

# Causal and Co-integration Analysis of Indian and Selected Asian Stock Markets

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## ABSTRACT

*The study investigates the interdependence of Indian Stock Market with other Asian equity markets like Pakistan, Sri Lanka, Malaysia, Korea, Japan, Singapore, Taiwan and China. Study uses monthly data over the period July 1997 to September 2012. By applying Augmented Dickey Fuller Unit Root Test, Johansen Co-integration Test, Granger Causality Test and Vector Error Correction Model (VECM) study find that all Asian stock indices are first difference stationary and long run equilibrium relationship exist among Asian markets. Study uncovers that causality run from stock markets of Sri Lanka, Korea, Singapore and China to India and from India to Pakistan. It also implies that Indian stock market is affected by stock indices of Sri Lanka, Japan, Singapore, and China. Major implication study derives is that Indian government should monitor movements of Asian equity markets very closely, because crisis in any Asian country may affect the performance of Indian stock market. Further robust research can be done by reducing the frequency of data which will be helpful in validating the result of this study.*

**Keywords:** *Asian Stock Markets, Co-integration Test, Granger Causality Test and Vector Error Correction Model*

## INTRODUCTION

In the era of global financial integration, investors prefer cross border investment to diversify their portfolios. If two countries' stock markets are co-integrated in long run, such exercise will be futile. But at the same time close supervising on the movements of other world equity markets is required to circumvent Indian stock market against depressing consequences.

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The association among world equity markets has spawned the interest of researchers of the globe to discover the co-movements among world equity markets (Dungey, Fry and Martin, 2003; Wong et al., 2004 and Cheng and Glascock, 2006), but very few had focused on effect of Asian equity markets on emerging market like India. Again some studies (Sahaand and Bhunia, 2011 and Srikanth, 2012) were in favor of long run co-integration among Asian markets, while others rejected it (Khanapuri, 2009 and Jeyanthi and Pandian, 2008). The main objective of this study is to explore dynamic linkages among Asian equity markets and Indian stock market by enhancing list of Asian countries covered in the previous studies and also by extending time period. Other objective of this study is to investigate the effectiveness of cross border investment strategy for the purpose of risk minimization. The major implication this study will have is how much influence Asian markets have on the performance of Indian stock market and whether the degree of influence has changed in recent time. Results of this study also have some implication for Policy maker because if co-movements will be found between Indian and Asian equity markets then collide in other regional markets may be transmitted to Indian stock market. Result of this study is also expected to be helpful to international portfolio managers, investors, academicians and researchers.

With this background, remainder of the paper is organized in the following sections. The next section, provides Review of Literature followed by Data interpretation and Methodology and empirical Analysis. Findings and conclusions from the end of the discussion.

## REVIEW OF LITERATURE

Literature related to association among stock markets can be classified into two broad categories. First part majorly focusing on effect of Developed equity markets on Indian stock market, while second more specifically spotlighting on effect of Asian equity markets on Indian stock market.

### **Literature Related to Interdependence between Developed and Indian Stock Market**

Kumar and Mukhopadyay (2002) examined co movement between US and Indian stock markets. They found causality and spillover effect running from US to Indian stock market. Lamba (2004) analyzed the dynamic

relationship among India, Pakistan, Sri Lanka, France, Germany, US, UK and Japan. Study found that developed equity markets influenced Indian market, but Indian market did not influence other Asian markets. In another study, Mukherjee and Mishra (2007) investigated the interdependence among the 23 countries of the world including India. Study found high degree of market integration. Countries from the same region were highly co-integrated. Raj and Dhal (2009) found strong integration of Indian market with other markets. Siddiqui, S. (2009) concluded that world stock market indices were associated with each other. Marimuthu (2010) examined co-movements among the stock markets of Malaysia, India, China, US and UK. Study found bidirectional causality between Malaysia and India. Study also concluded that US market dominated all Asian markets. Joshi (2011) examined the long run relationship among stock markets of USA, Brazil, Mexico, China and India. He concluded that long run co-integration exist among the markets. Contradicting to above all studies, Siddiqui (2008) explored that no European stock market played dominant role for Indian stock market. Similarly, Padhi (2011) found significant effect of US option market index on other international option markets, but no significant effect was found on Indian option market. Mukherjee and Bose (2008) also end up with similar result of no linkages.

