



## Inter Linkages of Asian Pacific Stock Markets: An Empirical Study

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(Received: 02/12/2015; Accepted: 04/05/2016)

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### Abstract

This article aims to test the linkages of Asia Pacific stock markets, which includes Australian Stock Exchange, BSE India, Shanghai Stock Exchange, Hong Kong Exchange and Tokyo Stock Exchange, by using daily data from April 2009 to March 2014. Kolmogorov–Smirnov Test (K–S test), Augmented-Dickey Fuller Test, and Phillips–Perron Statistic were used to identify the normality and the existence of unit root in the data. Johansen Trace-Statistic and Max-Eigen statistic explored the relationship in the long-run of sample indices and Engle-Granger Causality analysis was used to find the effect of causation of the sample indices. The findings evidenced normal distribution of all the sample indices and confirmed stationarity at the level difference during the study period. Long run relationships were found between Asia Pacific stock market indices – (ALL ORDINARIES, BSE SENSEX, HANG SENG INDEX, NIKKEI 225 and SSE COMPOSITE INDEX). ALL ORDINARIES, BSE SENSEX, HANG SENG INDEX, recorded unidirectional relationship with SSE COMPOSITE INDEX.

**Keywords:** Asia Pacific, stock markets, Kolmogorov–Smirnov Test (K–S test), ADF Test, Phillips–Perron Statistic, Johansen Trace-Statistic and Max-Eigen Statistic and Engle-Granger Causality Analysis

**JEL Classification:** F30, F36, G15

**Paper Classification:** Research Paper

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### Introduction

In the recent years, more and more countries have liberalized their capital markets. If capital market liberalization is effective, it is expected to lead to capital market integration. This enables investors, to buy foreign equity securities and diversify their investment portfolios. Based on the information about the integration or segmentation of capital markets, investors can optimize their portfolios to minimize their risks. Globalization measures of the world economies attract considerable attention of academicians and investors of stock market to the subject of co movement. According to portfolio diversification theories, when inter linkages in stock markets are noticed, then the international investors lose the opportunity of long run benefits of portfolio diversification. Hence, it becomes mandatory for portfolio managers and investors at the global

level to study the reliance of one market on the other at the international level. Hence this paper investigates the market integration of Asian Pacific countries, namely, Australia, India, Hong Kong, Japan and China.

The exchange of the capital across international borders through the purchase and sale of equity securities, takes places across nations. The global stock markets are not an exception to for reacting to the market information. The volatility spills over from national to international level. During 2008 – 2009, Asian Pacific Stock Markets were affected by the global financial crisis and this was reflected in world stock markets which experienced down turns. The effect of these problems impacted the international portfolio diversification. Hence this study investigates the integration between Asian Pacific Stock Markets index (ALL ORDINARIES, BSE SENSEX, HANG SENG INDEX, NIKKEI 225 and SSE COMPOSITE INDEX) to understand the dynamics of market movements and its effects on other indices.

The results of the study will provide an insight to help international investment practitioners, policy makers and other stakeholders who are involved in international trading of securities. The study does provide an idea to investors who wish to consider their investment in the Asian Pacific Stock Markets to take advantage of their rapid growth in order to improve portfolio returns. By knowing the relationship between markets, it can help investors to hedge the risk in their international portfolio. The present study adds to the literature by clearly bringing out the linkages of Asian Pacific Stock Markets.

### Review of Literature

Guidi and Ugur (2014) found that the stock markets of South Eastern Europe were co integrated with the German and the UK markets during 2000–2013. Andreou, Matsi and Savvides (2013) examined the linkages of stock and foreign exchange market in developing economies. The results evidenced bi-directional causality between the foreign exchange market and stock markets of emerging economies except Colombia. Using quintile regression approach, Tsai (2012) found the relationship between stock indices and exchange rates in Asian economies. Wang (2014) investigated the co movement of six major East Asian Stock Exchanges before and during 2007–2009 global financial crises found that the markets were less adaptive to the shocks in the USA after the crisis. Tripathi and Sethi (2012) noticed linkages between Indian stock market and emerging markets. Alkulaib, Najand and Mashayekh (2009) checked the dynamic linkages among equity markets in Middle East and North African countries and found that GCC influenced the other two regions. Do (2011) analyzed the integration of six ASEAN stock markets (Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam) with four international stock markets (US, ASEAN bloc, Asia and world) and the interaction channels between domestic and international stock markets. The researcher found integration/segmentation /interaction channels between domestic and international markets. Using Granger causality test, Do, Mcaleer and Sriboonchitta (2009) studied the linkages between international gold prices and ASEAN emerging stock markets and the results indicated the existence of relationship in the long run for SET, VNI indices. Kapoor and Singh (2013) examined the co-integration of Asian Capital Markets and found opportunities for diversification to the potential investors of Pakistan, India, Bangladesh, and China. Palamalai, Kalaivani and Devakumar (2013) examined the integration of major stock markets of India, Malaysia, Hong Kong, Singapore, South Korea, Taiwan, Japan, China and Indonesia which represents the Asian-Pacific Markets and found limited long run diversification benefits. Fan, Lu and Wang, (2009) investigated the relationship between the Chinese stock markets and major stock markets at international level, which included United States of America the United Kingdom, Japan and Hong Kong Stock Exchanges. The results of the above study

