Integration of the Indian Stock Market with Select Asian Stock Markets : An Analysis

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Abstract

The present study explored the long-term associative relationships and the short-run causal relationships between stock market indices of select Asian economies: India, China, Hong Kong, Indonesia, Japan, Singapore, South Korea, and Taiwan. These countries make significant contributions in terms of foreign portfolio investments in India. The techniques of the Augmented Dickey – Fuller test, Phillips – Perron test, Granger causality test, and Johansen cointegration test were employed to trace the interdependence among the selected markets. Both Augmented Dickey – Fuller and Phillips – Perron tests revealed that all markets contained unit root at level and were integrated of order one. The results of the Granger causality test indicated a unidirectional relationship between Nifty50 and Indonesian and Japanese stock markets. Furthermore, it was found that bi-directional causal relationships existed between the stock markets of India and Hong Kong as also Singapore. The quarterly data of all the indices spanning the period from January 01, 2000 – March 31, 2018 were collected for the study. The cointegration test results revealed that international investors from China, Japan, Hong Kong, Singapore, and South Korea would not benefit from portfolio diversification to the Indian stock markets since a long-term equilibrium relationship existed between these markets.

Keywords : **ADF, Granger causality test, Johansen cointegration test, long- term equilibrium relationship**

JEL Classification : C32, G12, G14

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Due to globalization and liberalization in the overall global economy, uncertainty, volatility, and complexity in the world's financial environment have increased. There is, therefore, an urgent need of international diversification of securities for the investors seeking optimum portfolio performance. The securities markets are highly dynamic and change their integration behavior with time, giving rise to the need to re-examine their linkages with other markets as time progresses. It is crucial to explore the dynamic linkages of the Indian stock markets with those of selected Asian countries by extending the time period covered in previous studies. An event in one country does not affect the country alone ; rather, its impact may be felt in

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economies worldwide. The impacts of the Covid-19 pandemic, October 1987 stock market crash, 1997 Asian financial crisis, and 2007 subprime crisis have drawn substantial attention of economists and financial practitioners towards the study of linkages among stock markets of various countries. Investors lost ₹ 14,21,820 crores on March 23, 2020, due to fears associated with the Covid-19 crisis. This single incident makes it clear that a deep understanding of cointegration among the stock markets is crucial for investors.

Rajwani and Mukherjee (2013) investigated the cointegration of Indian stock markets with selected Asian markets, including Indonesia, South Korea, Japan, Malaysia, Taiwan, Hong Kong, and China. They collected daily data for the period from January 1991 – December 2011. They observed that no long-run comovement existed between India and any of the Asian stock markets for the given time period. Seth and Sharma (2015) investigated the association between India, China, Indonesia, Malaysia, Japan, Singapore, South Korea, Taiwan, Israel, Pakistan, and USA for the period from January 1, 2000 – December 31, 2010. Their findings revealed that cointegration existed between the select Asian economies and those of the US region in pre, post, and subprime crisis periods. The existence of cointegration implies that the same factors drive US and Asian markets.

In the present study, stock market indices of selected Asian countries : India, China, Hong Kong, Indonesia, Japan, Singapore, South Korea, and Taiwan are taken into consideration. These constitute the largest and most important economies in terms of GDP. A very strong cointegration has been found between stock markets of India and Hong Kong, as also between stock markets of India and South Korea. A high degree of positive correlation exists between all pairs of markets under study. Cointegration tests have been applied to assess the existence of any spurious relations among these markets.

