A VECM Approach to Explain Dynamic Alliance Between Stock Markets

** Neeraj Nautiyal*
*** P. C. Kavidayal*

Abstract

This paper attempted to examine the extent of cross - country returns and comovement between the stock markets of six developed benchmark countries (USA, UK, Japan, Germany, France, and Hong Kong) and five emerging benchmark countries (Russia, India, China, Malaysia, and Korea). The study analyzed time series data between the periods from April 2006 to March 2016. This paper used time-series vector error correction model approach of stationarity test and cointegration test to establish long-run and short-run relationship between emerging and developed economies. To assess the stability of the relationship (response to shock) amongst the variables over time, forecast error variance decomposition was used. The empirical results suggested that short-run causality primarily ran from the Hong Kong market to India and from India to Malaysia, Germany to Korea, and also from France to China. The findings of the study showed that the speed of adjustment in the vector error correction model was significant but relatively slow. The variance decomposition analysis confirmed the short and long-run stock market linkage between the sample countries. Therefore, it was inferred that stock market integration and causation between different markets and indices had changed.

Keywords : **stock market linkage, integration, financial system, diversification, developing and developed markets, causality**

JEL Classification: C22, G10, G15, F30

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Advanced and globalized markets not only offer fresh opportunities to investors (reap rewards through global diversification), but also increase interlinkages among developing and developed stock markets that has reduced the scope for international arbitration. The growing international rivalry has put great pressure on the managements to lead companies to list outside their domestic sphere to explore their financial opportunities outside their home country. This synchronization has led to many exchanges in their structures, network, and governance mechanism. Also, these have led to earning resilience and thrust in the recent past. Cross-border integration is another impetus that came into existence due to the extension of the service realm by the respective stock exchanges. Convergence of different countries' stock markets is possible as these countries share a long-run and short-run relationship (Narayan, Mishra, & Narayan, 2011). Also, overseas transactions are now offered by exchanges to ease and enhance cross-border investment for budding investors. This has stimulated the momentum in emerging stock markets to channelize the worldwide capital and opening an additional alternative to cross-border relations. However, there are still few economies that are restricted to foreign involvement and ownership, but slowly and steadily, they are accepting the change and understand the essential

* *Associate Professor,* Graphic Era Hill University, Bhimtal, Sattal Road, Bhowali - 263 132, Nainital, Uttarakhand. E - mail : neerajnautiyal@yahoo.com
** *Head & Dean,* Department of Management Studies, Kumaun University, Opp. Ramleela Ground, Bhimtal, Mallital, Nainital, Uttarakhand. E - mail : pckavidayal@gmail.com

need of international trade and commerce. Hence, the effect of a change in one market dynamics on another cannot be denied. Rationally, this will encourage a desirous international trader to make international diversification in distinct markets and also inspire larger volume, as international diversification is sought due to the dissimilarity of the trade cycle, timing, and growth globally.

Close alliances among economies by virtue of large cross-border trade volume, ease in the financial mechanism, and large capital flows have created fusion among markets. Hence, while the trade association advances provincially, an understanding of international price co-dynamism among distinct markets is essential for an earnest consciousness of credence and integration. Realizing the essentiality of capital assets to the economy and policy, various research studies in the past across several developed and developing economies for determining the international integration have been conducted. However, literature studies centralized towards the Indian stock market are limited. Very few studies centralized towards India are available for a period before 2003. However, a rapid and dramatic makeover is witnessed since 2003. A significant increase in portfolio investment inflows from 2003 to 2007 (averaging 2.1% of the region's GDP) have been noticed compared to the period from 1995 to 2002 (averaging 1.2% of the region's GDP) over this period. Foreign capital flows have put a lot of volatility and have made an essential impact on the growth of emerging stock markets. Emerging economies, which offer promising returns, have always been a favorite destination for foreign institutional investors (FIIs), representing about a fourth of the total portfolio. Due to foreign investors, a number of operations at the same time in distinct countries and developed countries' engagement in several bilateral trade and economic settlements and a regional group is expected to contribute to the financial integration with other markets.

The present study is a moderate attempt to address certain concerns: (a) whether the Indian financial market is integrated with other global developing and developed markets ? (b) which markets have a governing influence? In this study, we attempt to fill the gap in the literature and provide recent empirical evidence on the stock market integration among five selected emerging stock markets (India, China, Russia, Korea, and Malaysia) and developed markets of the U.S., France, Germany, UK, Hong-Kong, and Japan. The objective of this research is to empirically tackle the concern of financial market integration for emerging economies. We consider that the current study could be informational and integral to the prevailing literature on the stock market integration in developing countries.

This study gauges how stock market co-dynamism and integration between country-pairs, differentiating between emerged and emerging markets has been stirred in terms of timing and depth during 2006 - 2016. Following the assertive viewpoint in the applied finance literature and in line with the data properties, we use vector error correction and cointegration model (VECM) to measure the integration of five developing countries' stock markets (Russia, India, China, Malaysia, and Korea) with six global markets such as U.S., UK, Japan, Germany, France, and Hong-Kong.

Literature Review

A large body of literature has acknowledged that international diversification is time erratic, evidencing to an increased correlation across global stock markets at the time of stress and downturns in the markets. Past studies also offered close comovement with one another due to adjacent economic connection. Economic concept and empirical outcomes advocate that financial integration and financial market expansion are expected to eliminate obstacles to exchange, to allocate capital more proficiently, and, therefore, contribute to economic progress (Calvi, 2010).

Some studies used correlations between markets as groundwork for discussing interdependencies in short-run and benefits of diversification. Some others examined the economic and financial conditions under which the correlations occur between these capital markets (Quinn & Voth, 2008 ; Wälti, 2011). Few other studies

emphasized on volatility linkages across international capital markets (Baele, 2005 ; Hardouvelis, Malliaropulos, & Priestley, 2006).