found a major reversal of co-movement in the long-run between the Chinese and the capital markets at global level since 1999. Pisedtasalai and Gunasekarage (2007) examined the causation effect of stock returns, volatility of return and the total volume of trade with respect to the South-East Asian Markets and found wide variations of stock returns and the volume of trade. Cha and Cheung, (1998) examined the causal relationship and found that the impact of U.S. and Japan were larger in China, Singapore than in Korea and Taiwan.

Majority of the national and international researchers studied either short run or long run relationship of Asian markets and other stock markets at the global level, only a few researchers studied the Asia Pacific Stock markets with other stock markets, the above reviews exhibit that most of the international stock markets were interlinked with other stock markets. Thus the present study investigated the inter linkages among Asian pacific stock markets which has its implications for investment diversification at short/long run.

### Objective of the Study

The primary aim of the present study is to identify the inter linkages of Asian Pacific Stock Markets during the study period from April 2009 to March 2014. Further, attempts were made to know the normality, stationarity, long run relationship (co integration) and causal relationships in selected Asian Pacific Stock Markets indices.

### Methodology

#### Sample

The Stock Exchanges in Asian Pacific region, Australia, India, China, Hong Kong and Japan countries were selected for the analysis of stock market integration. The leading stock markets of Asian-Pacific Region were selected on the basis of market capitalization listed in World Federation of Exchanges. The names of major index are given in Table 1.

**Table 1: Select Sample Stock Markets and Indices**

COUNTRY	STOCK MARKET	INDEX
Australia	Australian Stock Exchange	ALL ORDINARIES
India	Bombay Stock Exchange	BSE SENSEX
China	Shanghai Stock Exchange	SSE COMPOSITE INDEX
Hong Kong	Hong Kong Exchanges	HANG SENG INDEX
Japan	Tokyo Stock Exchange	NIKKEI 225

Source: World Federation of Exchanges

### Methods of Data Collection

The study mainly based on secondary data. For the analysis of stock market linkages for five years from April 2009 to March 2014, daily index prices were collected from the official website of yahoo finance.

### Hypotheses of the Study

*On the basis of objectives the following null hypotheses were framed to test the objectives.*

*H01: The daily returns of Asian Pacific Stock Markets indexes are not normally distributed*

*H02: There is no stationarity in the daily returns of Asian Pacific Stock Markets indexes*

*H03: There is no long run relationship in selected Asian Pacific Stock Markets indexes*

*H04: There is no causal relationship in selected Asian Pacific Stock Markets indexes.*

## Tools used for the Study

The following econometrics tools were used for analyze the inter linkages of Asian Pacific stock markets.

S.No.	Statistic/Econometric Tools	Purpose
1.	Summary Statistics (which includes Mean (the average), Standard Deviation (Variation in the data set), Skewness and Kurtosis (Distribution of the data), Kolmogorov–Smirnov Test (Finding the Normality of data)	To describe the nature of data set.
2.	Augmented Dickey Fuller Statistic and Phillips-Perron Statistic.	To identify the existence of unit root in the data set (Time Series data)
3.	Johansen Trace Statistic and Max-Eigen Statistics.	To test the co-movement of sample indices in the long-run.
4.	Granger Causality Analysis.	Examines the causal effect of the selected sample indices.

## Findings and Implications

The summary statistics results for the daily returns of ALL ORDINARIES, BSE SENSEX, HANG SENG INDEX, NIKKEI 225 and SSE COMPOSITE INDEX, during the study period from April 2009 to March 2014, are exhibited in Table 2.

