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Nexus of Asian Equity Markets and Global Financial Crisis

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Abstract

The purpose of this study is to examine the effect of Global Financial Crisis on interlinking connectivity of Asian equity markets. Weekly data of 12 major stock indices from 1st January, 2000 to 10th September, 2010 is used in the study. The impact of Global Financial Crisis 2007 on co-movement of Asian markets is analyzed by applying Rotated Factor Analysis technique. Results of the analysis revealed that Asian markets demonstrate a linear interaction. However, nexus of Asian markets stayed similar in pre-and post-financial crisis periods. Findings of the study can be used by Asian regional investors to construct their investment portfolios to minimize the systematic risk through diversification.

Keywords: Portfolio diversification; Factor analysis; Asian equity markets; Global Financial crisis

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1.0 INTRODUCTION

During this modern age of globalization, portfolio investors are interested in global as well as regional investment portfolios rather than local investment portfolios.[1] As Sharpe explained in his seminal paper that diversification can remove the unsystematic risk through making investment portfolios.[2] However, global portfolios are capable of reducing systematic risk.[3] Therefore, the investigation of the movement of international equity markets is one of the sources of information for investment portfolios and hedging decisions.

Portfolio diversification through Mean-variance approach is introduced by Markowitz in 1952[4] in his seminal paper "Portfolio Selection" and this framework was supported by many researchers thereafter.[5-8] Following this approach, international investors are interested in the stocks of those countries which are inversely related to one another. Among many researchers, some early researchers examined the co-movement among main financial markets to facilitate global investors in the selection of their portfolios.[9-11]

International capital movement was increased by mega globalization and financial liberalization since late 1980s, which enhanced the competitiveness of firms internationally. Resultantly Asian economies became industrialized out of the emerging economies. This tendency attracted international investors in Asian equity markets for broader chances of diversification in their investment portfolios.[12] Hui and Kwan investigated the impact of diversification in the context of Asian Pacific markets.[13] In addition to this, the study of Shachmurove revealed diversification opportunities in the South American markets as well.[14] Hui used data from mature and emerging markets through factor analysis approach to investigate investment opportunities in Asian markets in international perspective.[3]

The co-movements among equity markets were increased substantially during and after the international financial crisis 1987.[15-16] Currently, researchers are interested to investigate the impact of global financial crisis on co-movement of stock prices. Some recent studies have proved that co-movement of stock prices were increased during and post Asian financial crisis 1997 .[17-19] Results of the co-movement of stock markets have also been visualized during US subprime crisis.[20-22] However, the direction of causality was found opposite during the Asian crisis and subprime crisis. Volatility transmission was directed by Asian equity markets towards the US equity markets during Asian Crisis, while this case was reversed in subprime crisis.[23] Keeping in view the above facts, a fresh analysis is required to investigate cointegration in context of Asian markets post subprime crisis 2007 for the guidance of Asian (international portfolio) investors. The researchers intend to conduct this study to examine the current intertwining relationship among Asian equity markets. There are two main objectives of this study: first, to examine the co-movement among Asian stock market and second, to measure the impact of subprime financial crisis 2007 over the linkages of stock returns of these markets cited above. The section two of this paper will give the brief summary of literature review, and third section will explain the methodology and detail of data. Part forth contains the results as well as their interpretation. Fifth but final section will present the conclusion of the results in the view of results of analysis.

2.0 LITERATURE REVIEW

The empirical literature about benefits of international diversification is available since 1960s. As Grubel used mean-variance methodology by reducing country systematic risk in international diversification.[24] This risk-adjusted diversification was studied by many researchers.[25-27] Some studies applied cointegration methodology to reveal the function of emerging equity markets for the diversification of risk.[28-31]

Various methodologies were used by the researchers for the determination of co-movement among stock indices. Traditionally, correlations methodology was applied to measure the strength of co-movement among the equity market to diversify the risk while optimizing the investment portfolios. With increase in the number of markets, this bivariate technique was gradually replaced by multivariate techniques. Ripley used data of 19 international stock markets covering the period from 1960 to 1970 to investigate the pattern of variation among these markets through applying factor analysis technique. Results showed that Switzerland, Netherlands, Canada, and US were found in low degree of variability, whereas Japan and South Africa demonstrated the high degree of association.[11]