### **Literature Related to Interdependence Between Asian and Indian Stock Market**

Johnson and Soenen (2002) analyzed economic integration among Asian markets and found that stock markets of Hong Kong, Australia, Malaysia, Singapore, New Zealand and China were co-integrated with stock market of Japan. Bhattacharyya and Banerjee (2004) by applying Granger causality test study found that European and US stock markets were not granger cause by any other markets, but some Asian markets were granger causing each others. Narayan, Smyth and Nandha (2004) reported that stock market of Bangladesh, India and Sri Lanka Granger cause stock market of Pakistan. Chi, Li and Young (2006) found that Asian equity markets were more integrated with Japan than USA. Singh, Kumar and Pandey (2008) supported significant effect of world market on Indian stock market. Poshakwale and Thapa (2009) evaluated effect of foreign investment on Asian stock markets and co-integration among them. Study found that foreign investment affect volatility of Asian stock market. Sahaand and Bhunia (2011) studied financial market integration among South Asian equity markets. Study found long run equilibrium

relationship among the markets. Bhunia (2011) found long run co-integration among south East Asian markets. Srikanth (2012) analyzed the co-movements among India, Hong Kong, Indonesia, Malaysia, South Korea, Japan and China. Study found long run relationship among the markets. In et al. (2001) found that adverse news of local or other markets significantly affect market integration. In addition to this Lin (2005); Ji (2011) and Brailsford, Penm and Terrell(2006) also found identical results for other Asian markets.

Conversely, Nath and Verma (2003) suggested that no long run equilibrium relationship exist among India, Singapore and Taiwan markets and therefore equity market of south Asian were not interlinked with each others. Raju and Khanapuri (2009) examined the Asian stock market integration. They found varying degree of market integration in Asian region. Specially, Indian market is not affected by any other Asian markets. Jeyanthi and Pandian (2008) also found that Indian stock market was not co-integrated with other markets. These results were also supported by some other studies like Ng, 2002 and Daly, 2003.

## DATA AND METHODOLOGY

The aim of this paper is to investigate dynamic linkages of Indian Stock Market with Asian equity markets. The study uses monthly data of Asian stock market indices over the period July 1997 to September 2012 covering 183 samples. List of Asian countries and their respective stock market indices which study take into consideration are presented in Table 1. Time series data for all stock market indices are collected from Yahoo Finance.

**Table 1: Description of Stock Market Indices**

<b>Name of Country</b>	<b>Name of Index</b>	<b>Description of Index</b>
India	BSESN	BSE Sensex
Pakistan	KSE 100	Karachi Stock Exchange Index
Sri Lanka	CSEALL	Colombo Stock Exchange All Share Index
Malaysia	KLSE	Kuala Lumpur Stock Exchange Composite Index
Korea	KS11	KOSPI Composite Index
Japan	N225	NIKKEI 225
Singapore	STI	Straits Times Index
Taiwan	TWII	Taiwan Capitalization Weighted Stock Index
China	SSE	Shanghai Stock Exchange Composite Index

Correlation coefficients are used for examining short-run co-movements and multicollinearity among Asian stock market indices. As an essential step of Vector Error Correction Model, first, Augmented Dickey –Fuller (ADF) (1979, 1981) test has been applied. It is based on simple logic that non-stationary process has infinite memory as it does not show decay in a shock. The complete model with deterministic terms such as intercepts and trends is shown in equation (1):

$$\Delta Y_t = \alpha + \pi + \delta \sum Y_{t-1} + \sum_{i=1}^m \beta_i \Delta X_{t-1} + \epsilon_t \quad (1)$$

