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MANAGEMENT OF SHOCK AND VOLATILITY SPILLOVER EFFECTS ACROSS EQUITY MARKETS: A CASE STUDY OF INDIA, SINGAPORE AND SOUTH KOREA

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ABSTRACT

This paper analyzes own and cross shock-volatility spillover effect among the very well known three Asian Stock Exchange Markets namely India, Singapore and South Korea during boom period, global recession period and post recession period. We use a multivariate BEKK-GARCH model to identify the source and magnitude of spillovers. The empirical analysis showed that the markets exhibit strong own shock (ARCH) and volatility (GARCH) effects in all the above mentioned three periods while regarding cross market spillover effect, India is playing a leading role in transmission of both Shocks as well as Volatility effect to the Singapore and South Korea markets. Thus, the international investors need to consider this strong integration regarding shock and volatility effects which reduce potential gains from international portfolio.

Keywords: Multivariate GARCH-BEKK Model, Global Financial Crisis, Stock Market Integration, Volatility Spillover.

1. INTRODUCTION

In the present scenario, the financial markets in both developed as well as developing economies are experiencing extensive deregulation and liberalization. Information and communication technology as well as the innovation of the several financial products are also developing quite rapidly. All these factors individually and jointly promote the global equity markets integration. Meanwhile, in the past decades, the events of the financial crises have frequently happened, and every financial crisis is the turning point of economic cycle. For instance, Black Monday of 1987, Japanese Asset Price Bubble Collapse of 1991, Asian Financial Crisis of 1997, Dot Com Bubble of 2001 and Global Financial Crisis of 2007-2010. Owing to these aforesaid backgrounds, the topic about the dynamic linkages among different stock markets has received great attention in developed as well as developing economies of the Financial World. Researchers usually examine the cross-country interactions in both short-run and long-run while referring to international equity markets integrations. Moreover, they not only investigate the return causality linkages, but volatility spillovers effects too. The findings about dynamic links among different stock markets are important for numerous reasons. Firstly, the fundamental argument of Capital Asset Pricing Model (CAPM) suggests that the market risks of the asset are not able to be eliminated. Therefore, whether investors can diversify risk by investing in the transmultinational equities largely depends on the degree of co-movements among different stock markets. Secondly, if the returns causality exists among different stock indices, investors can exploit trading strategy to get profit even during financial turbulent periods. Thirdly, information about volatility spillover effects help to price options and optimize portfolios. Under financial crises, the discovery of volatility spillover is useful for the application of value at risk and hedging strategies. Finally, the assessment about the cross-country integration helps policy makers to monitor the potential for the financial contagion and control international capital flows, and finally make effective regulations to stabilize international financial system (Ng 2000).

We are trying to find out shock and volatility spillover effects during boom period, global recession period and also in the post recession period of three important emerging markets of Asia namely India, Singapore and South Korea. Our objective of this study is to analyze the own and cross shock-volatility spillover effects between these markets in three different time periods. It will provide insight to portfolio managers in designing their diversification strategy.

This paper considers a volatility spillover model by applying a bivariate BEKK-GARCH model of Engle and Kroner (1995), for which a BEKK representation is adopted, for each of the South East Asian countries against the US which is using daily returns for the last-10 years. This BEKK formulation enables us to reveal the existence of any transmission of shock and volatility from one market to another.

LITERATURE REVIEW

In the previous literature, studies have been conducted on volatility spillovers among developed markets (Hamao, Masulis and Ng, 1990; Karolyi, 1995; Koutmos and Booth, 1995). Subsequently, global stock market linkages have been widely studied for the developed markets and some emerging markets in Asia, South America and emerging Europe (Ng, 2000; Edwards and Susmel, 2001; Tse, Wu and Young, 2003; Kanokwan and Dibooglu, 2006; Chung, Lu and Tswei, 2007; Li and Majerowska, 2008; Beirne et al., 2010; Wang and Wang, 2010). The extent of the global linkage of emerging markets provides great implications to the international portfolio investors. It is clear that increasing global market linkage or co-movement reduces the independence of emerging markets from external shocks, hence eliminating the potential benefits of diversification into emerging markets.