Nonetheless, the steady upsurge in both provincial and global correlation across developed and developing economies indicated regional and global capital market integration. Financial integration is studied by applying many de jure and de facto measures at the empirical level, however, de facto studies have been more prevalent (Yu, Fung, & Tam, 2007), replicating the real scale of market associations. The route towards economic reforms and integration in developing countries has received ample firmness after the works of MacKinnon (1973) and Shaw (1973) where they advocated financial liberalization for financial advancement and economic development.

While examining the integration of BRIC countries with developed countries (US, UK, and Japan), Chittedi (2009) found a significant short-run adjustment to long-run equilibrium. By employing co-integration, causality, and error correction model, he reported a convincing co-integration between BRIC and developed countries.

A similar proof of long-run affinity and a short-run causal relationship was expressed by Mukherjee and Mishra (2007), who analyzed 23 economies that have territorial advantages. The markets of Brazil, Russia, India, China, and Argentina (BRICA) and their integration relationship with U.S. market were investigated by Aktan, Mandaci, Kopurlu, and Ersener (2009). A strong and statistically significant dominance of U.S. was expressed by the study. The dependency of Chinese stock market over Russian and Indian markets was demonstrated by Gupta and Agarwal (2011). Influence of Russia, China, and Brazil on the U.S. market after 2006 was revealed by Sheu and Liao (2011). A mild decline in the potential return from the approach of international diversification was also indicated by them.

In a recent study, Claus and Lucey (2012) explored capital market integration among 10 developed and developing economies of Australia, Hong Kong, India, Japan, South Korea, Malaysia, New Zealand, Singapore, Taiwan, and Thailand from April - May 2006. The outcome concluded that stock markets in the Asia Pacific region showed a restricted degree of integration, but the degree of segmentation varied among the 10 economies.

Hatemi (2012) indicated integration between the UAE financial market with the U.S. stock market while studying the degree of integration or segmentation between the two countries. The results further displayed that the degree of integration was high in falling markets instead of when the markets were up. A study between MENA countries' stock markets and developed financial markets was investigated by Neaime (2012). The sample comprised of daily observations of the national indices of the U.S., UK, and France and the MENA major stock market indices (Egypt, Jordan, Morocco, Tunisia, Kuwait, Saudi Arabia, and the United Arab Emirates). The findings displayed a strong correlation of Dubai, Egypt, Jordan, and Kuwait stock markets with the U.S stock market, while Tunisia and Morocco were highly correlated with the French stock market. The financial market of Saudi Arabia was found to be an exception with a weak correlation with any developed markets. Paskelian, Nguyen, and Jones (2013) also examined the causality and cointegrating relationship between MENA stock markets (Egypt, Jordan, Kuwait, Malta, Oman, Qatar, Saudi Arabia, and Tunisia) and the United States equity markets. The Granger causality results presented strong bidirectional causalities between several of the MENA stock markets. The Granger causalities also indicated that stock market returns of Egypt, Jordan, Kuwait, Malta, Oman, Qatar, Saudi Arabia, and Tunisia displayed cointegrating patterns.

Tuning with the Indian context, many researchers found the existence of cointegration of the Indian capital market with other world markets (Mitra & Bhattacharjee, 2015). Chakrabarty and Ghosh (2011) documented the positive impact of co-integration on investment diversification. Bhattacharjee and Swaminathan (2016) evidenced long run equilibrium cointegration of Indian equity market with some other developing stock markets around the world. They conducted a study to analyze the Indian stock market's integration with 33 selected countries of the globe. The long term relationship of India with these 33 countries was analyzed over three different phases. The results documented that co-integration of the Indian financial market with other markets was increasingly improving over the years with financial liberalization. Furthermore, the study found that the Indian

market was more responsive to the other Asian stock markets during the recession phase than in any other sub-sample periods.

Patel (2017) studied the daily index of 14 stock markets including the Indian market for a period from January 1998 to January 2017. The results of Granger causality test indicated that the BSE returns were dependent on BVSP, FTSE-100, and MXX only. A long run relationship was indicated among the selected stock markets. Overall, the Indian capital market was found to be integrated with other markets in short-term and long term.

Some researchers also produced a dissimilar outcome in relation to those who supported cross-border interlinkages. Few study outcomes are expressed here.

Authors like Awokuse, Chopra, Bessler (2009) advocated conflicting outcomes for the viewpoint of dynamic interlinkages between emerging and developed economies' equity markets. Yu et al. (2007) documented the fragile bond market integration in the Asian region from 1997 to 2003. They found that the weak development probably was due to the domestic or time specific factors in some Asian economies. Plummer and Click (2005) maintained that the deepening of domestic bond markets could toughen the financial integration. A mixed response was presented by Mukherjee (2011). He examined the fluctuation of stock market returns in India with that of the stock market volatility of other developing and developed markets. The empirical outcomes revealed that U.S. and Republic of Korea had a positive effect on the Indian stock market returns; whereas, the markets of Hong-Kong and China negatively impacted the Indian stock market.

It is clear from the above - mentioned studies that though we have plenty of evidence on stock market integration, but the results for countries like India, and many such developing countries still look for more empirical findings. Despite many stylized cases, the expanding linkage of the Indian capital market with global and regional markets since 1990s is rather scarce. The findings may vary due to variable specification, methodology, sample features, and the time span of the study. The current study is an attempt to step forward towards a broader magnitude, taking a wider series of models. The controversial influence and high-powered dominance of developed economies' equity markets over developing economies are investigated for the whole study period.

Objectives of the Study

The study is intended to seize the synchronization effect of economic connectivity, particularly with the backdrop of globalization and accelerating concern in the equity markets accompanied by rising growth. The attempt becomes more pertinent while the financial network world over is synchronized, and the shock of one market has a substantial effect on another. The study proceeds with testing the hypotheses, whether developed equity markets have any blow on the developing markets or not, and to measure the degree of correlation with respect to their own fluctuations. By applying cointegration and error-correction modeling mechanism, we inquire the pattern and degree to which the five emerging markets are connected with the rest of the stock markets. The study also examines the control of the developed markets on the developing stock markets by employing the variance decomposition method.