The null hypothesis of ADF unit root test is  $H_0: Y_t$  is not  $I(0)$ . If the calculated ADF statistic is less than the critical value, then the null hypothesis is rejected; otherwise accepted. If the variable is non-stationary at level, the ADF test will be performed at the first difference. In the second step, the Johansen's cointegration test (Johansen and Juselius, 1990) has been applied to check whether the long run equilibrium relationship exists among Asian indices. This test is based on two test statistics, viz., trace statistic, and maximum eigen value statistic. The trace statistic can be specified as:

$$Trace(r, k) = -T \sum_{i=r+1}^k \ln(1 - \lambda_i) \quad (2)$$

where  $\lambda_i$  is the  $i$ th largest eigen value of matrix  $\Pi$ , and  $T$  is the number of observations. In the trace test, the null hypothesis is that the number of distinct co-integrating vector(s) is less than or equal to the number of cointegration relations ( $r$ ). The maximum eigen value test examines the null hypothesis of exactly  $r$  cointegrating relations against the alternative of  $r + 1$  cointegrating relations with the test statistic:

$$\lambda_{\max}(r, r+1) = -T \ln(1 - \lambda_{r+1}) \quad (3)$$

Granger Causality test (Engle and Granger, 1987) has used following bi-variate regression model to find out direction of causality.

$$Y_t = \alpha_0 + \sum_{i=1}^m \alpha_i Y_{t-i} + \sum_{j=1}^n \beta_j X_{t-1} + \epsilon_t \quad (4)$$

$$X_t = \omega_0 + \sum_{i=1}^m \gamma_i Y_{t-i} + \sum_{j=1}^n \theta_j X_{t-1} + \epsilon_t \quad (5)$$

If all the coefficients of  $X$  in first regression equation of  $Y$ , i.e.  $\beta_j$  for  $j=1, \dots, n$  are significant, then the null hypothesis that  $X$  does not cause  $Y$  will be rejected.

In the final stage, Vector Error Correction Model (VECM) is applied to incarcerate both short and long run relationship among stock market indices. This model may have constant and / or trend in short run (i.e. Vector Auto Regression) and constant and / or trend in long run (i.e. Co-

Table 2: Descriptive Statistics of Stock Market Indices

	IND	PAK	SRI	MAL	KOR	JAP	SING	TAI	CHI
Mean	9314.35	6560.26	2180.34	972.66	1140.95	12720	2235.53	6896.86	2064.2
Median	6555.94	5865.01	1638.06	896.13	970.21	11715.39	2125.25	7024.06	1747.99
Maximum	20509.09	15391.58	7797.96	1646.11	2192.36	20337.32	3805.7	10066.4	5954.77
Minimum	2810.66	841.7	403.6	302.91	297.88	7568.42	856.43	3636.94	1060.74
Std. Dev.	5969.38	4685.42	1940.23	328.58	532.51	3339	667.48	1455.71	931.88
Skewness	0.44	0.22	1.32	0.45	0.32	0.38	0.24	-0.07	1.64
Kurtosis	1.56	1.56	3.77	2.12	1.75	1.86	2.05	2.26	6.1
Jarque-Bera	21.83	17.21	58.06	12.2	15.04	14.35	8.52	4.38	155.01
Probability	0	0	0	0	0	0	0.01	0.11	0

Table 3 Pair wise Pearson Coefficient of Correlation

	IND	PAK	SRI	MAL	KOR	JAP	SING	TAI	CHI
IND	1	0.92	0.87	0.94	0.97	-0.23	0.91	0.5	0.74
PAK	0.92	1	0.79	0.89	0.93	-0.19	0.88	0.39	0.65
SRI	0.87	0.79	1	0.89	0.87	-0.4	0.74	0.41	0.46
MAL	0.94	0.89	0.89	1	0.96	-0.24	0.91	0.53	0.68
KOR	0.97	0.93	0.87	0.96	1	-0.22	0.93	0.49	0.7
JAP	-0.23	-0.19	-0.4	-0.24	-0.22	1	0.06	0.51	0
SING	0.91	0.88	0.74	0.91	0.93	0.06	1	0.62	0.77
TAI	0.5	0.39	0.41	0.53	0.49	0.51	0.62	1	0.45
CHI	0.74	0.65	0.46	0.68	0.7	0	0.77	0.45	1

integrating Equation). General specification form of VECM is as follow:

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \dots + \Gamma_k - 1 \Delta Z_{t-k} - 1 + \alpha (\beta \mu_1 \delta_1) (Z_{t-1} - \mu_2 + \delta_2 t + \mu t)$$

Where, Z is Vector of 'K' co-integrating variables.  $\alpha$  is Speed of adjustment to equilibrium coefficient.  $\mu_1$ ,  $\beta$ ,  $\delta_1$  are Constant, Coefficient of variable and Coefficient of trend of Co-integrating Equation respectively.  $\mu_2$ ,  $\Gamma$ ,  $\delta_2$  are Constant, Coefficient of variables and Coefficient of trend of VAR respectively.