Review of Literature

Kaur et al. (2021) investigated the linkages between stock markets of Brazil, China, India, Korea, and Taiwan for the period from April 2010 – March 2020. No interlinkages were found among these markets. Further, bi-directional causal relationships were seen among the different pairs of countries such as Taiwan – China, Korea – India, Taiwan – India, Taiwan – Korea, Korea – Brazil, India – Brazil, Korea – India, and Taiwan – Korea. Agrawal et al. (2020) reviewed the integration status amongst developing and developed countries and found that global investors made more rational decisions by studying the strength of interdependency and cointegration of stock markets of different countries. In the last few years, investments made by FIIs or foreign portfolio investors have increased multifold in India, with the objective of diversification of their portfolios. Gawade et al. (2019) studied the linkages between G5 countries, namely Brazil, China, India, Mexico, and South Africa from 2001–2017. The results indicated a strong positive relationship between index returns of Indian markets and the Shanghai Composite Index (China). Bi-directional causality was also found between Indian and global stock market returns.

Patel (2017) examined the linkages among stock exchanges of 14 countries, namely, India, Hong Kong, Mexico, the U.K., Japan, the US, Indonesia, Brazil, Pakistan, South Korea, Russia, China, Switzerland, and Taiwan. He found a strong co-integration and long-term association between these exchanges. Patel (2014) assessed the interdependency of Indian stock markets with special reference to other Asian equity markets like China, Japan, Korea, Malaysia, Pakistan, Sri Lanka, Singapore, and Taiwan on monthly data from July 1997 – September 2012. He applied the augmented Dickey – Fuller test (referred to as ADF, hereafter) to check stationarity and the Johansen cointegration test (referred to as JCT, hereafter) for examining the long-run association, and Granger causality test (referred to as GCT, hereafter). All the benchmark Asian stock indices were observed to be stationary at the first difference, and a long-run equilibrium relationship among select Asian markets existed. The study reported unidirectional causality from stock markets of Sri Lanka to India, Korea to India, China to India, Singapore to India, and India to Pakistan. The study further showed that stock indices of

China, Japan, Singapore, and Sri Lanka affected the Indian stock markets. He suggested that the Indian government should closely watch the movements of stock indices of Asian equity markets, as an event happening in one Asian country may affect the performance of the Indian stock markets.

Dasgupta (2014) studied the integration of India with four SAARC countries. He considered the stock markets of Pakistan, Bangladesh, Sri Lanka, and Nepal and examined India's relationship among these four countries. Data were collected on a monthly basis from 2007 – 2012, and the ADF test, PPT, GCT, JCT, and VECM were applied for analysis. The Johansen and Juselius co-integration test suggested that the BSE Sensex was cointegrated with the stock markets of Pakistan, Sri Lanka, and Nepal. By applying GCT, short-run causality was also found between BSE's Sensex and other stock market indices.

Sharma et al. (2013) studied the linkages amongst BRICS countries and found that returns at Chinese stock exchanges caused returns at NSE (India). Further, returns of NSE (India) caused returns at all the stock exchanges of BRICS. IBOVESPA (Brazil) Granger caused the returns at Chinese, Indian, South African, and RSE (Russian) markets. Palamalai et al. (2013) studied the linkages in stock markets of emerging Asia-Pacific economies. They reviewed the stock markets of India, China, Indonesia, Malaysia, Hong Kong, Singapore, USA, Japan, Taiwan, UK, and South Korea for the period ranging from January 4, 2000 – January 31, 2013, on a daily basis. By applying the methods of correlation, JCT, GCT, and ADF test, they found long-run feedback relationship to exist between the major stock markets of China, India, Japan, Indonesia, Hong Kong, Malaysia, Taiwan, South Korea, Singapore, USA, and the United Kingdom. The results of the Granger causality test revealed that some amount of dynamic interactions and interdependencies existed in the short run, which implies that investors could diversify the portfolio in the short-run and could be benefited.

Tiwari et al. (2012) reported the existence of integration in nine Asian countries. They examined stock market data of Japan, Malaysia, India, China, Indonesia, South Korea, Hong Kong, Taiwan, and Singapore. The empirical daily data were collected from January 4, 2005 – February 28, 2012. Their findings were based on multiple cross-correlation and wavelet multiple correlation. The study showed that the integration with low-frequency data was more noticeable and significant in comparison to high-frequency data. Srikanth (2012) attempted to study the linkages between the Indian stock markets with select stock markets of the Asia-Pacific region using monthly data from January 2000 – December 2010. The study examined the stock markets of India, China, Indonesia, Japan, Malaysia, Hong Kong, and South Korea to explore the relationships among these markets. The results of the Johansen cointegration test suggested long-run relationships among all the markets.