Much work has focused on the impact of financial crisis on volatility spillovers and supports the hypothesis that the financial crisis resulted in market liberalization, integration, and volatility transmission. In et al. (2001) found that Hong Kong played an important role in the transmission of volatility to other Asian markets during the financial crisis. Nam, Yuhn and Kim (2008) investigated how the 1997 Asian crisis has changed Asian emerging markets by focusing on volatility spillovers. They found that the influence of US innovations on stock prices in this region increased after the crisis. Saleem (2009) examined the impact of Russia's 1998 financial crisis on the international linkage of the Russian market. They suggested that after the crisis, the Russian market showed a bi-directional connection with US and Asia, and unidirectional relationship with emerging Europe.

Manex Yonis (2011) investigated the co-movement and existence of volatility spillover of the US and South African stock markets He found evidence of return spillover from NYSE to JSE and volatility spillover between US and SA is persistence. Unidirectional link regarding transmission of shocks and volatility persistence between NYSE and JSE is revealed, the direction is from NYSE to JSE.

Indika Priyadarshani Karunanayake Athukoralalage (2011) examined the transmissions of volatility of Australian stock market and other international markets during two financial crises (the Asian Financial Crisis of 1997 and the Global Financial Crises of 2007-2010). There exists a significant influence arising from both crises on volatility in all four markets. Although, both crises impacted on increasing own- volatility in these four markets, only the recent GFC contributed to increase the cross-volatilities across these four markets.

DATA AND METHODOLOGY

The database consists of daily closing prices for three countries' stock markets indices namely India-CNX Nifty (National Stock Exchange), Singapore-STI (Singapore Stock Exchange) and South Korea-KOSPI (Korea Stock Exchange) from January 2003 to F.Yr 2012.The sample data is retrieved from Yahoo Finance website. The whole period data is divided into three different sub-periods which are as follows:

- 4 years and 7 months sample period: January 2003 – July 2007(Boom Period)
- 2 years and 8 months sample period: August 2007 – March 2010 (Recession Period)
- 3 years sample period: April 2010 – F.Yr 2012 (Post-Recession Period)

MULTIVARIATE BEKK-GARCH MODEL

To ensure positive definiteness, a new parameterization of the conditional variance matrix Ht was defined by Baba, Engle, Kraft and Kroner (1990) and thus came to be known as the BEKK model, which is viewed as another restricted version of the VEC model. It achieves the positive definiteness of the conditional co-variance by formulating the model in a way that this property is implied by the model structure. The form of the BEKK model is as follows

$$vech(H_t) = c + \sum_{j=1}^{q} A_j vech(\varepsilon_{t-j}\varepsilon'_{t-j}) + \sum_{j=1}^{p} B_j vech(H_{t-j}) ,$$

Where $A_{kj,}$ $B_{kj,}$ and C are N × N parameter matrices and C is a lower triangular matrix. The purpose of decomposing the constant term into a product of two triangular matrices is to guarantee the positive semi-definiteness of Ht. Whenever K > 1 an identification problem would be generated for the reason that there are not only a single parameterization that can obtain the same representation of the model.

The first-order BEKK model is

$$H_t = CC' + A'\varepsilon_{t-1}\varepsilon'_{t-1}A + B'H_{t-1}B.$$

The symmetric matrix A captures the ARCH effects, the elements a_{ij} of the symmetric matrix A measure the degree of innovation from market i to market j. While the matrix B focuses on the GARCH effects, the elements bij in matrix B represents the persistence in conditional volatility between market i and market j (Worthington and Higgs 2004). In other words, the diagonal parameters in matrices A_i and B_i– a_{11}, a_{22} and b_{11}, b_{22} capture the effects of own past shocks and volatility on its current conditional variance. The off-diagonal parameters in matrices A_i and Bi, a_{ij} and b_{ij}, measure the cross-market influences on the conditional variances and co-variances, which is also known as "volatility spillover" effects.

The BEKK model also has its diagonal form by assuming that A_{kj}, B_{kj} matrices are diagonal. It is a restricted version of the DVEC model. The most restricted version of the diagonal BEKK model is the scalar BEKK one with A = aI and B = bI where and b are scalars.

In this present research paper 1, 2 and 3 represents India, Singapore and South Korea respectively.

Estimation of a BEKK model still bears large computations due to several matrix transpositions. The number of parameters of the complete BEKK model is $(p+q)\ KN^2+N\ (N+1)/2$. Even in the diagonal one, the number of parameters soon reduces to $(p+q)\ K\times N+N\times(N+1)/2$, but it is still large. The BEKK form is not linear in parameters, which makes the convergence of the model difficult. However, the strong point lies in that the model structure automatically guarantees the positive definiteness of Ht. Under the overall consideration, it is typically assumed that p = q = K = 1 in BEKK form's application.