## EMPIRICAL ANALYSIS

First, Descriptive statistics like Skewness, Kurtosis, Jarque-Bera Statistic, and Probability Value are calculated for all stock market indices. Results of the same are presented in Table 2.

From table 2, it is clear that Stock market index of Taiwan is negatively skewed, while all other indices are positively skewed. Kurtosis values reveal that Sri Lankan and Chinese stock market indices follow Leptokurtic distribution while all other stock market indices follow Platykurtic distribution. Jarque-Bera statistic tests the null hypothesis that data follow normal distribution. By using probability values of Jarque-Bera statistics, null hypothesis is rejected for all stock market indices except Taiwan at 5% level of significance. This shows randomness and inefficiency of the market.

Result of Correlation analysis among equity market indices is reported in Table 3. It indicates that Indian Stock market is highly positively correlated with stock markets of Pakistan, Sri Lanka, Malaysia, Korea and Singapore. As the coefficient of correlation between these stock markets are higher than 0.8, there is a possibility of multicollinearity among these indices. While stock markets of Taiwan and China are moderately positively correlated with Indian stock market. However, Japanese stock market is negatively correlated with Indian stock market.

Result of ADF unit root test is reported in table 4. The null hypothesis of no unit root for all stock market indices are not rejected at level in both the model (i.e. constant and constant & trend) but it is rejected at first difference because ADF test statistic values are lower than the critical values at first difference. Thus, all Asian stock market indices are first difference stationary series or integrated of order one, i.e., I(1).

**Table 4: Results of Augmented Dickey-Fuller Unit Root Test**

	Level		First Difference	
	Constant	Constant & Trend	Constant	Constant & Trend
Name of Variable	ADF Test Value	ADF Test Value	ADF Test Value	ADF Test Value
IND	-0.618776	-2.424621	-13.18246*	-13.15669*
PAK	-0.132678	-2.028415	-11.84015*	-11.84455*
SRI	-0.154889	-3.418123	-11.11469*	-11.15782*
MAL	-0.279054	-3.070292	-11.82243*	-11.83403*
KOR	-0.766874	-2.899625	-12.58103*	-12.55872*
JAP	-2.16491	-2.16688	-12.84108*	-12.80379*
SING	-1.31091	-2.491017	-12.29649*	-12.26506*
TAI	-2.886704	-3.072252	-8.083871*	-8.070485*
CHI	-2.580911	-3.004631	-7.133137*	-7.131174*

\* Indicates ADS test value is significant at 1% level of significance.

For constant model, critical values at 1%, 5% and 10% level of significance are -3.4639, -2.8705 and -2.5770 respectively,

For constant and trend model, critical values at 1%, 5% and 10% level of significance are -4.0199, -3.4398 and -3.1443 respectively,

In the next step, the co-integration between non-stationary variables has been tested by the Johansen's Trace and Maximum Eigen value tests result is presented in table 5. This result indicates that at  $r=0$ , Trace Statistic and Maximum Eigen statistic values are higher than their respective critical values. Therefore, null hypothesis of no cointegration is rejected at  $r = 0$ , but first time it is not rejected at  $r = 1$ . Hence, both Trace and Maximum Eigen Value statistics indicate that one cointegrating equation exist at 5% level of significance.

Now, the Pair wise Granger causality test is performed among all pairs of Asian stock markets to determine direction of causality, but for space constrain, result of hypotheses which are rejected at 5% level of significance for Indian market are reported in Table 6. As the probability values for all these hypotheses are less than 0.05, null hypothesis of no causality are rejected at 5% level of significance. Study reveals that Indian stock market granger cause Pakistan stock market, while stock market of Sri Lanka, Korea, Singapore and China granger cause Indian stock market.