Hui and Kwan used data from Asia-Pacific and US equity markets to examine co-variation among the stock prices by employing factor analysis. Results revealed that Japan, Taiwan, Hong Kong, and US markets were categorized into different factors which showed that these countries are suitable for diversification.[13] Naughton employed factor analysis to investigate correlation between developed and Asian markets.[32] Low correlation was found between developed and Asian markets. Australia, Hong Kong, and US were grouped in same category but Japan and Korea were found in a separate group. Taiwan and Philippines were also located into a separate factor. However, it was concluded that potential diversification was available in Asian equity markets.

Meric and Meric focused the period of pre-crisis and post-crisis of 1987 to verify the co-integration of European stock indices. Using factor analysis technique, they reported that three factors were found statistically significant before market crash but only two factors were present after crash. These results suggest that co-movement among markets is increased due to market crash.[16] Tuluca and Zwick used data of thirteen equity markets to reveal the Asian crisis impact on international equity markets. Factor analysis technique was applied and analysis reported that all markets other than Asian markets were found into one factor, whereas Asian equity markets were divided into two groups. Therefore, the study suggested that potential diversification was reduced due to similarity of co-movement among equity markets.[33]

Illueca and Lafuente applied factor analysis technique to examine the linkages among fifteen international equity markets. The findings postulated that four factors were generated through analysis for North and South America, Asia, and Europe.[34] Hui used factor analysis to examine the potential benefits of diversification for Singaporean investors using the data of Asian Pacific markets including US market. The findings suggested that big and developed markets such as Australia, US, and Japan are relatively better for Singaporean investors. Taiwanese stock market is also used for diversification but Singapore, Thailand, South Korea, Philippines, and Hong Kong market were not beneficial for the reduction of risk.[3]

Valadkhani, Chancharat and Harvie used maximum likelihood (ML) and principal component (PC) methodologies to explore the co-movements of stock market indices. They studied monthly data of thirteen countries from 1987 to 2007. Asian countries were falling into first factor, whereas developed countries were classified in the second factor. Results of both the techniques (i.e. ML & PC) were consistent. It is reported that Asian stock returns were showing high correlation among themselves which reduces the potential of diversification within these markets and similar trend was found in the developed markets. It is concluded that investors should make investment in both Asian emerging and the developed markets.[35]

Hui, Tsui and Chua used data of eleven Asian equity markets namely: Thailand, Taiwan, Singapore, Philippines, Malaysia, New Zealand, Korea, Japan, Indonesia, Hong Kong, and Australia as well as US market to investigate portfolio potency by diversifying the systematic risk of these economies. The results were obtained by using factor analysis technique in pre-crisis as well as post-crisis periods. It is suggested that benefits of diversification were increased when dividends are included in returns.[36]

While summing up the literature review, it could be noticed that different methodologies have been used by researchers; however, the focus of this study is to examine the co-integration among Asian equity markets to evaluate the benefits of regional portfolio diversifications. Co-integration among the markets suggests a long run co-movement among these markets. In the Modern Portfolio Theory (MPT), the key determinant of optimal portfolio is one where the correlation between the equity markets should be negative and weak. Cross-economies diversification can be achievable only when equity markets are not moving very closely with each other. In general, a high return cannot be attained only through minimizing risk unless stepping into broader diversification.[37] Therefore, the results of this study will be beneficial to Asian portfolio investors. The finding of study can be utilized for reduction of systematic risk through going in diversified investments.

3.0 METHODOLOGY AND RESULTS

The main stock index of 12 Asian countries (from 1st January, 2000 to 10th September, 2010) was used as a proxy to determine the co-movement among these countries for diversification. The indices which were used as a proxy are mentioned in Table 1. According to Brooks it is preferable that financial raw data series should be converted into log-returns; therefore, all indices were converted into log-returns series.[38] The formula of continuous compounding returns was employed as follows:

$$r_t = \ln\left(\frac{P_t}{P_{t-1}}\right)\times 100$$

Where r_t denotes the continuous compounded return at time t, ln is used for natural log, and p_t is used for value of index at time t.