Hypotheses

The present study tests the following null hypotheses:

- **Hypothesis H01 :** There is no significant cointegration between the selected emerging countries' stock markets and developed countries' stock markets.
- **Hypothesis H02 :** There is no direction of causality from developed stock markets to developing stock markets.

↳ **Hypothesis H03 :** Emerging stock markets are not influenced by their own innovative shocks in a short and long-run.

Problem Statement

Overseas investment strategies and their impact on pricing patterns in emerging markets is argumentative ; an understanding of the integration of financial network becomes essential due to its imperative nature. The increasing cross - border integration has inspired many researchers all over the world to examine the mechanism of stock market volatility that is disseminated all over.

The scholastic attempt is intended to evaluate whether a long and a short run relationship between the equity exchanges of the developed and emerging economies exist or not? In the modern times, when capital markets are less restricted by taxes, tariffs, and regulations etc., levied by countries, there exists a possibility of the high extent of assimilation between stock exchanges. Therefore, it can be rationally assumed that today's stock market mechanism is more intriguing, and a particular exchange would have some effect on the other. Also, the extension of the present attempt shows the extent to which the volatility in the developing equity markets can be explained by the shock that comes from six developed equity exchanges.

Materials and Methodology

(1) Sample Selection : The present work aims to investigate the co-integration of global exchanges. We applied monthly time series dataset of 10 financial years from April 1, 2006 to March 31, 2016 that consisted of 146 monthly observations. The selection of the sample stock indices consisted of emerging countries such as India, China, Russia, Malaysia, Korea, and six developed countries such as U.S., Germany, France, England, Hong-Kong, Japan, as defined in the Table 1. The selection of stock markets was influenced by the significant trade and financial relations the sampled countries shared. The proxy of the countries' indices was made from one of the popular indices of that country. To make the study simple, the names of countries and the names of their respective indices are used interchangeably as it symbolizes the indices for the purpose of evaluation.

Table 1. List of Stock Market Indices of Developing and Developed Countries

Name of the Country	Name of the Index
Emerging Economies	
India	BSE 30
China	SHANGHAI Composite
Russia	RTS
Korea	KOSPI
Malaysia	KLCI
Developed Economies	
USA	S&P 500
France	CAC
Germany	DAX
England	FTSE 100
Hong Kong	HANGSANG
Japan	NIKKEI 225

(2) Tools Applied for Analysis: With the objective to give more concrete and close associations, the presence of unit root and co-integration in and between time series data would be tested. The unit root and co-integration test confirmed and allowed us to apply (VECM) modeling technique which assumes variables to be endogenous. Besides distinguishing between the nature of long-run and short-run relationship among capital markets, it also seizes the synergy between them. Further, variance decomposition analysis verifies the validity of the relationship (if any) at the time of any shock that occurs in the financial system.

(3) Lag Order Selection Criteria : To specify a multivariate co-integration correctly, a suitable lag selection is essential. Earlier literature evidenced that AIC is an improved criterion for long period data. Additionally, the difference between the values at different lag lengths is very small. Testing the Akaike information criteria (AIC) and Schwarz Bayesian criteria (SBC) brought us to apply AIC for selecting the lag length correctly.

Table 2. Test for Unit Root

		Null Hypothesis: Variable is non-stationary.				Null Hypothesis: Variable is non-stationary.			
		Augmented Dickey-Fuller Test Statistic				Phillips-Perron Test Statistics			
		Intercept but no Trend		Intercept & Trend		Intercept but no Trend		Intercept & Trend	
Variables	**Level / First Difference**	***t* - stat**	***p* - value**	***t* - stat**	***p* - value**	**Ad. *t*-stat**	***p* - value**	**Ad. *t* - stat**	***p* - value**
BSE	Level	-.99	.75	-1.79	.704	-0.782	.823	-1.57	.802
	First Difference	-12.2	.0000	-12.2	.000	-45.3	.0001	-45.3	.000
S&P	Level	-1.66	.447	-2.57	.295	-1.61	.473	-2.45	.348
	First Difference	-37.8	.000	-37.8	.000	-37.6	.000	-37.6	.000
CAC	Level	-2.01	.281	-1.70	.748	-2.01	.281	-1.70	.748
	First Difference	-40.6	.000	-40.6	.000	-40.6	.000	-40.6	.000
DAX	Level	-1.52	.522	-1.63	.779	-1.46	.550	-1.56	.808
	First Difference	-32.2	.000	-32.2	.000	-42.4	.000	-42.4	.000
FTSE	Level	.409	.905	-2.20	.487	-0.543	.880	-2.42	.365
	First Difference	-40.7	.000	-40.7	.000	-40.8	.000	-40.8	.000
HANGSANG	Level	-1.67	.354	-6.76	.860	-0.601	.243	-2.38	.756
	First Difference	-21.1	.001	-11.67	.000	-23.1	.001	-26.7	.000
NIKKIE	Level	-1.88	.524	-2.34	.569	-2.57	.598	-3.31	.431
	First Difference	-24.7	.001	-35.7	.001	-31.6	.000	.41.6	.001
KOSPI	Level	-2.41	.863	-3.63	.634	-.4.55	.510	-1.85	.689
	First Difference	-32.6	.000	-32.6	.000	-40.1	.000	-37.8	.001
SHANGAI	Level	-3.22	.503	-3.22	.780	-1.52	2.64	-2.21	.641
	First Difference	-36.1	.001	-35.8	.001	-33.8	.001	-27.76	.000
KLSI	Level	.692	.321	-2.75	.497	-1.73	.752	2.76	.574
	First Difference	-10.7	.000	-43.2	.000	-26.8	.001	-18.8	.001
RTS	Level	-2.68	.863	-1.76	.364	-.475	.356	-2.75	.540
	First Difference	-45.1	.000	-22.1	.001	-31.7	.000	-29.6	.000

Note. Optimum lag is selected according to the AIC, critical values are based on MacKinnon (1990) ; critical values are -3.9611 (99%), - 3.4113 (95%), and -3.1275(90%) with no trend and with trend, respectively.