Research Methodology

In order to explore the long-term equilibrium relationship among the sampled Asian countries' stock markets indices, benchmark indices of India, Indonesia, China, Hong Kong, Japan, Singapore, South Korea, and Taiwan were selected for analysis. These countries are the primary source of foreign portfolio investments in India. Hence, there is a need to assess whether the construction of cross-country portfolios would benefit FPIs. India is the second most important country receiving FDI after China. Table 1 indicates the list of countries and symbols/variables used in the study.

Regardless of whether it is related to the domestic or global economy, each type of relevant information is quickly incorporated or discounted in the benchmark indices (Kumar & Dhankar, 2009). The indices used are Nifty50 (India), Jakarta Stock Exchange (JCI, Indonesia), Shanghai Composite Stock Exchange (SHCOMP, China), Hang Seng (Hong Kong), Nikkei 225 (Japan), Straits Times (Singapore), Korean Stock Exchange (South Korea), and TWSE (Taiwan) for the period from January 01, 2000 – March 31, 2018. Data were collected on a quarterly basis from the website of the Bloomberg database in US dollar terms. The quarterly continuously compounded returns (Nifty50, JCI, SHCOMP, Hang Sang, Nikkei 225, Straits Times, KOSPI, TWSE) were

Table 1. ***List of Countries and Symbols Used***

S. No.	Countries Selected for Study	Stock Exchanges/ Symbols Used/ Variables
1.	India	Nifty50
2.	China	SHCOMP
3.	Hong Kong	Hang Sang
4.	Indonesia	JCI
5.	Japan	Nikkei 225
6.	Singapore	Straits Times
7.	South Korea	KOSPI
8.	Taiwan	TWSE

calculated for the India, Indonesia, China, Hong Kong, Japan, Singapore, South Korea, and Taiwan markets, respectively by taking the log of the series.

$$R = (\text{Log}\, P_t - \text{Log}\, P_{t-1}) * 100 \quad \text{.....(1)}$$

where,

R = Quarterly return,
P_t = Closing price of current quarter,
P_{t-1} = previous quarter closing price.

Granger Causality Test

C.W.J. Granger proposed the Granger causality test in 1969. The regression equations for the test are given below :

$$Y_t = \Sigma^n_{i=1}\alpha_i X_{t-i} + \Sigma^n_{j=1}\beta_i Y_{t-j} + \mu_{1t} \quad \text{.....(2)}$$

$$X_t = \Sigma^n_{i=1}\gamma_i X_{t-i} + \Sigma^n_{j=1}\delta_i Y_{t-j} + \mu_{2t} \quad \text{.....(3)}$$

In the above equations, Y_t , X_t are the variables to be tested ; α_i , β_i , γ_i, δ_i are coefficients explaining the relations of the dependent variable with the lag terms of independent variables and lag terms of the dependent variable ; μ_{1t} and μ_{2t} are white noise error terms ; t is the time period ; and i and j are the number of lags. The null hypothesis is $\alpha_i = \delta_i = 0$. If α_i is statistically significant, but δ_i is not, it means X causes Y. In the reverse case, Y causes X. But if both the values are statistically significant, causality runs both ways.

Before applying the Granger causality and Johansen cointegration tests, the stationarity aspect of the data must be checked to avoid spurious regression. The augmented Dickey–Fuller test (with intercept and trend) and PP test were used to check the stationarity characteristics of data. Both tests are conducted to check the robustness of the unit root test (Patel, 2017 ; Srivastava, 2007). The augmented Dickey – Fuller test augments the lagged values of the dependent variable in the series.