Generally, financial time series have the problem of auto-correlation, therefore, it is suggested that constant correlation can be measured only after eliminating auto-correlation among the series. If the stock returns are found stationery on the same level, estimation can be made using original series. To estimate co-movement of two variables, the correlation coefficient test is applied. Factor analysis, a multivariate technique, is applied to examine the correlation coefficient more than two variables.

Factor analysis technique is useful to find out maximum and minimum degree of relationship among the variables by dividing them into the different groups. Additionally, it is a combination of statistical tools which are applicable to divide the correlated data

into different factors according to their degree of association to each other. Factor analysis is applied through two types of methods: namely, principle component (PC) and maximum likelihood (ML). The assumption of normality is not required in the principal component method, whereas maximum likelihood (ML) demands the normality of the data. Due to abnormality in data, it is preferred to implied Principal Component Analysis method.

Table 1 Descriptive statistics of Asian stock markets

Name of Countries	Proxy	Minim	Maxim	Mean	Std. Dev.	Skewness	Kurtosis
		Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
India	SENSEX	-.17380	.13171	.00223	**.03673**	-.619	2.491
Sri Lanka	DSE	**-.31229**	**.28883**	**.00428**	.03495	.013	21.347
Hong Kong	HSI	-.17815	.11719	.00058	.03404	-.248	2.260
China	SHCOMP	-.14897	.13945	.00095	**.03697**	.019	1.362
Indonesia	JCI	-.23297	.11587	.00276	.03548	-.894	4.321
Malaysia	KLCI	**-.11448**	.12590	.00101	***.02273***	-.437	4.043
Korea	KOSPI	-.22929	.17032	.00115	**.03940**	-.548	3.584
Pakistan	KSE100	-.20098	.12795	.00345	**.03753**	-.992	3.759
Japan	NKY	-.27884	**.11450**	***-.00122***	.03241	-1.303	9.819
Singapore	FSSTI	-.16468	.15321	.00039	.02958	-.510	5.199
Taiwan	Taiw. ST	-.13082	.18318	-.00011	.03537	-.160	2.380
Philippine	Philip. ST	-.20154	.16185	.00107	.03271	-.207	4.529

Table 2 Correlation matrix (2000-2010) Asian markets

	1	2	3	4	5	6	7	8	9	10	11
India	1										
Sri Lanka	.148 (**)	1									
Hong Kong	.592 (**)	.098 (*)	1								
China	.127 (**)	.039	.241 (**)	1							
Indonesia	.427 (**)	.084 (*)	.456 (**)	.187 (**)	1						
Malaysia	.367 (**)	.115 (**)	.443 (**)	.191 (**)	.439 (**)	1					
Korea	.525 (**)	.103 (*)	.644 (**)	.171 (**)	.443 (**)	.377 (**)	1				
Pakistan	.118 (**)	.046	.108 (*)	.021	.094 (*)	.144 (**)	.136 (**)	1			
Japan	.511 (**)	.140 (**)	.629 (**)	.155 (**)	.453 (**)	.377 (**)	.627 (**)	.099 (*)	1		
Singapore	.621 (**)	.162 (**)	.755 (**)	.171 (**)	.526 (**)	.487 (**)	.655 (**)	.150 (**)	.643 (**)	1	
Taiwan	.435 (**)	.112 (**)	.556 (**)	.198 (**)	.378 (**)	.421 (**)	.645 (**)	.166 (**)	.505 (**)	.572 (**)	1
Philippine	.371 (**)	.087 (*)	.419 (**)	.116 (**)	.500 (**)	.375 (**)	.393 (**)	.108 (*)	.406 (**)	.466 (**)	.395 (**)

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Table 3 Rotated component matrix for the period 2000 -2010 (Varimax Rotation) Asian markets