Data Analysis and Results

(1) Descriptive Statistics : Indian and Malaysian stock exchanges scored highest average returns, while the Russian equity market got the lowest returns for the entire sample period. During this period, Hong - Kong, Korea, and U.S. markets provided almost similar returns. The Indian equity market also scored highest returns in terms of risk adjustment (average stock return adjusted to standard deviation). Negative skewness and positive kurtosis were measured for all 11 sample markets. However, both the skewness and the kurtosis concerning China's market substantially varied from the rest of the markets. Jarque - Bera measure is found to be very high for all sampled equity markets except the Chinese market, indicating that the stock returns are not normally distributed. In other words, this suggests an opportunity of earning abnormal returns in each sampled stock market except the Chinese stock market due to its normal distribution character.

(2) Unit Root Test : To develop the correctness and validity of the specified models and to obtain relevant inferences, it is imperative to convert the data series into stationary form. In other words, unit root of the time series can disturb the model specification; hence, determining the stationarity is an essential step of the data set. The fundamental requirement for estimating the presence of cointegration is the first order integration $I(1)$ variables. To test this, the Augmented Dickey-Fuller (Dickey & Fuller, 1979) and the Phillips and Perron (Phillips & Perron, 1988) tests were used. The Table 2 shows that all variables are unit root at the level $I(0)$, but after converting them to first difference, that is, $I(1)$, they all become stationary. Therefore, one can establish cointegration.

(3) Cointegration : To find cointegration, we applied the Johansen method of co-integration developed by Johansen (1988) and Juselius (1990) that is built upon the vector auto regressive technique to determine the existence of the cointegrating vector(s). For a comprehensive view, full results of the test are not reported from the trace form of the Johansen and Juselius test for all likely system alignments (detailed reports could be made available upon request). To determine the number of cointegrating vectors, Johansen and Juselius (1990) contributed two likelihood ratio tests, which are marginally different from unity. The trace test examines the null hypothesis of r cointegrating relations against the alternative of n cointegrating relations, where n is the number of variables in the system for $r = 0, 1, 2 \ldots n\text{-}1$.

The trace test by Johansen and Juselius is used, and the results are presented in the Table 3. It indicates that there is at least one cointegration vector between different countries' stock markets, and hence, the one which is cointegrated will revert to the long run relationship, even if there is disequilibrium in the short run. The outcome determines two cointegrating equations at the 0.05 level. It is further validated by high statistic likelihood ratio (LR) values. The test reveals the existence of cointegration among all markets. Hence, the investors can invest in these markets for a long-term duration as the returns of these stock markets are highly linked with one another. The appropriate lag length is determined on the basis of Akaike information criterion (AIC), with the supplementary requirement that the errors are white - noise processes (Gonzalo, 1994).

(4) Long - Run Relationship and Short - Run Relationship : The long and short-run relationship between sampled stock indices is appraised by the vector error correction model (VECM) approach. The short-run causality is estimated by 5% significance level of combined F statistics of differenced dependent variable coefficients, while the long run causality is determined by the significant lagged error correction term(s) as it is determined through the long run co-integrating relationship(s). The vector error correction model outcome is displayed with a significant error correction term (ECM (-1)). In symmetry with theory, we also observe a negative value in our study. Further, the results (Table 4) indicate bidirectional causality between Korea and Germany, Shanghai and

Table 3. Results of Johansen Cointegration Test for all Markets' Unrestricted Cointegration Rank Test (Trace)

Name of Variables	Hypothesis	Eigen Value	Statistic	Critical Value	Remarks
ΔBSE - ΔS&P	None*	0.190832	33.572	15.49	Co-integration
	At most 1*	0.142013	14.09	3.84	
ΔBSE - ΔCAC	None*	0.198114	35.57	15.49	Co-integration
	At most 1*	0.152911	15.26	3.84	
ΔBSE - ΔDAX	None*	0.219159	39.94	15.49	Co-integration
	At most 1*	0.170377	17.18	3.84	
ΔBSE - ΔFTSE	None*	0.239078	40.02	15.49	Co-integration
	At most 1*	0.149371	14.88	3.84	
ΔBSE - ΔHANGSANG	None*	0.242580	41.98	15.49	Co-integration
	At most 1*	0.163465	16.42	3.84	
ΔBSE - ΔNIKKIE	None*	0.214910	37.67	15.49	Co-integration
	At most 1*	0.154261	15.41	3.84	
ΔKOSPI - ΔS&P	None*	0.211699	39.36	15.49	Co-integration
	At most 1*	0.173035	17.47	3.84	
ΔKOSPI - ΔCAC	None*	0.200289	37.23	15.49	Co-integration
	At most 1*	0.165709	16.66	3.84	
ΔKOSPI - ΔDAX	None*	0.260649	49.24	15.49	Co-integration
	At most 1*	0.208057	21.46	3.84	
ΔKOSPI - ΔFTSE	None*	0.248504	44.06	15.49	Co-integration
	At most 1*	0.175750	17.78	3.84	
ΔKOSPI - ΔHANGSANG	None*	0.320714	55.16	15.49	Co-integration
	At most 1*	0.191766	19.58	3.84	
ΔKOSPI - ΔNIKKIE	None*	0.227497	41.65	15.49	Co-integration
	At most 1*	0.176852	17.90	3.84	
ΔSHANGAI - ΔS&P	None*	0.207684	33.51	15.49	Co-integration
	At most 1*	0.123248	12.10	3.84	
ΔSHANGAI - ΔCAC	None*	0.270610	40.77	15.49	Co-integration
	At most 1*	0.119887	11.74	3.84	
ΔSHANGAI - ΔDAX	None*	0.285079	42.64	15.49	Co-integration
	At most 1*	0.120118	11.77	3.84	
ΔSHANGAI - ΔFTSE	None*	0.278913	42.50	15.49	Co-integration
	At most 1*	0.126327	12.42	3.84	
ΔSHANGAI - ΔHANGSANG	None*	0.255471	39.20	15.49	Co-integration
	At most 1*	0.122939	12.06	3.84	
ΔSHANGAI - ΔNIKKIE	None*	0.246233	37.86	15.49	Co-integration
	At most 1*	0.120920	11.85	3.84	
ΔKLCI - ΔS&P	None*	0.228035	39.36	15.49	Co-integration
	At most 1*	0.155559	15.55	3.84	
ΔKLCI- ΔCAC	None*	0.282030	45.95	15.49	Co-integration