**Table 2: Results of Descriptive Statistics for Daily Returns of Selected Asian Pacific Stock Markets Index from April 2009 to March 2014**

	All Ordinaries	BSE Sensex	Hang Seng Index	Nikkei 225	SSE Composite Index
Mean	0.000384	0.000743	0.000478	0.000569	0.0000512
Std. Dev.	0.009643	0.012973	0.013181	0.014226	0.012998
Skewness	-0.169372	2.006331	0.132458	-0.537306	-0.364031
Kurtosis	4.124537	28.81268	5.411148	6.652193	5.265475

Sources: Data obtained from yahoo finance and computed by E views Package 7

The highest mean return was recorded by BSE Sensex (0.000743), followed by NIKKEI 225 index with a mean return of 0.000569, the HANG SENG index earned a mean return of 0.000478 and the lowest mean return was recorded by SSE COMPOSITE INDEX during the study period. NIKKEI 225 index recorded the highest standard deviation of 0.014226 while ALL ORDINARIES Index recorded the lowest standard deviation of 0.009643, when compared with other indices. All the five sample index returns were negatively skewed except BSE Sensex and HANG SENG index. The returns of sample index value were leptokurtic, as the value of kurtosis was greater than three. From the analysis of descriptive statistics, it is clearly understood that BSE Sensex recorded the highest return with risk during the sample period.

**Table 3: Summary Results of Normality Test for Selected Asian Pacific Stock Indices returns from April 2009 to March 2014**

Index	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Nikkei 225	0.039	1228	0.000	0.973	1228	0.000
Hang Seng Index	0.055	1228	0.000	0.974	1228	0.000
SSE Composite Index	0.061	1228	0.000	0.971	1228	0.000
All Ordinaries	0.043	1228	0.000	0.989	1228	0.000
BSE Sensex	0.065	1228	0.000	0.904	1228	0.000

Sources: Data obtained from yahoo finance and computed by E views Package 7

Table 3 displays the results of test for normality using Kolmogorov – Smirnov and Shapiro-Wilk Tests for the selected Asian Pacific Stock Market index, during the period of the study April 2009 to March 2014. The significant value of sample indices, namely, ALL ORDINARIES, BSE SENSEX, HANG SENG INDEX, NIKKEI 225 and SSE COMPOSITE INDEX was 0.000, which was less than the critical value of 0.05. Hence, the null hypothesis that “There is no normal distribution in the selected Asian Pacific Stock market index returns” is rejected. In other words, all five Asian Pacific stock market indices were normally distributed during the period of study.

**Table 4: Summary Results of Stationarity Test for Selected Asian Pacific Stock Indices Returns from April 2009 to March 2014**

		ALL ORDINARIES	BSE SENSEX	HANG SENG INDEX	NIKKEI 225	SSE COMPOSITE INDEX
AUGMENTED DICKEY FULLER TEST		-35.1277	-33.29841	-35.61523	-36.826	-35.07579
PHILLIPS – PERRON TEST		-35.12656	-33.25924	-35.62292	-36.812	-35.07912
C R I T I C A L VALUE	1% LEVEL	-3.435319	-3.435432	-3.435327	-3.435466	-3.435398
	5% LEVEL	-2.863622	-2.863672	-2.863626	-2.863687	-2.863657
	10% LEVEL	-2.567928	-2.567955	-2.56793	-2.567963	-2.567947

Sources: Data obtained from yahoo finance and computed by E views Package 7

Table 4 indicates the results of Augmented Dickey Fuller Test and Phillips – Perron Test, for the returns of ALL ORDINARIES, BSE SENSEX, HANG SENG INDEX, NIKKEI 225 and SSE COMPOSITE INDEX from April 2009 to March 2014. ADF Test clearly denotes that all sample indices returns were stationary. ADF Test value of ALL ORDINARIES was 35.1277, BSE SENSEX was 33.29841, HANG SENG index was 35.6152, NIKKEI 225 was 36.826 and SSE COMPOSITE INDEX was 35.07579 were greater than critical value at all levels. Phillips – Perron Test value of ALL ORDINARIES was 35.12656, for BSE Sensex it recorded a value of 33.25924, HANG SENG index 35.62292, NIKKEI 225 the PP statistic was 36.812, SSE Composite Index recoded 35.07912, which were also greater than the critical values at 1%, 5% and 10%. The analysis of ADF Test and Phillips – Perron Test indicates that all the five sample indices returns attained stationary at the level difference itself. Hence the null hypothesis, “The Stock market index returns of Asia pacific are not stationarity during the study period”, is rejected.