Name of Countries	Factors				
	1	2	3	4	5
India	**.685**	.255	-.035	.010	.099
Sri Lanka	.071	.029	.013	.014	.992
Hong Kong	**.808**	.236	.145	.001	-.008
China	.121	.096	**.969**	-.008	.011
Indonesia	.311	**.754**	.084	-.020	-.022
Malaysia	.298	**.605**	.206	.138	.099
Korea	**.826**	.181	.056	.062	.000
Pakistan	.085	.064	-.007	**.984**	.014
Japan	**.785**	.162	.028	-.008	.020
Singapore	**.790**	.347	.037	.045	.071
Taiwan	**.694**	.219	.144	.153	.023
Philippine	.247	**.774**	-.062	.020	-.005
% of Variance Extracted	31.672	15.788	8.668	8.484	8.423
Cumulated % of Variance Extracted	31.672	47.459	56.127	64.611	73.035

Table 4 Sub-period factor analysis before and after global financial crisis (Varimax Rotation)

Name of Countries	**Factors**				
	1	**2**	**3**	**4**	**5**
Sub-Period (Jan, 2000- July, 2007)					
India	**.667**	.165	.063	-.066	.050
Sri Lanka	.071	.014	.046	.040	**.982**
Hong Kong	**.798**	.064	.040	.100	-.021
China	.062	.025	-.034	**.933**	.037
Indonesia	.219	**.776**	.058	.175	-.123
Malaysia	.341	.167	.438	.325	.016
Korea	**.806**	.193	.059	.030	-.040
Pakistan	.038	.036	**.927**	-.091	.042
Japan	**.747**	.044	-.039	.035	.074
Singapore	**.769**	.259	.131	.048	.092
Taiwan	**.671**	.135	.176	.181	.012
Philippine	.206	**.815**	.062	-.096	.136
% of Variance Explained	29.565	12.099	9.329	8.982	8.500
Cumulative % of Variance Explained	29.565	41.664	50.993	59.975	68.475
Sub-Period (July, 2007- Sep, 2010)					
India	**.654**	.423	-.021	.006	.173
Sri Lanka	.072	.036	.029	.026	**.984**
Hong Kong	**.831**	.334	.216	.056	-.018
China	.140	.152	**.973**	.006	.030
Indonesia	.445	**.763**	.058	-.047	.083
Malaysia	.383	**.788**	.160	.063	.082
Korea	**.869**	.254	.084	.044	.085
Pakistan	.101	.049	.005	**.986**	.026
Japan	**.855**	.256	.039	.047	-.023
Singapore	**.838**	.372	.057	.035	.056
Taiwan	**.706**	.384	.136	.208	.034
Philippine	.406	**.694**	.111	.098	-.100
% of Variance Explained	36.23	20.13	8.89	8.67	8.63
Cumulative % of Variance Explained	36.23	56.37	65.26	73.93	82.56

Table 5 Summary of the impacts of global financial crisis on Asian markets

Factors	Before Crisis (Jan,2000- July,2007)	After Crisis (August,2007- Sep, 2010)
Factor 1	India, Hong Kong, Korea, Japan, Singapore, Taiwan	India, Hong Kong, Korea Japan, Singapore, Taiwan
Factor 2	Indonesia, Philippine	Indonesia, Malaysia, Philippine
Factor 3	Pakistan	China
Factor 4	China	Pakistan
Factor 5	Sri Lanka	Sri Lanka

Table 1 shows the results of descriptive statistics of Asian Stock Markets. Minimum values -.31229 demonstrated the downward trend in Sri Lankan equity market during study period and minimum value -.11448 of Malaysian market disclosed the lowest decreasing trend among the sample of Asian markets. However, maximum value demonstrated by Sri Lankan market decoupling itself from the group of Asian markets. In the same way, mean value of Sri Lankan market shows that the behavior of this market is not consistent with other markets in this region. However, Malaysian equity market has revealed a minimum spread; so far, the behavior of this market is not affected to a greater extent during the global crisis. Conversely, the equity markets of Korea, Pakistan, India, and China revealed a high standard deviation. Therefore, such results were indicated instable behavior in these markets and identified a locus of high volatility.