	At most 1*	0.154840	15.47	3.84	
ΔKLCI - ΔDAX	None*	0.272325	44.99	15.49	Co-integration
	At most 1*	0.157314	15.74	3.84	
ΔKLCI - ΔFTSE	None*	0.303059	48.71	15.49	Co-integration
	At most 1*	0.1549999	15.49	3.84	
ΔKLCI - ΔHANGSANG	None*	0.245636	40.54	15.49	Co-integration
	At most 1*	0.146874	14.61	3.84	
ΔKLCI - ΔNIKKIE	None*	0.270515	30.78	15.49	Co-integration
	At most 1*	0.019050	1.76	3.84	
ΔRTS - ΔS&P	None*	0.256251	43.87	15.49	Co-integration
	At most 1*	0.165469	16.64	3.84	
ΔRTS - ΔCAC	None*	0.240191	41.87	15.49	Co-integration
	At most 1*	0.164837	16.57	3.84	
ΔRTS - ΔDAX	None*	0.262451	45.36	15.49	Co-integration
	At most 1*	0.171925	17.35	3.84	
ΔRTS - ΔFTSE	None*	0.335778	54.28	15.49	Co-integration
	At most 1*	0.165459	16.64	3.84	
ΔRTS - ΔHANGSANG	None*	0.242923	41.39	15.49	Co-integration
	At most 1*	0.157696	15.78	3.84	
ΔRTS - ΔNIKKIE	None*	0.247071	43.14	15.49	Co-integration
	At most 1*	0.169051	17.03	3.84	

Note. Trace test suggests two cointegrating eqns. at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level.
Δ denotes stationary at first difference.
Trend assumption : Linear deterministic trend. Lags interval (in first differences): 1 to 6.

Table 4. Long-Run and Short-Run Granger Causality Based on VECM

Variables	Long Run Causality	Short Run Causality
BSE ⇨ S&P	YES	NO
BSE ⇨ CAC	YES	NO
BSE ⇨ DAX	YES	NO
BSE ⇨ FTSE	NO	NO
BSE ⇨ HANGSANG	NO	YES
BSE ⇨ NIKKIE	YES	NO
KOSPI ⇨ S&P	YES	NO
KOSPI ⇨ CAC	YES	NO
KOSPI ⇨ DAX	YES	YES
KOSPI ⇨ FTSE	YES	NO
KOSPI ⇨ HANGSANG	NO	NO
KOSPI ⇨ NIKKIE	YES	NO

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SHANGHAI ⇨ S&P	YES	NO
SHANGHAI ⇨ CAC	YES	YES(10%)
SHANGHAI ⇨ DAX	YES	NO
SHANGHAI ⇨ FTSE	YES	NO
SHANGHAI ⇨ HANGSANG	YES	YES
SHANGHAI ⇨ NIKKIE	YES	YES
KLCI ⇨ S&P	YES	NO
KLCI ⇨ CAC	YES	NO
KLCI ⇨ DAX	NO	NO
KLCI ⇨ FTSE	NO	NO
KLCI ⇨ HANGSANG	NO	YES(10%)
KLCI ⇨ NIKKIE	NO	NO
RTS ⇨ S&P	YES	NO
RTS ⇨ CAC	YES	NO
RTS ⇨ DAX	YES	NO
RTS ⇨ FTSE	YES	NO
RTS ⇨ HANGSANG	NO	NO
RTS ⇨ NIKKIE	YES	NO

France, and between Malaysia and Hong-Kong stock markets. Indian and Korean markets report long run causal effect with U.S., France, Germany, and Japanese stock markets. The results between Indian and U.S. stock markets are rather intuitive as the U.S. stock market is the world's most powerful security market and probably has heavy influence on other financial markets. The Chinese market is found to have a high causal effect on all the developed markets; indeed, it has a bidirectional effect with France and Hong-Kong markets. This can be attributed to the strengthening trade relations among China and the other countries considered in the present study. On the other hand, the Russian market has a low direction of causality with the Hong Kong market. However, its long-run relationship with rest of the developed markets is quite high. Amongst all the emerging markets, the Malaysian stock exchange is found to have the most unsteady short and long-run causality effect with developed markets.

Only a unidirectional long-run relation is evidenced by the stock indices of U.S. and France. The complete analysis coincides with the existence of causality from developed to developing equity markets; hence, the hypothesis H02 is rejected. It shall be noticed that the cointegrating equation acknowledges only one co-dynamism between the two series over a period of time, and it does not confirm the correlation between the variables. Hence, we can conclude that the results reveal that all in all, the stock indices all over the globe take a clue from one another.

↳ **Variance Decomposition Analysis (VD) :** Since cointegration merely acknowledges the long run relationships' existence among the selected variables, it does not completely confirm the firmness of such an association, particularly when some degree of shock occurs in the financial system. To understand the essentiality of exogenous shocks in describing the dependent variables, we calculate the fractions of the forecast error variance attributable to the respective orthogonal shocks. The variance of the errors in forecasting can be attributed to the variance of any dependent variable in response to the orthogonal shocks to it. It happens due to the nature of

forecasting variable to remain constant without the shocks. Hence, variance decomposition is computed to test the repeated interfaces and firmness of causal relationship between variables. Variance decomposition estimates the degree of change in the endogenous variables as an effect of its own shocks against shock to other variables.