Johansen cointegration test is employed to find out any stochastic trend among the stock markets of India, China, Hong Kong, Indonesia, Japan, Singapore, South Korea, and Taiwan. When there is any long-run

equilibrium relationship or stochastic trend, investors will not benefit by diversifying their portfolios across these markets, as the markets move in the same direction in the long run.

Data Analysis and Results

First of all, an attempt has been made to understand the characteristics/properties of the return series and the graphical presentation of the return series. Table 2 depicts the return series's mean, median, standard deviation, skewness, kurtosis, etc.

It is clear from Table 2 that all the stock markets gave positive returns in the given time period. The Indonesian stock market gave the maximum returns, followed by Indian, Korean, and Chinese markets. The Chinese stock market is a precarious market because its standard deviation is high compared to the other markets. Data of skewness and kurtosis show that returns are not normally distributed. SHCOMP (China) market displays a positively skewed distribution ; whereas, all other countries in the dataset follow negatively skewed distributions. Kurtosis value of all the markets is greater than three except for Nikkei 225 (Japan) (2.8897). The Jarque – Bera test also verifies that the returns of all the markets are not normally distributed, which supports the results of skewness and kurtosis. Now we will proceed to check the stationarity of the return data.

Table 2. ***Descriptive Statistics***

	LR NIFTY50 (India)	LR JCI (Indonesia)	LR SHCOMP (China)	LR Hang Seng (Hong Kong)	LR Nikkei 225 (Japan)	LR STRAITS TIMES (Singapore)	LR KOSPI (South Korea)	LR TWSE (Taiwan)
Mean	0.0090	0.0107	0.0051	0.0033	0.0001	0.0044	0.0065	0.0009
Median	0.0068	0.0181	0.0031	0.0092	0.0045	0.0063	0.0107	0.0068
Maximum	0.1774	0.2095	0.1892	0.1315	0.1026	0.1591	0.1534	0.1786
Minimum	–0.1358	–0.1931	–0.1627	–0.1175	–0.1027	–0.1274	–0.1455	–0.1450
Std. Dev.	0.0599	0.0650	0.0659	0.0460	0.0412	0.0477	0.0611	0.0603
Skewness	–0.0170	–0.2687	0.0712	–0.4389	–0.2757	–0.3280	–0.3799	–0.4180
Kurtosis	3.0461	4.2501	3.6908	3.8030	2.8997	4.6120	3.2575	3.6882
Jarque – Bera	0.0098	5.5546	1.4926	4.2462	0.9423	9.0869	1.9306	3.5181
Probability	0.9951	0.0622	0.4741	0.1197	0.6243	0.0106	0.3809	0.1722
Sum	0.6463	0.7692	0.3650	0.2343	0.0083	0.3185	0.4713	0.0639
Sum Sq. Dev.	0.2551	0.3002	0.3084	0.1504	0.1207	0.1614	0.2649	0.2583
Observations	72	72	72	72	72	72	72	72

Note. LR indicates log return.

As depicted in Table 3, a high degree of positive correlation exists between all pairs of markets. Hence, this demands the application of the cointegration test to assess the same. The next issue is to examine whether there exists a long-run or short-run aspect of this implication. If a short-run relationship exists, it will be beneficial for investors to diversify their portfolios. If a long-run relationship prevails, it will help regulators of these markets maintain the coherence of their policies and practices. The results of ADF and PP tests are shown in Table 4 and Table 5, respectively.