**Table 5: Results of Johansen's Co-integration Test**

Cointegration among the Variables	H0	Trace Statistic	5% Critical Value	Maximum Eigen Statistic	5% Critical Value
IND, PAK, SRI, MAL, KOR, JAP, SING, TAI AND CHI	r = 0	206.6694*	197.3709	62.16840*	58.43354
	r ≤ 1	144.5010	159.5297	48.24245	52.36261
	r ≤ 2	96.25856	125.6154	27.41665	46.23142
	r ≤ 3	68.84191	95.75366	22.95009	40.07757
	r ≤ 4	45.89182	69.81889	19.47102	33.87687
	r ≤ 5	26.42081	47.85613	14.30264	27.58434
	r ≤ 6	12.11817	29.79707	6.497274	21.13162
	r ≤ 7	5.620894	15.49471	5.419575	14.26460
r ≤ 8	0.201319	3.841466	0.201319	3.841466	

\* indicates that test values are significant at 5% level of significance.

Trace test and Max-Eigen value test indicate 1 cointegrating eqn(s) at the 0.05 level.

**Table 6: Results of Granger Causality Tests**

Null Hypothesis	F-Statistic	Probability	Decision
IND does not Granger Cause PAK	6.82227	0.0014	Reject Null
SRI does not Granger Cause IND	3.22833	0.042	
KOR does not Granger Cause IND	5.84873	0.0035	
SING does not Granger Cause IND	4.64449	0.0108	
CHI does not Granger Cause IND	18.9958	3.00E-08	

As Johansen Cointegration test suggested that stock market indices are cointegrated, use of Vector Autoregressive (VAR) model for estimation might be a misspecification of the model. Therefore, for estimating these indices, study applied Vector Error Correction Model and the result of the same is presented in Table 7. The coefficients of cointegrating equation which represent the speed of adjustment in the next month to maintain the long run equilibrium condition between Indian stock market and all other Asian stock markets is significant. This negative coefficient represents that positive long run equilibrium relationship exist between Indian and other

Table 7: Results of Vector Error Correction Model

	D(IND)	D(PAK)	D(SRI)	D(MAL)	D(KOR)	D(JAP)	D(SING)	D(TAI)	D(CHI)
C	23.88 (56.09)	56.0624 (43.299)	17.3064 (15.313)	3.81878 (4.1395)	7.20612 (6.2123)	-50.0556 (56.634)	-0.47221 (11.217)	-24.9552 (39.234)	0.64018 (17.669)
CointEq1	<b>-0.093</b> * (0.035)	0.00752 (0.0270)	0.0377* (0.0095)	0.00292 (0.0025)	0.00472 (0.0038)	0.04483 (0.0353)	-0.01017 (0.0070)	0.01288 (0.0245)	-0.00811 (0.0110)
D(IND(-2))	-0.4094 (0.0933)				-0.04657 (0.0103)	-0.28834 (0.0942)	-0.05456 (0.0186)	-0.17369 (0.0652)	
D(PAK(-1))					0.02349 (0.0103)	0.21021 (0.0945)		0.17264 (0.0654)	
D(PAK(-2))		-0.15098 (0.0744)	0.05326 (0.0263)						
D(SRI(-2))	1.1278 (0.2947)				0.07059 (0.0326)		0.14611 (0.0589)		
D(MAL(-2))		2.23697 (0.9836)							
D(JAP(-2))	-0.25193 (0.0918)								
D(SING(-2))	1.51004 (0.6233)								
D(TAI(-1))					0.04082 (0.0167)	0.40849 (0.1522)			
D(TAI(-2))									0.09616 (0.0469)
D(CHI(-2))	1.58254 (0.2755)	0.98865 (0.2127)	0.15626 (0.0752)	0.04428 (0.0203)	0.15559 (0.0305)		0.18734 (0.0551)	0.45645 (0.1927)	0.27213 (0.0867)

\* indicates that coefficient of Error Correction Term are significant at 5% level of significance.

Values in parenthesis are standard error of the respective coefficient.

stock markets. Short run movements between these indices are captured by lagged difference terms of market indices which again implied that in short run Indian stock market is affected by its own lagged values as well as by lagged value of stock markets of Sri Lanka, Japan, Singapore and China.