EMPIRICAL ANALYSIS

The following tables show the descriptive statistics for the sample returns in the three sub-sample periods. As shown that the return series during global recession period is more volatile than that in the boom and post recession period as all standard deviations during recession period are higher. All skewness and kurtosis exhibit larger values and the J-B test statistics is highly significant at the l% level, indicating the distribution of all returns which are not distributed normally

Table 1: Combined Descriptive Statistics

Year	**2003-2007**			**2007-2010**			**2010-2012**		
Index	**Nifty**	**STI**	**KOSPI**	**Nifty**	**STI**	**KOSPI**	**Nifty**	**STI**	**KOSPI**
Mean	0.1190	0.0820	0.0948	0.02740	0.0250	-0.013	0.0091	0.0149	0.0196
Std. Dev	1.4320	0.8895	1.2875	2.25256	1.7907	1.9198	1.0753	0.8731	1.1866
Skewness	-1.090	-0.413	-0.340	0.14062	0.1789	-0.486	0.0627	-0.407	-0.443
Kurtosis	11.747	5.0497	4.724	9.00986	6.4992	8.7018	3.6800	5.0359	6.474
Jar-Bera	4016.57	241.39	169.87	1039.17	355.19	960.47	15.560	156.45	418.56
Prob	0	0	0	0	0	0	0	0	0

UNIT ROOT TEST

Table provides the results of two types of unit root test for each of the sample returns: the augmented Dickey-Fuller (ADF) and Phillips-Peron (PP) tests. Large negative values for the ADF and PP test statistics reject at 1 % level of significance the null hypothesis of a unit root, implying that all sample return series are stationary processes in the three sub-sample periods.

Table 2: Unit Root Test for Return Series (2003-2007)

Variables	Augmented Dickey-Fuller Test Intercept	Phillips-Perron Test Intercept
	Level	**Level**
NIFTY	-25.64149	-32.0479
STI	-33.58194	-33.62041
KOSPI	-33.28378	-33.26645

Critical values of ADF & PP test statistics for 1%, 5% and 10% level of significance are -3.43319, -2.8626 and - 2.56742 respectively

Table 3: Unit Root Test for Return Series (2007-2010)

Variables	Augmented Dickey-Fuller Test Intercept	Phillips-Perron Test Intercept
	Level	**Level**
NSE	-25.15776	-25.13608
STI	-26.87218	-26.86638
KOSPI	-26.05405	-26.05401

Critical values of ADF & PP test statistics for 1%, 5% and 10% level of significance are -3.43319, -2.86268 and -2.56742 respectively

Table 4: Unit Root Test for Return Series (2010-2012)

Variables	Augmented Dickey-Fuller Test Intercept	Phillips-Perron Test Intercept
	Level	**Level**
NSE	-27.26535	-27.2827
STI	-27.56776	-27.57537
KOSPI	-27.58222	-27.65339

Critical values of ADF & PP test statistics for 1%, 5% and 10% level of significance are -3.43319, -2.86268 and - 2.56742 respectively

CORRELOGRAM OF SQUARED RETURN SERIES

We examine the null hypothesis of a white-noise process for sample returns using the L-Jung Box test statistic, with a lag of 16 for the squared returns. This implies the squared returns of the three market indices exhibit significant signs of serial correlation indicate that significant linear and nonlinear dependencies exist.

Table 5: L-Jung Box test Q-statistic (2003 – 2007)

Lags	Nifty RTN SQ		STI RTN SQ		KOSPI RTN SQ	
	Q-Stat	Prob	Q-Stat	Prob	Q-Stat	Prob
1	5.5527	0.018	5.9064	0.015	1.6393	0.2
2	13.979	0.001	17.116	0.000	72.447	0.0
3	14.027	0.003	40.558	0.000	87.129	0.0
4	20.714	0.000	49.543	0.000	108.65	0.0
5	20.714	0.001	78.756	0.000	151.93	0.0
6	21.911	0.001	92.926	0.000	167.35	0.0
7	28.124	0.000	115.58	0.000	201.84	0.0
8	28.131	0.000	122.65	0.000	204.56	0.0
9	30.437	0.000	144.54	0.000	230.15	0.0
10	37.405	0.000	166.84	0.000	240.94	0.0
11	37.406	0.000	174.81	0.000	256.89	0.0
12	40.88	0.000	185.11	0.000	271.68	0.0
13	46.496	0.000	197.31	0.000	291.56	0.0
14	46.624	0.000	197.99	0.000	331.18	0.0
15	46.637	0.000	206.26	0.000	359.68	0.0
16	51.621	0.000	211.42	0.000	377.86	0.0