The Table 5 presents the results of the variance decomposition. It reveals the significance of shock in most of the cases. All five emerging stock markets are influenced by their own innovative shocks in a short and long-run outline. Developed and developing markets significantly impact one another. In the long run (10 months), the variance decomposition of BSE is explained approximately 59% by its own innovative shocks, and 18.15% is explained by the HANSANG past shocks. In a short-run, HANGSANG explains approximately 21% of its own shocks to BSE. For KOSPI, 64% is explained by its own past shocks in a long run, while 83% is explained in the

Table 5. Variance Decomposition Analysis

VD of India								
Period	**S.E.**	**BSE**	**CAC**	**DAX**	**FTSE**	**HANGSANG**	**S &P**	**NIKKEI**
1	965.80	100.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1085.01	82.92	0.22	4.57	3.78	8.34	0.00	0.17
3	1200.01	68.01	3.00	3.75	3.13	21.06	0.13	0.90
4	1223.67	67.37	4.36	3.85	3.01	20.41	0.14	0.87
5	1250.97	66.65	4.23	4.76	3.09	20.05	0.32	0.89
6	1285.12	63.21	6.94	4.65	4.87	19.00	0.44	0.89
7	1302.04	61.58	7.16	5.43	5.07	19.12	0.52	1.13
8	1324.19	59.68	6.98	5.27	5.86	18.89	2.19	1.13
9	1341.42	59.68	7.45	5.25	5.74	18.46	2.16	1.27
10	1353.49	59.64	7.33	5.18	5.83	18.15	2.33	1.54
VD of Korea								
Period	**S.E.**	**KOSPI**	**CAC**	**DAX**	**FTSE**	**HANGSANG**	**S &P**	**NIKKEI**
1	88.97	100.00	0.00	0.00	0.00	0.00	0.00	0.00
2	93.46	92.42	0.89	0.29	2.32	0.03	0.01	4.05
3	98.89	83.00	2.12	0.30	3.44	6.46	0.19	4.51
4	104.69	80.62	3.38	1.45	3.55	6.23	0.75	4.02
5	107.46	76.52	3.63	1.83	3.73	7.56	2.39	4.33
6	112.31	71.19	5.13	4.62	3.87	7.03	2.30	5.87
7	115.76	68.32	4.96	5.54	5.53	7.16	2.17	6.31
8	117.58	67.10	5.09	6.04	6.35	6.95	2.22	6.24
9	118.74	65.88	5.24	5.93	6.38	8.18	2.24	6.14
10	120.87	63.73	6.16	5.98	7.47	8.39	2.27	5.99
VD of China								
Period	**S.E.**	**SHANGHAI**	**CAC**	**DAX**	**FTSE**	**HANGSANG**	**S & P**	**NIKKEI**
1	179.79	100.00	0.00	0.00	0.00	0.00	0.00	0.00
2	200.89	84.11	1.81	7.75	0.07	1.31	0.47	4.48
3	208.97	78.89	3.57	7.78	0.13	4.10	1.30	4.23
4	219.41	72.45	6.89	7.36	3.31	3.75	2.16	4.07
5	253.52	63.54	5.17	5.71	14.46	5.81	2.18	3.14

6	270.05	56.99	4.69	5.70	14.78	11.50	1.93	4.42
7	276.52	54.36	4.49	6.05	14.10	11.88	4.39	4.73
8	282.07	52.69	4.61	6.34	13.56	12.23	4.55	6.01
9	290.86	49.56	4.63	6.83	16.64	11.68	4.31	6.35
10	295.45	48.52	4.61	7.68	16.82	11.92	4.19	6.27

VD of Malaysia

Period	S.E.	KLCI	CAC	DAX	FTSE	HANGSANG	S &P	NIKKEI
1	57.32	100.00	0.00	0.00	0.00	0.00	0.00	0.00
2	57.95	97.88	0.18	0.17	1.17	0.12	0.13	0.35
3	62.42	86.86	3.52	5.06	1.13	2.68	0.35	0.40
4	63.44	85.88	3.53	4.93	1.74	2.62	0.79	0.50
5	64.43	83.27	3.43	5.31	3.44	2.54	1.26	0.75
6	65.28	82.57	3.42	5.30	3.41	3.15	1.37	0.79
7	67.54	77.40	3.86	5.97	5.36	3.52	2.53	1.35
8	68.11	76.36	3.95	6.18	5.27	3.51	3.34	1.39
9	68.54	75.57	3.90	6.48	5.21	3.80	3.49	1.56
10	68.98	74.66	3.88	6.52	5.70	3.84	3.63	1.76

VD of Russia

Period	S.E.	RTS	CAC	DAX	FTSE	HANGSANG	S &P	NIKKEI
1	141.1	100.00	0.00	0.00	0.00	0.00	0.00	0.00
2	154.28	93.59	0.29	0.22	1.79	0.89	0.20	2.98
3	160.09	87.25	0.82	2.00	2.19	3.70	0.57	3.44
4	171.64	79.30	1.47	3.7	1.9	6.28	1.87	5.26
5	176.5	75.073	1.8	4.26	2.19	6.21	1.81	8.53
6	180.89	72.70	3.6	4.44	2.52	6.56	1.98	8.14
7	183.2	72.01	3.58	4.34	2.50	6.48	1.93	9.13
8	184.05	71.82	3.55	4.30	2.51	6.57	2.03	9.16
9	186.94	69.66	3.58	4.18	2.49	8.95	2.07	9.04
10	187.79	69.33	3.55	4.29	2.77	8.90	2.11	9.03

short run. It is evident that over 48% of the forecast-error variance of the SHANGHAI market can be attributed to its past own shocks, while a positive shock in FTSE and HANGSANG affect 17% and 12% variances, respectively on the SHANGHAI market. In a long run, the KLCI stock market explains 75% of its own shocks, while its past own shocks explain 87% of the variance quarterly. The Russian market also explains 70% of its own shocks, while the effect of HANGSANG accounts for less than 9% of the forecast-error variance. Hence, the outcome of the test approves the short and long run equity market relationship between the developing and developed world.