## FINDINGS

This paper investigates the dynamic linkages of Asian equity markets with Indian stock market using monthly data from July 1997 to September 2012. The empirical analyses find five interesting results. First, Indian Stock market is highly positively correlated with stock markets of Pakistan, Sri Lanka, Malaysia, Korea and Singapore. Second, all Asian stock market indices are stationary at first difference. Third, study finds long run equilibrium relationship among Asian equity market indices. Therefore, stock market indices of Asian countries will move together in long run and portfolio diversification within Asian markets will be futile. But at the same time close supervising on the movements of these equity markets is required to circumvent Indian stock market against depressing consequences. Fourth, granger causality test reveals that Indian stock market granger cause Pakistan Stock market, while Indian stock market is granger caused by stock markets of Sri Lanka, Korea, Singapore and China. Hence, changes in the stock markets of Sri Lanka, Korea, Singapore and China precede the Indian stock market. Besides Pakistan stock market is preceded by Indian stock market. One possible reason for such causation might be that market capitalizations of Chinese, Korean and Singapore stock markets are higher while market capitalization of Pakistan stock market is lower than Indian stock market. Fifth, result obtained from VECM suggests that lagged value of stock markets of Sri Lanka, Japan, Singapore and China affect Indian stock market.

## CONCLUSION

The findings of this study have some important policy implications. First Indian portfolio manager can use Japanese market for portfolio diversification, because they are negatively correlated with each other. Second, study supported the previous result that dynamic linkages exist between Indian stock market and other Asian equity markets (Johnsen & Soenen, 2002; Chi, Li & Young, 2006; Marimuthu, 2010; Srikanth, 2012).

Hence, portfolio diversification within Asian countries may not aid in risk minimization. But still, Indian government and regulatory bodies should monitor movements of other Asian equity markets very closely, because crisis in any Asian equity market may affect the performance of Indian stock market. Third, study revealed that causality exists among Asian equity markets, which is again in line with result obtained by previous studies (Bhattacharyya & Banerjee, 2004; Narayan, Smyth & Nandha, 2004). Fourth, study contributed to the existing body of literature of interdependence and causality between Indian stock market and Asian countries stock markets. Fifth, standard deviation of Indian stock market is highest among all Asian stock markets which might create hindrance for foreign investors (Poshakwale and Thapa, 2009). Thus, Security Exchange Board of India (SEBI) should undertake some actions to reduce the volatility (Risk) of Indian stock market. This may increase net foreign investments of India and ultimately these foreign investments can be utilized for the development of Indian economy. Finally autonomous regulatory bodies and visionary system of government can definitely contribute in efficient working and development of Indian Stock Market. The results obtained in this study are based on monthly data of stock market indices used in this study. Use of some other indices of the same countries or different frequency of data may generate different results. Therefore one needs to be cautious before generalizing the results. In future more robust analysis can be done by reducing the frequency of data which will help in validating the result of this study.

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## REFERENCES

- Bhattacharyya, M. & Banerjee, A. (2004). Integration of global capital markets: An empirical exploration. *International Journal of Theoretical and Applied Finance*, 7(4), 385-405.
- Bhunia, A. (2011). Interdependence between Indian and other South-East stock market. *International Journal of Marketing, Financial Services and Management Research*, 1(6), 76-83.

- Brailsford, T. J., Penm, J. H. W. & Terrell, R. D. (2006). An analysis of Asian market integration pre and post-crisis. *International Journal of Theoretical and Applied Finance*, 9(4), 483-501.
- Cheng, H. & Glascock, J. L. (2006). Stock market linkages before and after the Asian financial crisis: Evidence from three greater China economic area stock markets and the US. *Review of Pacific Basin Financial Markets and Policies*, 9(2), 297-315.
- Chi, J., Li, K. & Young, M. (2006). Financial integration in East Asian equity markets. *Pacific Economic Review*, 11(4), 513-526.
- Daly, K. J. (2003). South-East Asian stock market linkages- Evidence from pre and post October 1997. *ASEAN Economic Bulletin*, 20(1), 73-85.
- 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(366a), 427-431.
- Dickey, D. A. & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica: Journal of the Econometric Society*, 49(4), 1057-1072.
- Dungey, M., Fry, R. & Martin, V. L. (2003). Equity transmission mechanisms from Asia to Australia: Interdependence or contagion? *Australian Journal of Management*, 28(2), 157-182.
- Engle, R. F. & Granger C. W. J. (1987). Co-integration and error-correction: Representation, estimation and testing. *Econometrica*, 55(2), 251-276.
- In, F., Kim, S., Yoon, J. H. and Vincy, C. (2001). Dynamic interdependence and volatility transmission of Asian stock markets evidence from Asian crisis. *International Review of Finance Analysis*, 10, 87-96.
- Jeyanthi, B. J. Q. & Pandian, P. (2008). An empirical study of Co-integration and correlation among Indian, emerging and developed markets, *The ICFAI Journal of Applied Finance*, 14(11), 35-47.
- Ji, P. I. (2011). The impact of Asian crisis on market integration: Evidence from East Asian real interest rate. *Applied Economics Letters*, 18(3), 245-249.
- Johansen, S. & Juselius, K. (1990). Maximum likelihood estimation and inference on co-integration with applications to the demand for money. *Oxford Bulletin of Economics and Statistics*, 52(2), 169-210.
- Johnson, R. & Soenen, L. (2002). Asian economic integration and stock market co-movement. *The Journal of Financial Research*, 25(1), 141-157.