Table 6: L-Jung Box test Q-statistic (2007 – 2010)

Lags	Nifty RTN SQ		STI RTN SQ		KOSPI RTN SQ	
	Q-Stat	Prob	Q-Stat	Prob	Q-Stat	Prob
1	3.3935	0.065	13.374	0	23.145	0
2	11.400	0.003	93.356	0	63.801	0
3	14.166	0.003	108.25	0	67.291	0
4	18.888	0.001	154.38	0	156.78	0
5	29.189	0.000	172.28	0	232.60	0
6	33.699	0.000	202.11	0	300.83	0
7	40.370	0.000	206.98	0	303.17	0
8	41.546	0.000	228.43	0	323.94	0
9	46.573	0.000	252.40	0	340.37	0
10	59.734	0.000	284.02	0	413.09	0
11	60.903	0.000	290.98	0	421.84	0
12	64.763	0.000	306.59	0	439.63	0
13	65.661	0.000	320.84	0	442.57	0
14	68.552	0.000	352.00	0	454.64	0
15	72.011	0.000	369.79	0	473.98	0
16	72.320	0.000	381.14	0	492.11	0

Table 7: L-Jung Box test Q-statistic (2010 – 2012)

Lags	Nifty RTN SQ		STI RTN SQ		KOSPI RTN SQ	
	Q-Stat	Prob	Q-Stat	Prob	Q-Stat	Prob
1	0.1626	0.687	13.194	0	18.616	0
2	0.4271	0.808	47.528	0	103.47	0
3	13.890	0.003	82.709	0	124.76	0
4	16.890	0.002	96.498	0	138.61	0
5	23.475	0.000	122.61	0	166.63	0
6	25.813	0.000	128.66	0	194.09	0
7	31.821	0.000	145.84	0	220.21	0
8	41.372	0.000	184.19	0	233.54	0
9	50.449	0.000	200.04	0	286.18	0
10	50.478	0.000	234.45	0	305.18	0
11	62.392	0.000	256.67	0	348.87	0
12	66.895	0.000	261.19	0	367.54	0
13	67.660	0.000	278.24	0	399.74	0
14	74.351	0.000	282.50	0	447.86	0
15	74.834	0.000	300.78	0	458.99	0
16	80.795	0.000	331.39	0	475.46	0

Testing of ARCH effect in standardized residuals up to 4 lags

Table 8: Return Square Series of NSE STI and KOSPI (2003-2007)

Index	F-Statistics	P-value	Obs R Squared	P-value
CNXNIFTY	23.88599	0.000	88.74581	0.0000
STI	3.099156	0.015	12.31953	0.0151
KOSPI	17.72515	0.000	67.15639	0.0000

Table 9: Return Square Series of NSE, STI and KOSPI (2007-2010)

Index	F-Statistics	P-value	Obs R Squared	P-value
CNXNIFTY	0.007189	0.9999	0.028965	0.9999
STI	8.884698	0.0000	34.02202	0.0000
KOSPI	34.97381	0.0000	116.8786	0.0000

Table 10: Return Square Series of NSE, STI and KOSPI (2010-2012)

Index	F-Statistics	P-value	Obs R Squared	P-value
CNXNIFTY	2.902153	0.0211	11.51071	0.0214
STI	12.78935	0.0000	48.28882	0.0000
KOSPI	10.57508	0.0000	40.36269	0.0000

The LM test statistic shows that there is evidence for ARCH effect and time varying volatility for the three countries in all time frames except for Nifty in (2007-2010) while L-Jung Box Q-Statistics Test shows the presence of ARCH effect in all series in three sub sample periods. These results are in favour of a model that incorporates ARCH/GARCH features.