Table 2 shows results of correlation between Asian markets. The highest correlation found in the markets of Singapore and Hong Kong having the value, i.e. r = .755 at 5% the level of significance. Second highest correlation found between the markets of Singapore and Korea having the value, i.e. r = .655. The Strong correlation exists between the markets of India and Hong Kong, i.e. r= .592. Whereas, India and Korea, r = .525., India and Singapore, r = .621., China and Korea, r = .644, China and Japan, r = .629, China and Taiwan, r = .556, Indonesia and Singapore, r = .526, Indonesia and Philippine, r = .500), Korea and Japan, r = .627, Korea and Taiwan, r = .645, Japan and Singapore, r = .643, Japan and Taiwan, r = .505, Singapore and Taiwan, r = .572. No relationship exists between Sri Lanka and China, Sri Lanka and Pakistan as well as China and Pakistan. However, the group of these markets is not interconnected with Asian Pacific markets. Contrarily, Malaysia, Indonesia, and Philippines are showing a separate group that indicates a very close connectivity among these markets.

Principal Component Technique was applied in analysis. Eigenvalues of different factors were considered to identify the factors and finally five factors were kept having total variance of 73% and only two factors contain eigenvalue greater than one. The Kaiser- Mayer- Olikin (KMO) measure was reported 0.916 which shows the sampling adequacy and the Bartlett Test of sphericity having the significant value which shows the acceptance of alternate hypothesis and explains that the correlation matrix was not an identity matrix.

Table 3 represents the results of varimax rotation and total variance of five factors is 73.035%. By comparing factors weights, first two factors having maximum variance among the five. Factor one relatively explained larger variance that is 31.672% containing markets of India, Hong Kong, Korea, Japan, Singapore and Taiwan; it shows co-movement between these markets. The second factor explains 15.788% of the variance containing markets of Indonesia, Malaysia, and Philippines. Out of five, remaining three factors are showing an independent co-movement of China, Pakistan and Sri Lankan markets.

Table four represents the sub-period analysis; markets were divided into two sub-groups. First group contains data from January, 2000 to July, 2007 (before Global Financial Crisis) and second group contains the data from August, 2007 to September, 2010 (after Global Financial Crisis). The purpose of the subgroup analysis is to identify the market behavior before and after Global Financial Crisis.

Analysis of sub-period depict that co-movements exist among the markets of India, Hong Kong, Korea, Japan, Singapore, and Taiwan having variance of 29.56%, before Global Financial Crises; whereas, the markets' factors remained unchanged after the Crisis period having variance of 36.23%. Indonesia and Philippine having variance of 12.09% before crises which shows consistency in their behavior but the Malaysian market was grouped with Indonesia and Philippine and the variance increased to 20.13%. Movement of China, Pakistan and Sri Lankan markets remained unchanged and independent before and after crisis periods.

Table 5 represents the summary of comparative results before and after crisis. Apparently, overall behavior of Asian Markets stayed constant and not affected by global financial crisis to greater extent except Malaysia.

4.0 CONCLUSION

The aim of this study was to examine association among Asian equity markets during pre-and-post Global Financial Crisis period. Twelve major Asian equity markets were selected for analysis using factor analysis methodology. The purpose of analysis is to study the behavior of stock markets for portfolio investment in order to avoid market specific systemic risk. Rotated Factor Analysis technique was applied on all these markets and the whole period of study was investigated. Then second analysis was executed in the context of examining interdependence of Asian equity markets by splitting the same study period into pre-and post-Global Financial Crisis. Crux of the results showed that association among markets of India, Hong Kong, Korea, Japan, Singapore, and Taiwan remained unchanged before and after Global Financial Crisis periods. However, Malaysia linkage is promoted with Indonesia and Philippine in the post crisis period. In milieu of Asian market, no major change is highlighted before and after crisis periods except Malaysia. Pakistan, China, and Sri Lankan equity market as these markets were documented as an exclusively independent behavior during both pre-and post-crisis periods.

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