombay stock exchange that is sensex was highly positively correlated with Hang Seng and after that Shanghai Composite Index, S&P 500 and Nikkei. Finally, it was clearly explicated that the selected international stock market indices associated with every other and exclusively sensex were more associated in the midst of other Asian stock exchanges. Chattopadhyay and Behera [7] examined the financial integration for Indian stock market and Indian stock market was not associated with the developed market although it exist the short-run impact. Sharma [8] analysed the dynamic relationship between Asian emerging markets and United States of America. Asian emerging market indices, that is, India, china, Japan, Malaysia, South Korea, Philippines, Singapore and Hong Kong had included under the study. The selected market indices, the maximum positive correlation founded between US and Singapore followed by Phillipines. India, Japan and South Korea indicated also very positive correlation but China was least positively correlated with US market. There was no negative correlation between any Asian market and US market. Palamalai *et al.* [9] examined the stock market integration between most important stock markets on the up Asia-Pacific nations, namely, India, China, Japan, Indonesia, Hong Kong, Malaysia, Singapore, Taiwan and South Korea. Bhat *et al.* [10] explained on comparing the competencies of the stock markets of India and Pakistan. By using different statistical tests the results derived definitely reject the null hypothesis of the stock markets of India and Pakistan was achieved in feeble emergence. Bhunia and Ganguly [11] illustrated by the study whether the Indian stock market index persuaded by choosing an Asian country's stock market or not. Multivariate co-integration test showed that the long-run relationship

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between the Indian stock market and selected eight countries stock market and bi-directional causality existed involving the preferred variables of stock market indices by using Granger causality test. Arekar and Jain [12] analysed the short run and long run association involving Indian and world major stock market. The result showed that the Indian stock market is enormously related to Singapore stock market and the return time series has found to non-stationary at the zero level and the first difference the return series was found to be stationary. The causality existed between the Indian stock market in Taiwan and Malaysian stock market. Ultimately, it was clearly explained that there was no causality existed between the markets. Saha and Bhunia [13] observed the causal relationship between the Indian stock market and US stock market by using cointegration and variance decomposition tests. The cointegration test revealed that there subsisted balance relationship in the long run between both markets. Patel and Shah [14] examined the model associations and causal relationship between Indian stock market and selected Asian stock markets, that is, Bombay stock exchange, Shanghai stock exchange, Nikkei, Hang Sang and Jakarta stock exchange before and after the change in trading time in Bombay stock exchange. It was found that Bombay stock exchange has highest correlation with Jakarta and Hang Sang, but less correlation with Hang Sang and Nikkei, although Jakarta stock exchange has an additional impact on the Bombay stock exchange. Chien *et al.* [15] observed the active procedure of convergence between selected five ASEAN countries and cross-border stock markets in China with the help of recursive cointegration test. The overall regional economic integration among China and five ASEAN countries has progressively enlarged. The coefficients of error correction model were statistically significant and negative with Indonesia and China, however the coefficients of other countries was insignificant. Patel [16] examined the interdependence between Indian stock market and other Asian stock markets resembling Japan, Korea, Pakistan, Singapore, Sri Lanka, Malaysia, Taiwan and China. He found that all Asian stock indices are first difference stationary and long run stable relationship existed among Asian markets. Lingaraja *et al.* [17] explained the study of inter-linkage, co-movement and causal relationship of Indian stock market with promising stock market indices returns in Asia. This paper empirically tested the inter-linkage, relationship and interdependence of Nifty with other emerging markets in Asia. A unique work of its kind, Saha and Bhunia [18] found a long run equilibrium relationship among South East Asian equity markets. Gupta and Agarwal [19] considered whether Bombay stock exchange returns were correlated to the other Asian stock exchanges or not and evaluated the allocation of the stock market returns of India with other selected Asian stock exchanges. Japan, Hong