Table 11: Multivariate GARCH-BEKK (2003-2007)

Variable	Coeff	Std-Error	T-Stat	Signif
A(1,1)	0.350945	0.030849	11.37633	0.000000
A(1,2)	0.055931	0.014048	3.98149	0.000068
A(1,3)	0.07171	0.026262	2.73058	0.006322
A(2,1)	0.163944	0.056114	2.92164	0.003482
A(2,2)	0.156705	0.02583	6.06678	0.000000
A(2,3)	-0.00612	0.04356	-0.14061	0.888179
A(3,1)	-0.0735	0.054491	-1.34894	0.177356
A(3,2)	0.029168	0.020889	1.3963	0.162623
A(3,3)	0.210036	0.034358	6.11322	0.000000
B(1,1)	0.890255	0.016776	53.06618	0.000000
B(1,2)	-0.02501	0.005945	-4.20747	0.000025
B(1,3)	-0.03434	0.011804	-2.90936	0.003622
B(2,1)	-0.00193	0.015846	-0.12179	0.903063
B(2,2)	0.992405	0.00441	225.0428	0.000000
B(2,3)	0.012793	0.009062	1.41165	0.158052
B(3,1)	0.01591	0.016518	0.96319	0.335453
B(3,2)	-0.00703	0.005529	-1.27226	0.203281
B(3,3)	0.970115	0.009187	105.591	0.000000

1-India, 2-Singapore 3-South Korea

The off-diagonal elements of matrix A and B capture the cross-market effects such as Shock Spillover and Volatility Spillover among the three markets i.e. stock exchanges. First, we find evidence of bidirectional shock transmissions between NIFTY and STI at 1% significance level as the pair of off-diagonal parameter $a12$ and $a21$ is statistically significant. The two-way Shock Spillover indicates strong connection between the stock markets of Singapore and Korea. The bidirectional shock spillover indicates the news about shocks in one stock exchange affect the volatility of other stock exchange and vice versa. In terms of cross-shock spillover effects in the markets, past innovations in Singapore have more effect (0.164) on future volatility in India.

The significant $a13$ indicates uni-directional shock spillover from India (NIFTY) to Korea (KOSPI).Therefore among the three countries shocks arising in India stock market spillovers in Korea as well as Singapore stock markets. Own-Shock Spillovers i.e. a11, a22, and a33 in all markets are significant at 1% level. It is highest for India (0.372) and lowest for Korea (0.125).

Second, there are no bidirectional volatility linkages between the three countries. The significant coefficient $b12$ and b13 indicate uni-directional volatility spillover from India

(NIFTY) to Singapore (STI) and Korea (KOSPI) respectively. Own-volatility spillovers in all markets are large and significant. The overall persistence of stock market volatility is highest for Singapore (0.992) and lowest for India (0.890).

Table 12: Multivariate GARCH-BEKK (2007-2010)

Variable	Coeff	Std-error	T-Stat	Signif
A(1,1)	-0.29374	0.036531	-8.04088	0.0000000
A(1,2)	-0.02367	0.021437	-1.10413	0.2695370
A(1,3)	-0.0593	0.027531	-2.15378	0.0312570
A(2,1)	0.022232	0.025772	0.86266	0.3883230
A(2,2)	0.257254	0.026614	9.6662	0.0000000
A(2,3)	0.080259	0.019314	4.1554	0.0000320
A(3,1)	0.335817	0.037436	8.97036	0.0000000
A(3,2)	-0.01885	0.02427	-0.77671	0.4373310
A(3,3)	0.200654	0.025643	7.82487	0.0000000
B(1,1)	0.967432	0.008962	107.946	0.0000000
B(1,2)	0.003575	0.005922	0.60373	0.5460250
B(1,3)	0.007149	0.006517	1.09698	0.2726490
B(2,1)	-0.02831	0.0076	-3.72561	0.0001950
B(2,2)	0.964139	0.006823	141.302	0.0000000
B(2,3)	-0.04052	0.004733	-8.56009	0.0000000
B(3,1)	-0.03196	0.00658	-4.85666	0.0000010
B(3,2)	0.021906	0.004044	5.41753	0.0000006
B(3,3)	0.97554	0.00418	233.396	0.0000000

1-India, 2-Singapore 3-South Korea

We find evidence of bidirectional shock transmissions between India (NIFTY) and Korea (KOSPI) as the pair of off-diagonal parameter a13-a31 are statistically significant at 5% level. In terms of cross-shock spillover effects in the markets, past innovations in Korea have more effects (0.335) on future volatility in India. Own-shock spillovers coefficients a11, a22, and a33 in all markets are significant at 1% level. It is highest for Singapore (0.257) and lowest for Korea (0.200). However, before the recession it is highest for India.