- Joshi, P. (2011). Market integration and efficiency of Indian stock markets: A study of NSE. NSE Paper No. 198, 1-29.
- Kumar, K. K. & Mukhopadhyay, C. (2002). A case of US and India. NSE Paper No. 39, 1-28.
- Lamba, A. (2004). An analysis of the dynamic relationships between South Asian and developed equity markets. NSE Paper No. 83, 1-29.
- Lin, M. C. (2005). Capital market integration and market liberalization in Asian emerging markets. *International Journal of Management*, 22(2), 249-265.
- Marimuthu, M. (2010). The co-movements of the regional stock markets and some implications on risk diversification, *The IUP Journal of Applied Economics*, 9(2), 61-80.
- Mukherjee, K. & Mishra, R. K. (2007). International stock market integration and its economic determinants: A study of Indian and world equity markets. *Vikalpa*, 32(4), 29-44.
- Mukherjee, P. & Bose, S. (2008). Does the stock market in India move with Asia? A multivariate co-integration-vector auto-regression approach. *Emerging Markets Finance & Trade*, 44(5), 5-22.
- Narayan, P., Smyth, R. & Nandha, M. (2004). Interdependence and dynamic linkages between the emerging stock markets of South Asia. *Accounting and Finance*, 44(3), 419-439.
- Nath, G. C. & Verma, S. (2003). Study of common stochastic trend and co-integration in the emerging markets a case study of India, Singapore and Taiwan. NSE Paper No. 72, 1-24.
- Ng, T. H. (2002). Stock market linkages in south-east Asia. *Asian Economic Journal*, 16(4), 353-377.
- Padhi, P. (2011). On the linkages among selected Asian, European and the US implied volatility indices. NSE Working Paper No. 3, 1-35.
- Poshakwale, S. S. & Thapa, C. (2009). The impact of foreign equity investment flows on global linkages of the Asian emerging equity markets. *Applied Financial Economics*, October, 19(22), 1787-1802.
- Raj, J. & Dhal, S. C. (2009). Is India's stock market integrated with global and major regional markets? *The ICFAI Journal of Applied Finance*, 15(2), 5-37.
- Raju, G. A. & Khanapuri, H. R. (2009). Regional integration of emerging stock markets in Asia: Implications for international investors. *The Journal of Investing*, Fall, 18(3), 31-39.
- Sahaand, M. & Bhunia, A. (2011). Modeling dynamic financial market integration: An empirical study on equity markets in India and se-

lect south Asian countries. *International Journal of Contemporary Business Studies*, 2(12), 39-49.

- Siddiqui, S. (2008). Exploring integration between selected European stock market indexes and senscx. *Pranjana*, 11(2), 79-90.
- Siddiqui, S. (2009). Examining associations between S&P CNX nifty and selected Asian & US stock markets. *Vision: The Journal of Business Perspective*, 13(1), 19-30.
- Singh, P., Kumar, B. & Pandey, A. (2008). Price and volatility spillovers across North American, European and Asian stock markets: With special focus on Indian stock market, Working Paper No.2008-12-04, 1-45. IIM Ahmedabad.
- Srikanth, P. (2012). Integration of Indian stock market with other markets in the Asia-Pacific region. *The IUP Journal of Financial Economics*, 10(1), 18-32.
- Wong, W. K. (2004). The relationship between stock markets of major developed countries and Asian emerging markets. *Journal of Applied Mathematics and Decision Sciences*, 8(4), 201-218.