**Table 5: Results of Johansen Co- Integration Test for Selected Asian Pacific Stock Indices Returns from April 2009 to March 2014**

INDEX	No. of Hypothesized CE	Trace Statistic	0.05 Critical Value	Max-Eigen Statistic	0.05 Critical Value
ALL ORDINARIES & BSE SENSEX	None	505.8416	15.49471	279.4081	14.2646
	At most 1	226.4335	3.841466	226.4335	3.841466
ALL ORDINARIES & HANG SENG INDEX	None	537.0958	15.49471	320.0231	14.2646
	At most 1	217.0728	3.841466	217.0728	3.841466
ALL ORDINARIES & NIKKEI 225	None	494.5347	15.49471	259.0736	14.2646
	At most 1	235.4611	3.841466	235.4611	3.841466
ALL ORDINARIES & SSE Composite index	None	495.3702	15.49471	272.8118	14.2646
	At most 1	222.5584	3.841466	222.5584	3.841466
BSE SENSEX & HANG SENG INDEX	None	479.6271	15.49471	257.5204	14.2646
	At most 1	222.1068	3.841466	222.1068	3.841466
BSESENSEX & NIKKEI 225	None	484.7673	15.49471	254.7902	14.2646
	At most 1	229.9771	3.841466	229.9771	3.841466
BSE SENSEX & SSE COMPOSITE INDEX	None	470.0114	15.49471	244.1827	14.2646
	At most 1	225.8287	3.841466	225.8287	3.841466
HANG SENG INDEX & NIKKEI 225	None	472.0662	15.49471	256.7327	14.2646
	At most 1	215.3335	3.841466	215.3335	3.841466
HANG SENG INDEX & SSE COMPOSITE INDEX	None	481.833	15.49471	273.6392	14.2646
	At most 1	208.1938	3.841466	208.1938	3.841466
NIKKEI 225 & SSE COMPOSITE INDEX	None	465.2622	15.49471	242.7864	14.2646
	At most 1	222.4758	3.841466	222.4758	3.841466

Sources: Data obtained from yahoo finance and computed by E views Package 7.

Table 5 presents the results of co integration test for selected Asia Pacific Stock Market Indices, namely, ALL ORDINARIES, BSE SENSEX, HANG SENG INDEX, NIKKEI 225 and SSE COMPOSITE INDEX. It was found that both the Trace Test and Maximum Eigen Test values of selected sample indices were greater than the critical value at 5% level and it reveals that there was long run equilibrium relationship between ALL ORDINARIES, BSE SENSEX, HANG SENG INDEX, NIKKEI 225 AND SSE COMPOSITE INDEX. Hence the null hypothesis, "There is no long run relationship in selected Asia pacific stock market index return", is rejected.

The results of Granger Causality Test for identifying the causal relationship between selected sample indices of Asia Pacific stock markets, namely, ALL ORDINARIES, BSE SENSEX, HANG SENG INDEX, NIKKEI 225 and SSE COMPOSITE INDEX, for the period of study April 2009 to March 2014, are displayed in Table 6.

**Table 6: Results of Granger Causality Test for Selected Asian Pacific Stock Markets Indices Returns from April 2009 to March 2014**