Secondly, there are bidirectional volatility linkages between India (NSE) with Korea (KOSPI) and Singapore (STI). As pair of coefficients b23-b32 is statistically significant at 1% level. The significant *b*21 and b31 indicate uni-directional volatility spillover from Singapore (STI) to India (KOSPI) and Korea (KOSPI) to India (Nifty) at 1% level. Own-volatility spillovers coefficients b11, b22 and b33 in all markets are large and significant. The overall persistence of stock markets' volatility is highest for Korea (0.975) and lowest for Singapore (0.964).

Table 13: Multivariate GARCH-BEKK (2010-2012)

Variable	Coeff	Std Error	T-Stat	Signif
A(1,1)	-0.12483	0.067051	-1.86176	0.0626378
A(1,2)	0.141666	0.027224	5.20364	0.0000002
A(1,3)	0.102769	0.034887	2.94577	0.0032221
A(2,1)	0.153011	0.064443	2.37436	0.0175792
A(2,2)	0.04129	0.042227	0.97781	0.3281672
A(2,3)	-0.30468	0.050316	-6.05525	0.0000000
A(3,1)	0.291172	0.071366	4.07998	0.0000450
A(3,2)	0.026153	0.036046	0.72554	0.4681204
A(3,3)	0.244844	0.040919	5.9836	0.0000000
B(1,1)	-0.52949	0.159909	-3.31121	0.0009289
B(1,2)	0.30919	0.154409	2.00241	0.0452405
B(1,3)	-0.03272	0.160906	-0.20338	0.8388383
B(2,1)	1.349306	0.165016	8.17681	0.0000000
B(2,2)	0.687354	0.157697	4.35869	0.0000130
B(2,3)	0.063007	0.140862	0.44729	0.6546626
B(3,1)	-0.05899	0.117438	-0.50227	0.6154785
B(3,2)	0.014327	0.026251	0.54579	0.5852128
B(3,3)	0.957025	0.015076	63.4803	0.0000000

1-India, 2-Singapore 3-South Korea

We find evidence(s) of bidirectional shock transmissions between India (NSE) with Singapore (STI) India with Korea as the pairs of off-diagonal parameter a12-a21 and a13-a31 are statistically significant at 1% level. The two-way shock spillover indicates strong connection between the stock markets in the times of global recession. The bidirectional shock spillover indicates the news about shocks in one stock exchange affects the volatility of other stock exchange and vice versa. In terms of cross-shock spillover effects in the markets, past innovations in Korea have more effects (0.291) on future volatility in India. Own-shock spillovers coefficients a11, a22, and a33 in all markets are significant at 1% level. It is highest for Korea (0.245) and lowest for Singapore (0.041).

Secondly, there are bidirectional volatility linkages between India (NSE) and Singapore (STI). As pair of coefficients b12-b21 is statistically significant at 5% level .It indicates that the conditional variance of NSE index of India depends on past volatility of the STI indices of Singapore implying strong connection between them. No unidirectional volatility spillover effect was found among the three countries. Own-volatility spillovers coefficients b11, b22 and b33 in all markets are large and significant. The overall persistence of stock market volatility is highest for Korea (0.957) and lowest for India (-0.529).

CONCLUSION & FINDINGS

Keeping in mind this analytical study conducted over a period of several months by the researcher, it can be easily interpreted & concluded. I find out that in the pre-crisis period and in the post crises period we found bidirectional shock spillovers between the India and Singapore markets which means cointegration of these markets during in these two periods and unidirectional shock effect from India to Korea market while in global recession period both India and Singapore markets become independent but India is still spillover its shock effect to South Korea market.

In respect of volatility spillover effects we can conclude on the basis of this research that there is a unidirectional volatility spillover effects from India to Singapore and Korea in boom period and India to Singapore in post-recession period while during recession period there is a bi-directional volatility transmission effects between Singapore and Korea. Own Innovation (news) spillover effect is significant in all the periods of the three markets.It is Highest for India in boom period, for Singapore in recession period and for Korea in post-recession period. Own volatility spillover effect is significant in all the periods of the three markets. It is highest for Korea in recession and in post-recession period while it is highest for Singapore in boom period.

It can further be conclude conveniently that apparently India is playing a leading role in transmission of both shocks as well as volatility effect to the Singapore and Korea markets in all the three time frames i.e. boom, recession and post recession periods. Therefore, the international investors need to consider this strong integration regarding shock and volatility effects which reduce potential gains from international portfolio. The investors also need the trading strategy which consists of taking a position in one market following the signals given by the volatility of another market. A good understanding of the volatility spillover effects is an important ingredient for designing trading and hedging strategies and optimizing portfolios.

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