Kong, Indonesia, Malaysia and Korea as the other countries stock exchanges included in this research work. Deepak and Sandeep [20] examined the integration and changing paradigms of Indian stock markets with selected global stock markets. This research work was considered major five countries stock indices that were Sensex, Nifty, Hang Seng index, S&P 500 and KLSE Composite index. It was found that correlation with the returns of the indices has increased over the period. It has observed the rising interdependency and association of the markets. Every index measured the subsistence of long run association and causality test showed single and mutual integration among the indices. Bhatia and Binny [21] examined the comparative study of Indian and Chinese stock market volatility and the relationship between them. This study used only monthly return of Bombay stock exchange and Shanghai composite index. It was found that the highest volatility in the year 2008 in both the markets and Indian stock market initiated to be more volatile than Chinese stock market. Although stock market returns of Indian stock market was relatively more than Chinese market. Jayashree [22] analysed a comparative study of Bombay stock exchange and international stock exchanges with special reference to pharmaceutical industries. Australian Security market, Shanghai Stock Exchange, Hong Kong Stock Exchange, Frankfurt Stock Exchange, Germany Stock Exchange and Bombay stock exchange were included and ten pharmaceutical companies were indiscriminately selected under this study. As a result, Indian stock market was highly influenced and long run relationship existed by different international stock exchanges. These results identified the international pharmaceutical companies affected in the Indian pharmaceutical industry. Iqbal *et al.* [23] examined the active interrelationship among the Stock Markets between India, Pakistan and United States. As a result, negative cointegration showed among the stock markets of India, Pakistan and United States, whereas causality test illustrated the facts of unidirectional causality consecutively as of New York stock exchange to Bombay and Karachi stock exchanges. Mukherjee [24] illustrated the comparative study between Indian stock market and selected international markets. This study covered New York Stock Exchange, Hong Kong Stock exchange, Tokyo Stock exchange, Russian Stock exchange and Korean Stock exchange. After analysis, it was found that Indian stock markets had suited extra associated with the International stock markets.

This study fills up the gap and problems in the study by focusing on the financial implication and cointegration between Indian stock markets (BSE-SENSEX), Chinese stock market (SSE) and Japanese stock market (NIKKEI-225). After the previous literatures review the researcher found that the studies

sometime associated and correlated to Indian stock market with other Asian countries stock markets and very few study has worked just only related to BSE, SSE and NIKKEI index and financial implications of stock between them. Therefore the aim of this research work is the financial implication of stocks and empirical association between sensex and selected emerging Asian countries stock market that is Shanghai Composite Index and NIKKEI 225.

### Data and Methodology

This study measured daily time series data of Indian stock market (BSE-SENSEX), Chinese stock market (Shanghai Composite Index-SSE) and Japanese stock market index (NIKKEI 225) which was obtained from yahoo.finance. The daily time series data was considered for the period from January 4, 2010 to September 7, 2016 relating to three stock markets. Then the daily time series data of three stock price indices was transformed into natural logarithm for reducing heteroskedasticity problem [25]. With the intention of observe the causal relationship; this research work selected purposively BSE-SENSEX, Shanghai

Composite Index-SSE and NIKKEI 225. After taking natural logarithm, these indices were used in this study as lxx (Sensex), lsci (Shanghai Composite Index) and lnk (NIKKEI). For determining empirical results, Augmented Dickey-Fuller unit root test both at level and 1st differenced and Granger pairwise causality test were used. All the results were computed using Eviews 9 software.

### Empirical results and analysis

#### Correlation statistics

Correlation statistics (table 1) demonstrated that Indian stock market was positively associated with Chinese and Japanese stock market. The correlation between Indian stock market and Chinese stock market was low (0.40), which was significant statistically at 1% level and at the same time, Indian stock market was highly positively associated (0.90) with Japanese stock market, which was also significant statistically at 1% level. However, Japanese stock market was associated positively but poorly (0.38), which was statistically significant at 1% level.