(5) Testing the Hypotheses: The results of Table 3 indicate that there is atleast one co-integration vector between different countries' stock markets, and hence, the one which is cointegrated will revert to the long run relationship, even if there is disequilibrium in the short run. Hence, the first hypothesis H01 is rejected. From the results of Table 4, it can be conceded that there is existence of causality from developed to developing equity markets. Thus,

the second hypothesis H02 is rejected. The Table 5 proves that all five emerging stock markets are influenced by their own innovative shocks in a short and long-run outline, and developed and developing markets significantly impact one another. Thus, the third hypothesis H03 is rejected.

Summary, Conclusion, and Implications

The study is an attempt to affiliate and find dynamic synergy (if any) between developed and developing equity markets. It aimed to evaluate the extent to which the sample five emerging markets are integrated with the six selected globally developed equity markets. The observation extracted from the Johansen - Juselius technique suggests the presence of a sturdy long-run relationship between the sample markets. The cointegrating effect presents a strong equilibrium dynamism that forces stock prices not to drift apart for a long-run from one market to another market. Besides this, a short run market interface was also addressed with the help of Granger-causality approach in the context of VECM analyses. The outcome reports that the short-run causality predominantly runs from the Hong-Kong market to India and from India to Malaysia, Germany to Korea, and also between France to China markets. It can be said that diversification opportunities to earn short and abnormal returns is not possible in these markets. Contrary to many observations made in the past, our results do not report dominance of the U.S. stock market in the Asian equity markets. In other words, the effect of the U.S. market, if extended against the previous studies done on integration and causation between the equity markets, has changed.

Moreover, the VECM efficient approach offers additional validation for indifference (with few exemptions) of the few emerging markets in the short run to progress in the developed equity markets as the results are statistically insignificant. The variance decomposition analysis also validates the short and long-run stock market alliance between the selected countries. The results report that the Hong-Kong market seems to impact Indian, Chinese, and Korean markets. This means that any development in the Hong-Kong market can be considered in policy making about India, China, and Korea markets. A close link is also witnessed between China and Germany equity markets.

The findings obtained by this study are consistent with the results of other similar studies such as : Bhattacharjee and Swaminathan (2016), Mitra and Bhattacharjee (2015), Vohra (2016), Mukherjee and Mishra (2010), Siddiqui (2009), and Raj and Dhal (2010), who found the existence of co-movement and integration of the Indian financial market with other markets. Researchers like Claus and Lucey (2012), Darrat and Zhong (2002), Neaime (2012), Hatemi (2012), Paskelian et al. (2013), Hoque (2007), etc., also found a short and long run relationship between developed and developing economies. However, the present outcome is contradictory to the study results obtained by scholars like Qadan and Yagil (2015) ; Menon, Subha, and Sagaran (2009) .

The interpretation of these outcomes is also clear for institutional investors. Emerging equity markets advocate an opportunity to diversify internationally. Exploring new emerging markets also offer high risk-reward tradeoffs and a realm of the possibility to hedge funds globally, which are hardly targeted in developed markets. The findings of the study would enable the regulators to formulate better policies to ensure efficient price discovery.

Limitations of the Study and Scope for Further Research

Our study applied traditional unit root tests, which are unable to address a possible structural break problem in the data. Also, the current study did not take into account the existence of seasonality in the data series. Furthermore, the study did not focus on the reduction of the crisis effect on financial developments and growth relationships over the post-crisis study period.

The change of sources and frequency of observations may become one reason for outcome variation. Hence, a

promising input for further research is to use high-frequency data. A study on the issue of volatility spillovers between developed and developing economies can add further scope to the present field of research. A study of the determinants of economic integration and comovement is also appealing since the problem is still unanswered, and the literature is limited. The study can be further extended by involving/examining the policy responses of each country's Central bank with an aim of extracting better recommendations for emerging economies to attract capital inflows. Another avenue for future research is to explore whether the effect of finance on growth is permanent or transitory.

References

Aktan, B., Mandaci, P. E., Kopurlu, B. S., & Ersener, B. (2009). Behaviour of emerging stock markets in the global financial meltdown: Evidence from BRIC - A. *African Journal of Business Management, 3* (7), 396 - 404.

Awokuse, T.O., Chopra, A., Bessler, D.A. (2009). Structural change and international stock market interdependence: Evidence from Asian emerging markets. *Economic Modelling, 26* (3), 549 - 559.

Baele, L. (2005). Volatility spillover effects in European equity markets. *Journal of Financial and Quantitative Analysis, 40* (2), 373 - 401.

Bhattacharjee, S., & Swaminathan, A.M. (2016). Stock market integration of India with rest of the world: An empirical study. *Indian Journal of Finance, 10* (5), 22 - 32. DOI: 10.17010/ijf/2016/v10i5/92934

Calvi, R. (2010). *Assessing financial integration: A comparison between Europe and East Asia* (Economic Papers 2008-2015, No. 423). Directorate General Economic and Financial Affairs (DG ECFIN), European Commission. Retrieved from http://ec.europa.eu/economy_finance/publications/economic_paper/2010/pdf/ecp423_en.pdf

Chakrabarty, A., & Ghosh, B.K. (2011). Long run financial market cointegration and its effect on international portfolio diversification. *Indian Journal of Finance, 5* (4), 27 - 37.

Chittedi, K. R. (2009). *Global stock markets development and integration : With special reference to BRIC countries* (MPRA Paper 18602). Retrieved from https://mpra.ub.uni-muenchen.de/id/eprint /18602

Claus, E., & Lucey, B.M. (2012). Equity market integration in the Asian Pacific region: Evidence from discount factors. *Research in International Business Finance, 26* (3), 137 -163. doi:10.1016/j.ribaf.2011.09.002

Darrat, A., & Zhong, M. (2002). Permanent and transitory driving forces in the Asian-Pacific stock markets. *Financial Review, 37*(1), 35 - 51.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association, 74* (366), 427- 431.

Gonzalo, J. (1994). Five alternative methods of estimating long-run equilibrium relationships. *Journal of Econometrics, 60* (1-2), 203 - 233.