Null Hypotheses	F-Statistic	Prob.	Null hypotheses
BSE SENSEX does not Granger Cause ALL ORDINARIES	0.43386	0.6481	Accepted
ALL ORDINARIES does not Granger Cause BSE SENSEX	2.10901	0.1218	Accepted
HANG SENG INDEX does not Granger Cause ALL ORDINARIES	0.19949	0.8192	Accepted
ALL ORDINARIES does not Granger Cause HANG SENG INDEX	40.1884	0.0001	Rejected
NIKKEI 225 does not Granger Cause ALL ORDINARIES	1.60753	0.2008	Accepted
ALL ORDINARIES does not Granger Cause NIKKEI 225	0.43036	0.6504	Accepted
SSE COMPOSITE INDEX does not Granger Cause ALL ORDINARIES	0.31313	0.7312	Accepted
ALL ORDINARIES does not Granger Cause SSE COMPOSITE INDEX	5.41923	0.0045	Rejected
HANG SENG INDEX does not Granger Cause BSE SENSEX	0.06989	0.9325	Accepted
BSE SENSEX does not Granger Cause HANG SENG INDEX	0.50203	0.6054	Accepted
NIKKEI 225 does not Granger Cause BSE SENSEX	0.52054	0.5943	Accepted
BSE SENSEX does not Granger Cause NIKKEI 225	1.61461	0.1994	Accepted
SSE COMPOSITE INDEX does not Granger Cause BSE SENSEX	2.14615	0.1174	Accepted
BSE SENSEX does not Granger Cause SSE COMPOSITE INDEX	3.29636	0.0373	Rejected
NIKKEI 225 does not Granger Cause HANG SENG INDEX	2.64137	0.0717	Accepted
HANG SENG INDEX does not Granger Cause NIKKEI 225	0.3366	0.7143	Accepted
SSE COMPOSITE INDEX does not Granger Cause HANG SENG INDEX	0.66767	0.5131	Accepted
HANG SENG INDEX does not Granger Cause SSE COMPOSITE INDEX	3.38024	0.0344	Rejected
SSE COMPOSITE INDEX does not Granger Cause NIKKEI 225	0.96721	0.3804	Accepted
NIKKEI 225 does not Granger Cause SSE COMPOSITE INDEX	0.79817	0.4504	Accepted

Sources: Data obtained from yahoo finance and computed by E views Package 7.

The results reveal that ALL ORDINARIES INDEX recorded unidirectional causal relationship with HANG SENG COMPOSITE INDEX and SSE COMPOSITE INDEX. BSE SENSEX and HANG SENG INDEX experienced unidirectional causal relationship with SSE COMPOSITE INDEX. The probability value was less than 0.05 and the rest of indices did not exhibit causality with other indices. From Granger causality Test, the study noticed unidirectional causal relationship but it was observed that there was no bidirectional relationship noticed in Asian Pacific stock market indices. Hence the null hypothesis, "There is no causal relationship in Asia pacific stock market index", is rejected.

Existing reviews exhibits that most of the international stock markets were interlinked with other stock markets. Similarly, in the present study overall results of Co integration Test and Granger Causality Test proved that long run and causal relationship employed among the selected Asian Pacific Stock markets during the present study period.

## Summary and Conclusion

This study investigated the integration and linkages of Asian Stock Markets Indices, namely ALL ORDINARIES INDEX, BSE SENSEX, HANG SENG INDEX, NIKKEI 225, AND SSE COMPOSITE INDEX. Descriptive Statistics, K – S Test, ADF Test, Phillips Perron Test, Johansen Trace Statistic and Engle Granger Causality Analysis were used to analyze the stock market integration and linkages. From the empirical analysis, it was found that all the five sample indices returns of Asian Pacific Region were normally distributed. The Augmented Dickey Fuller Statistic and Phillips Perron Statistic clearly revealed the returns of the five sample indices returns attained stationarity at level difference. The Johansen Trace- Statistic and Max-Eigen Statistic results indicated relationship among the sample indices in the long run in all the sample indices- ALL ORDINARIES INDEX, BSE SENSEX, HANG SENG INDEX, NIKKEI 225, AND SSE COMPOSITE INDEX. GRANGER CAUSALITY TEST SHOWED UNIDIRECTIONAL CAUSAL RELATIONSHIP BETWEEN ALL ORDINARIES INDEX, HANG SENG INDEX AND SSE COMPOSITE INDEX. FURTHER, BSE SENSEX, HANG SENG INDEX witnessed unidirectional causation with SSE COMPOSITE INDEX whereas rest of the indices did not exhibit causal relationship with other indices. To conclude, investors could benefit from long term portfolio diversification if their investments are in the listed firms of the five sample indices.

## Limitations of the study

This study was limited to a period of ten years and was based only on secondary data. All the limitations, associated with various tools like Descriptive Statistics, ADF test, Phillips – Perron Test, Johansen co integration test, GARCH (1, 1) Model, Vector Error Correction and Engle-Granger Causality Analysis are applicable to this study. Also the study results are applicable only to selected Asian Pacific stock markets.

## Scope for Further Study

Many researchers focused either on short run or long run relationship among Asian stock markets but the present study focused on identifying both short run and long run relationship among Asian Pacific Stock Markets. This study can be developed in future by the following ways. Further studies can be done with other international stock markets. The same title and area of study can be done in other relevant foreign exchange market, commodity market etc. The study period can be extended. Inter linkages of stock market can be undertaken with the help of advanced tools.

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