The Augmented Dickey – Fuller test and Phillips – Perron test (refer to Table 4 and Table 5) results reveal that

Table 3. ***Correlation Among the Stock Market Returns***

	LR JCI (Indonesia)	LR SHCOMP (China)	LR Hang Seng (Hong Kong)	LR Nikkei 225 (Japan)	LR STRAIT TIMES (Singapore)	LR KOSPI (Korea)	LR TWSE (Taiwan)
LR NIFTY50	0. 873	0.792	0.931	0.678	0.919	0.920	0.816

Table 4. ***Augmented Dickey – Fuller Test Results***

Indices	Level Form (with Intercept and Trend)	At First Difference (with Intercept and Trend)	Decision
Nifty50	–1.0871	–6.3790*	*I*(1)
JCI	–2.345811	–61.46654*	*I*(1)
SHCOMP	–1.8762	–6.6285	*I*(1)
Hang Sang	–3.150456	–67.08731*	*I*(1)
Nikkei 225	–4.125552	–76.18582*	*I*(1)
Straits Times	–2.277372	–63.34791*	*I*(1)
KOSPI	–1.2203	–6.7516*	*I*(1)
Taiwan	–2.459498	–61.47952*	*I*(1)

Table 5. ***Phillips – Perron Unit Root Test***

Indices	Level Form (with Intercept and Trend)	At First Difference (with Intercept and Trend)	Decision
Nifty50	–2.5314	–62.5232*	*I*(1)
JCI	–2.2226	–64.57012*	*I*(1)
SHCOMP	–2.16265	–64.050*	*I*(1)
Hang Sang	–2.7263	–67.2932*	*I*(1)
Nikkei 225	–1.2830	–68.9433*	*I*(1)
Straits Times	–1.8162	–65.8776*	*I*(1)
KOSPI	–0.3241	–65.4872*	*I*(1)
Taiwan	–2.22080	–63.14558*	*I*(1)

all countries' quarterly stock price indices are measured in terms of US dollars, including the intercept and trend component, which are non-stationary at level. It indicates that mean and variance are not constant. However, the stock price indices are stationary (with intercept and trend) at the first difference, meaning all the stock market indices are first order integrated, or *I*(1). The next step is to examine whether they are cointegrated. The stock market indices exhibit trend and intercept, and therefore, stationarity is checked with intercept and trend by the Augmented Dickey – Fuller and Phillips – Perron tests.

Bilgili (1998) found that the Johansen maximum likelihood estimators depolarized the use of two-step estimators and could estimate and test for the presence of multiple cointegrating vectors. The Monte Carlo analysis proved that the Johansen procedure performs better than both single equation methods and alternative

Table 6. ***Johansen Cointegration Test of Nifty50 with Select Asian Countries' Stock Markets (Pair-Wise)***

S. N.	Pairs of Stock Prices Indices	No. of CE(s)	Trace Statistic	CV (0.05)	*p* - value	Whether Cointegration Present or Not Present
1.	Nifty50 – JCI (Indonesia)	None	12.08740	15.49471	0.1528	Not Present
		At most 1	0.559445	3.841466	0.4545	
2.	Nifty50 – SHCOMP (China)	None	15.494712	21.47740	0.0562**	Present
		At most 1	1.692906	3.841466	0.1932	
3.	Nifty50 – DAX (Germany)	None*	30.01180	15.49471	0.0002*	Present
		At most 1	0.650177	3.841466	0.4200	
4.	Nifty50 – Hang Seng (Hong Kong)	None*	46.60664	15.49471	0.0000*	Present
		At most 1	0.067094	3.841466	0.7956	
5.	Nifty50 – Nikkei 225 (Japan)	None*	19.21619	15.49471	0.0131*	Present
		At most 1	0.014323	3.841466	0.9046	
6.	Nifty50 – Straits Times (Singapore)	None*	22.02499	15.49471	0.0045*	Present
		At most 1	0.671639	3.841466	0.4125	
7.	Nifty50 – KOSPI (South Korea)	None*	47.22002	15.49471	0.0000*	Present
		At most 1	0.757685	3.841466	0.3841	
8.	Nifty50 – TWSE (Taiwan)	None	9.2904	15.494	0.3392	Not Present
		At most 1	0.00694	3.84146	0.9330	

Note. CE denotes cointegrating equation(s).

*$p < 0.05$ denotes rejection of the hypothesis at the 0.05 level.