**Table – 1: Correlation Statistics**

	LNK	LSCI	LSX
LNK	1.00		
LSCI	0.38 (0.00)	1.00	
LSX	0.90 (0.00)	0.40 (0.00)	1.00

\*(.) indicates the probability

This indicated that there were successful co-movements existed significantly between Indian stock market and Chinese stock market and between Indian stock market and Japanese stock market under the study period.

#### Unit root test results

Since the time series data was considered in this study, therefore, it is obligatory to check whether the series is stationary or not. For this purpose, we considered Augmented Dickey-Fuller unit root test

method both at level and first differenced on the condition that the null hypothesis is stationary against the alternative hypothesis that the series is non-stationary. ADF unit root test results based on SIC as an optimum lag length (not tabulated) were shown in table 1. Table 2 revealed that both the series were not stationary at level because the t-statistic was less than (ignoring the sign) the critical value at 5% level but it was stationary at 1st differenced as the t-statistic was more than (ignoring the sign) the critical value at 5% level.

**Table -2: ADF Unit Root Test Results**

	t-stat	C.V. at 5%	Decision	t-stat	C.V. at 5%	Decision
lsci	-1.44	-2.86	Non-stationary	-38.59	-2.86	Stationary
lsx	-1.55	-2.86	Non-stationary	-37.97	-2.86	Stationary
lnk	-1.18	-2.86	Non-stationary	-42.27	-2.86	Stationary

Since the time series data was non-stationary at level, it was understandable that ordinary regression may produce false regression results. At that juncture it is better to check pairwise Granger causality test whether there are causal relationship among stock markets or not.

#### Pairwise causality test results

At this moment the pairwise Granger causality test was performed among three pairs of Asian stock markets to find out the causal direction on the condition that the null hypothesis is there is causal relationship if the probability is less than 0.05 against the alternative hypothesis that there is no causal relationship if the

probability is more than 0.05. The pairwise Granger causality test results were tabulated in table 3.

**Table – 3: Pairwise Granger Causality Test Results**

Null Hypothesis:	Observations	F-Statistic	Probability
LSX does not Granger Cause LNK	1651	1.07110	0.3429
LNK does not Granger Cause LSX		7.17872	0.0008
LSX does not Granger Cause LSCI	1629	1.12865	0.3237
LSCI does not Granger Cause LSX		2.65137	0.0709
LSCI does not Granger Cause LNK	1629	4.55868	0.0106
LNK does not Granger Cause LSCI		1.09377	0.3352

Source: Authors own calculation

It was observed that there was no causal relationship from Indian stock market to Japanese stock market because the probability was 0.3429 but there existed a direction of causality from Japanese stock market to Indian stock market because the probability was 0.0008. It indicated that there existed a unidirectional causality between Indian stock market and Japanese stock market. Again, there was no direction of causality from Indian stock market to Chinese stock market because the probability was 0.3237 and also there was no direction of causality from Chinese stock market to Indian stock market because the probability was 0.0709. It indicated that there was no direction of causality between Indian stock market and Japanese stock market. Finally, there existed a direction of causality from Chinese stock market to Japanese stock market because the probability was 0.0106 but there was no direction of causality from Japanese stock market to Chinese stock market because the probability was 0.3352. It indicated that there existed a unidirectional causality between (i) Indian stock market and Japanese stock market and (ii) Chinese stock market and Japanese stock market.

## CONCLUSION

This research work investigates the relationship in terms of direction of causality among Indian stock market, Chinese stock and Japanese stock market using pairwise correlation and pairwise Granger causality tests. Correlation statistics indicated that three stock markets associated positively. Out of which, the correlation statistics was highest between Indian stock market and Japan stock market. Granger causality test results demonstrated that there existed a unidirectional causality between (i) Indian stock market and Japanese stock market and (ii) Chinese stock market and Japanese stock market but there was no causal direction between Indian stock market and Chinese stock market, as supported in [25, 26].

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