Gupta, N., & Agarwal, V. (2011). Comparative study of distribution of Indian stock market with other Asian markets. *International Journal of Enterprise Computing and Business Systems, 1*(2), 1 - 20.

Hardouvelis, G.A., Malliaropulos, D., & Priestley, R. (2006). EMU and European stock market integration. *Journal of Business, 79* (1), 365-392. DOI: org/10.1086/497414

Hatemi, J. A. (2012). Is the UAE stock market integrated with the USA stock market? New evidence from asymmetric causality testing? *Research in International Business and Finance, 26* (2), 273 - 280.

Hoque, H. A. A. B. (2007). Co - movement of Bangladesh stock market with other markets: Cointegration and error correction approach. *Managerial Finance, 33*(10), 810 - 820. doi : https://doi.org/10.1108/03074350710779250

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control, 12* (2-3), 231 - 254.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration - With applications to demand for money. *Oxford Bulletin of Economics and Statistics, 52* (2), 169 - 210. doi: https://doi.org/10.1111/j.1468-0084.1990.mp52002003.x

MacKinnon, J. G. (1990). *Critical values for cointegration tests* (Queen's Economics Department Working Paper No. 1227). Retrieved from http://www.econ.queensu.ca/faculty/mackinnon/

MacKinnon, R.I. (1973). *Money and capital in economic development.* Washington, DC : The Brookings Institute.

Menon, N.R., Subha, M.V., & Sagaran, S. (2009). Cointegration of Indian stock markets with other leading stock markets. *Studies in Economics and Finance, 26* (2), 87 - 94.

Mitra, A., & Bhattacharjee, K. (2015). Financial interdependence of international stock markets: A literatute review. *Indian Journal of Finance, 9* (5), 20 - 33. DOI: 10.17010/ijf/2015/v9i5/71447

Mukherjee, K., & Mishra, R. K. (2007). International stock market integration and its economic determinants: A study of Indian and world equity market. *Vikalpa, 32* (4), 29 - 44.

Mukherjee, K., & Mishra, R. K. (2010). Stock market integration and volatility spillover: India and its major Asian counterparts. *Research in International Business and Finance, 24* (2), 235 - 251. DOI : https://doi.org/10.1016/j.ribaf.2009.12.004

Mukherjee, P. (2011). An exploration on volatility across India and some developed and emerging equity markets. *Asia Pacific Development Journal, 18* (2), 79 - 103.

Narayan, P. K., Mishra, S., & Narayan, S. (2011). Do market capitalization and stocks traded converge? New global evidence. *Journal of Banking and Finance, 35* (10), 2771 - 2781.

Neaime, S. (2012). The global financial crisis, financial linkages and correlations in returns and volatilities in emerging MENA stock markets. *Emerging Markets Review, 13* (3), 268 - 282.

Paskelian, O. G., Nguyen, C. V., & Jones, K. (2013). Did financial market integration really happen in MENA region? An analysis. *Journal of Economic Cooperation Development, 34* (1), 111 - 134.

Patel, R. J. (2017). Co - movement and integration among stock markets: A study of 14 countries. *Indian Journal of Finance, 11*(9), 53 - 66. doi:10.17010/ijf/2017/v11i9/118089

Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika, 75* (2), 335 - 346.

Plummer, M.G., & Click, R. (2005). Bond market development and integration in ASEAN. *International Journal of Finance and Economics, 10* (2), 133 -142.

Qadan, M., & Yagil, J. (2015). Are international economic and financial co-movement characterized by asymmetric co-integration? *Review of Accounting and Finance, 14*(4), 398- 412. DOI: http://doi.org/10.1108/RAF-02-2015-0026

Quinn, D. P., & Voth, H. - J. (2008). A century of global equity market correlations. *American Economic Review: Papers & Proceedings, 98* (2), 535- 540.

Raj, J., & Dhal, S. (2010). *Integration of India's stock market with global and major regional markets* (Bank for International Settlement, Paper No. : 42). Retrieved from http://www.bis.org/publ /bpp/bispap42h.pdf

Shaw, E.S. (1973). *Financial deepening in economic development*. New York : Oxford University Press.

Sheu, H. J., & Liao, C. H. (2011). Dynamics of stock market integration between the US and the BRIC. *African Journal of Business Management, 5* (9), 3674 - 3689. DOI: 10.5897/AJBM10. 1342

Siddiqui, S. (2009). *Examining associations between S&P CNX nifty and selected Asian and US stock markets.* Retrieved from: http://www.nseindia.com/content/research/res_paperfinal235.pdf

Vohra, P. S. (2016). A study of co-movement among indices of Bombay Stock Exchange. *Indian Journal of Finance, 10* (9), 11-29. DOI: 10.17010/ijf/2016/v10i9/101476

Wälti, S. (2011). Stock market synchronization and monetary integration. *Journal of International Money and Finance, 30* (1), 96-110.

Yu, I. - W., Fung, K. - P., & Tam, C. - S. (2007). *Assessing financial market integration in Asia - Equity markets* (Hong Kong Monetary Authority Working Papers, no 04/2007). Retrieved from https://www.hkma.gov.hk/media/eng/publication-and-research/research/working-papers/HKMA WP 07_ 10_full.pdf

About the Authors

Dr. Neeraj Nautiyal is an Associate Professor of Finance in School of Management at Graphic Era Hill University, Bhimtal, Nainital, Uttarakhand. He obtained his Ph.D. in Management from Kumaun University, Nainital, Uttarakhand and holds MBA, M.Com, and UGC- NET qualification. His industry and academic experience extend to 12 years. His research interests include Indian capital market, model development, and data analysis.

Prof. P. C. Kavidayal is Professor and Head at Department of Management Studies, Kumaun University Campus, Bhimtal, Nainital, Uttarakhand. Dr. Kavidayal is a Gold Medalist in B. Com & M. Com and earned his Ph.D. in the area of industrial relations from Kumaun University, Nainital. His major areas of research include capital markets, corporate finance, financial services, and human resource management. His teaching interests include financial management, financial accounting, investment management, management accounting, and tax planning.