**$p < 0.10$ denotes rejection of the hypothesis at the 0.10 level.

multivariate methods. Johansen methodology dominates the Engle – Granger methodology in the cointegration analysis. Pair-wise Johansen cointegration test is applied to check whether the international investors would be benefitted from the investments in the Indian stock markets.

From Table 6, we observe the results of pair-wise cointegration between Nifty 50 – JCI, Nifty50 – SHCOMP, Nifty50 – Hang Sang, Nifty50 – Nikkei 225, Nifty50 – Straits Times, Nifty50 – KOSPI, and Nifty50 – TWSE. No long-run relationship exists between Nifty50 – JCI and Nifty50 – TWSE, thereby indicating that they are informationally inefficient and arbitrage opportunities exist in these markets. It is further concluded that the Indian stock markets are not linked individually with the Taiwanese and Indonesian stock markets.

The long-run equilibrium relationship indicates that investors in these markets will not benefit from portfolio diversification in these markets in the long run. If trace statistic is less than the critical value (5%), then the hypothesized number of cointegrating equations (CE) are accepted. If a long-run relationship exists, the next step is to check the causality relationship between these markets.

Table 7 shows the long-run association relationship between Nifty50 with major developed stock markets. When all the select Asian countries' stock markets, that is, China, Hong Kong, Japan, Singapore, South Korea, Indonesia, and Taiwan are taken together, cointegration exists, and three cointegrating vectors are found among these markets, thereby implying that in the long run, they move together. This indicates that these markets are informationally efficient, and further, no arbitrage opportunity exists in the long run. The long-run equilibrium relationship suggests that investors in these markets will not benefit from portfolio diversification in the long run.

The results of Table 8 show that there is a bi-directional relationship between Nifty50 (India) and Hang Sang

Table 7. ***Multivariate Cointegration of Nifty50 with the Select Asian Stock Markets***

Pairs of Stock Prices Indices	No. of CE(s)	Trace Statistic	Critical Value (0.05)	*p* - value	Whether Cointegration Present or Not Present
Nifty50–	None*	318.1870	159.5297	0.0000	
Shanghai	At most 1*	172.1572	125.6154	0.0000	
Composite Stock Exchange,	At most 2*	115.1966	95.7536	0.0012	
Hang Seng, Nikkei 225,	At most 3	64.7959	69.8188	0.1179	Present
Straits Times,	At most 4	37.0527	47.8561	0.3450	
Korean Stock Exchange,	At most 5	18.0303	29.7970	0.5638	
JCI, and TWSE	At most 6	4.4178	15.4947	0.8671	
	At most 7	0.0869	3.8414	0.7681	

Note. CE denotes cointegrating equation (s).

Trace test indicates three cointegrating equation(s) at the 0.05 level.

* denotes rejection of the hypothesis at the 0.05 level.

(Hong Kong), Nifty50 and Nikkei 225 (Japan), and Nifty50 and Straits Times (Singapore). This implies that Nifty50 affects the stock markets of Hong Kong, Japan, and Singapore; whereas, the stock markets of Hong Kong, Japan, and Singapore affect Nifty50 in the short - run. The hypotheses $H03^1$, $H03^2$, $H04^1$, $H04^2$, $H05^1$, and $H05^2$ are rejected. Information is observed to flow in both directions. It is found that a uni-directional causal relationship exists in the case of Nifty – JCI, meaning that Nifty Granger causes JCI, but JCI does not Granger cause Nifty50 (both results at 2 lags). Thereby, hypothesis $H01^1$ is rejected. It is further observed that a unidirectional causal relationship exists in the case of Nifty – SHCOMP, meaning that SHCOMP Granger causes Nifty50 at 1 lag, but

Table 8. ***Granger Causality Test***

S. No.	Countries	Hypotheses No.	Null Hypotheses	Lags	*F*-Statistic	Null Hypotheses Decision
H01	Nifty50 – JCI	$H01^1$	Nifty50 does not Granger cause JCI.	2	3.36527*	R
	(Indonesia)	$H01^2$	JCI does not Granger cause Nifty50.	2	0.59399	A
H02	Nifty50 –	$H02^1$	Nifty50 does not Granger cause SHCOMP.	1	0.94863	A
	SHCOMP (China)	$H02^2$	SHCOMP does not Granger cause Nifty50.	1	5.56241*	R
H03	Nifty50 – Hang Seng	$H03^1$	Nifty50 does not Granger cause Hang Seng.	2	3.72769*	R
	(Hong Kong)	$H03^2$	Hang Seng does not Granger cause Nifty50.	5	2.85150*	R
H04	Nifty50 –	$H04^1$	Nifty50 does not Granger cause Nikkei 225.	8	2.90703*	R
	Nikkei 225 (Japan)	$H04^2$	Nikkei 225 does not Granger cause Nifty50.	1	0.11146	A
H05	Nifty50 – Straits	$H05^1$	Nifty50 does not Granger cause Straits Times.	1	32.5310*	R
	Times (Singapore)	$H05^2$	Straits Times does not Granger cause Nifty50.	3	7.92030*	R
H06	Nifty50 – KOSPI	$H06^1$	Nifty50 does not Granger cause KOSPI.	1	0.01083	A
	(South Korea)	$H06^2$	KOSPI does not Granger cause Nifty50.	2	7.94053*	R
H07	Nifty50 – TWSE	$H07^1$	Nifty50 does not Granger cause TWSE.	1	1.57001	A
	(Taiwan)	$H07^2$	TWSE does not Granger cause Nifty50.	1	1.85309	A

Note. * indicates significant at 5% ; R indicates rejected, A indicates Accepted.

Nifty50 does not Granger cause SHCOMP. Hence, hypothesis $H02^2$ is rejected.

It is observed that a unidirectional causal relationship exists in the case of Nifty50 and Nikkei 225, meaning that Nifty50 Granger causes Nikkei 225 at 8 lags, but Nikkei 225 does not Granger cause Nifty50. It is further observed that a unidirectional causal relationship exists in the case of Nifty50 and KOSPI, meaning that KOSPI Granger causes Nifty50 at 2 lags, but Nifty50 does not Granger cause KOSPI, which leads to the rejection of $H04^1$ and $H06^2$.

Finally, it is observed that no causal relationships exist in the case of Nifty50 and TWSE, meaning that TWSE does not Granger cause Nifty50 and Nifty50 does not Granger cause TWSE. Accordingly, $H07^1$ and $H07^2$ are accepted.

Conclusion

In this study, the linkages between Nifty50 and stock markets of select countries, namely China, Hong Kong, Indonesia, Japan, Singapore, South Korea, and Taiwan, are considered together by utilizing the unit root test technique followed by the Johansen and Juselius cointegration test and Granger causality test. A high degree of correlations of Nifty50 is observed with the Asian countries. This suggests strengthening of the integration of India's stock markets with Asian countries. The ADF and PP tests show that all the stock market indices are non-stationary at level and stationary at first difference, $I(1)$. Hence, the econometric analysis of Nifty 50 with the stock markets of developed and emerging economies shows that there exists a long-run association relationship between the pairs of Nifty50 – SHCOMP (China), Nifty50 – Hang Seng (Hong Kong), Nifty50 – Nikkei 225 (Japan), Nifty50 – Straits Times (Singapore), and Nifty50 – KOSPI (South Korea). The cointegration results reveal that there will be no benefit of portfolio diversification for international investors for investments made among the cointegrating countries. In other words, investors from China, Hong Kong, Japan, Singapore, and South Korea will not benefit from diversification to India in the long run because international capital inflows into Indian securities markets are more than the outflows from India to overseas capital markets. Investors from these countries should pay due attention to invest in India for the long term.

Further, these trends of integration in emerging economies provide opportunities for portfolio diversification in the rest of the countries, namely Indonesia and Taiwan. This can motivate global fund managers to design suitable investment strategies for exploiting the markets for abnormal returns. However, in the short - run, the scope of these opportunities is somewhat limited due to systematic and transitory fluctuations inherent to stock markets, as evidenced by the results of the causality tests.

It is further observed that a high degree of significant cointegration exists between Nifty50 and KOSPI and Nifty50 and Hang Seng. It signifies that the stock markets of South Korea (represented by KOSPI) and Hong Kong (represented by Hang Seng) have a dominant role over Nifty50. The results of cointegration reveal that the dependence of Indian stock markets on the developed stock markets represented by the indices Nikkei 225, Hang Seng, and Straits Times is substantially higher than its dependence on other emerging stock markets.

The results of the Granger causality test indicate the existence of a bi-directional relationship between Nifty50 (India) and Hang Sang (Hong Kong), Nifty50 and Nikkei 225 (Japan), and Nifty50 and Straits Times (Singapore) over the short - run at different lags. Therefore, the short-run movements of stock returns in these three countries can influence the performance of the Indian stock markets.

At the same time, a unidirectional causality is observed to exist between Nifty50 and JCI (Indonesia), Nifty50 and SHCOMP (China), Nifty50 and Nikkei 225 (Japan), and Nifty50 and KOSPI (South Korea). No causality is observed to exist for the Taiwanese Stock Market.

Policy Implications

An understanding of causal relationships and integration can help policymakers in framing suitable policies to isolate the economy from shocks caused by crises moving from other markets to the domestic market. Cointegrated stock markets are expected to contribute to financial stability since they cannot deviate significantly from the path of long-run equilibrium. Investors cannot reap consistent benefits from arbitrage activities over the long - run in cointegrated markets.

Internationally integrated capital markets reduce the scope for independent monetary policy. Foreign portfolio investors (FPIs), institutional investors like LIC, mutual fund companies, and high net-worth individuals (HNIs) can reduce the systematic risk and earn potential gains by investing in non-cointegrating countries in the long run, that is, the Indonesian and Taiwanese stock markets.

Limitations of the Study and Scope for Further Research

Although the present study contributes significantly towards research in capital markets, it also has certain limitations that are enumerated below :

Price movements of stock markets of all countries in the study are expressed in USD terms, which would tend to add an extra aspect of volatility to these prices. Cointegration may be checked for stock market data of various countries in terms of their domestic currencies. Analysis has been done for daily data ranging from April 1, 2000 – March 31, 2018. Shorter or longer durations may be taken for analysis. The causal relationships found in the study might not persist in all periods outside the time period of the study, owing to the time-varying nature of causal relationships in the context of stock markets.

Investments in foreign markets lead to the import and export of capital. It is, therefore, of great importance to policy makers. This area has largely remained outside the domain of extant research. Scope for future research would involve studying cointegration amongst all developed and emerging economies using multivariate cointegration techniques.

Only the stock market indices of selected Asian economies are considered in terms of long-run relationships. Macro variables may affect the stock markets like inflation, interest rate, exchange rate, GDP, money supply, etc. Studies undertaken in the future may incorporate these variables. The results are based on the quarterly data ; one can use the daily, monthly, or yearly data for analysis. The present study has analyzed the relationships for the financial years 2000 – 2001 to 2017 – 2018. Future studies may be extended to see the linkages before and after the sub-prime crises of 2007. Cointegration is checked with the National Stock Exchange index Nifty50. In the future, the Bombay Stock Exchange's benchmark index (Sensex) may also be considered for the analysis.

Authors' Contribution

Dr. Pravin Kumar Agrawal collected various research papers from online libraries of MNNIT Allahabad, IIM Lucknow, and IIFT Delhi during his PhD work and collected the required data from Bloomberg Terminal. He carried out this research under the supervision of his thesis supervisor, Prof. Tanuj Nandan. Dr. Pravin Kumar Agrawal analyzed the data, and Dr. Ashutosh Pratap Singh helped compile the data and findings.

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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