Dynamic Linkages of Return and Asymmetric Volatility Spillovers Among Asian Emerging Stock Markets: Evidence from Post-Global Financial Crisis Period

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Abstract. The purpose of this study is to investigate the dynamics of return linkages and volatility spillovers between Asian emerging stock markets. The findings revealed that the own lagged volatility spillovers are statistically significant in all cases. Our findings also show that the asymmetric volatility spillovers are significant in all sampled stock markets except China. We find unidirectional volatility spillovers from the markets of China towards Malaysia, South Korea and Japan, from Hong Kong towards South Korea, from Pakistan towards Japan and South Korea. Moreover, the volatility spillovers of most of the stock markets are significant and bidirectional. Therefore, these markets are interrelated, and the spillover effect should be taken into consideration by policymakers, fund managers and investors.

Introduction

Stock markets play a vital role in the global financial markets. Recent removal of investment blockades, easy access for capital, speedy flow of information and the ease of doing business are some of the factors that attracted a lot of investors towards the financial markets across the globe and the markets are becoming more integrated than ever before.

Strong capital inflows faced by emerging economies and growth projections appeared higher as compared to developed economies. The petitioners of the financial market need to identify the transmission patterns of volatility over time to establish a better and risk-free portfolio. Portfolio diversification is a theory introduced by the Markowitz [8]. He developed the concept of minimizing the risk by diversifying the portfolio across the globe.

Association and linkages between these markets is a critical issue that needs to be unveiled. Therefore, it became the main motivation to conduct this study and so that the relationship between different equity markets can be explored. The selected indexes are the Pakistan Stock Exchange (PSX) from Pakistan, Shanghai Stock Exchange (SSE) from China, Hang-Sheng Index (HK50) from Hong Kong, Nikkei 225 index from Japan, Kuala Lumpur Composite Index (KLCI) from Malaysia and the KOSPI composite index (KS-11) from South Korea.

The main reasons for conducting this study are as follows: Firstly, the previous studies focus on return linkages and transmission of volatility between different markets, while this study will contribute in the literature by examining returns and asymmetric volatility spillover in emerging markets of Asia. Secondly, economic dynamics are changing after the advent of Belt and Road Initiative (BRI) and a lot of investment and development can be seen across the globe, especially in the region of south and east Asia. Thirdly, the equity markets of the countries such as Pakistan elevated to emerging market from the frontier, Sri Lanka from standalone to the frontier, which is the case with other selected countries. It shows that Asian countries are showing abnormal growth and are achieving a considerable position among the world financial markets.

Literature Review

A significant number of researchers analyzed volatility spillover among the developed equity markets, however, few studies are available that analyzed emerging and frontier markets. This study

also overviews the literature on developed, emerging and frontier markets. Studies related to developed markets include Eun and Shim [3], Ng [9], Baele [1], Savva et al [10], Fang et al [4], Diebold & Yilmaz [2]. Eun and Shim [3] studied the developed markets of nine different countries to investigate the international transmission mechanism of stock market movements, located main channels of interactions and traced out the dynamic responses of one market to innovations in another market. Baele [1] quantifies the magnitude and time-varying nature of volatility spillovers from the aggregated European (EU) and US market to 13 local European equity markets and allowed for regime shifts in the shock spillover intensity. Authors found regime switches are important aspects due to which shock spillover varies significantly with the passage of time. Country-specific spillover effects have been found in the equity markets of the USA and Germany by Wagner & Szimayer [13] when they studied the occurrence of volatility transmission in these countries. They used daily data of 10 years starting from 1992. Fang et al. [4] also investigated the volatility transmission between equity and bond markets of the USA and Japan. They found unidirectional volatility transmission from the bond to equity markets within domestic cross markets. However, the volatility spillover effect was strong between international stock markets but weak for stock to bond markets.

In different time periods, various authors investigated the spillover effect between different equity markets of developed and emerging economies. Ng [9] studied the spillover effect from Japan and the US towards different Pacific-Basin countries and found out that the spillover effect is significant. Joshi [7] studied the return and volatility transmission mechanism in the equity markets of India, Hong Kong, Japan, China, Indonesia and, Korea and discovered the transmission to be bidirectional. However, the volatility magnitude associations were low, hence it indicates that the integration among the markets is weak. Gallo & Otranto [5] studied the transmission mechanisms of volatility between the markets of Hong Kong, Korea, Thailand, Malaysia, and Singapore using Markov Switching bivariate model. The results indicate market characterization with long term spillover from Hong Kong to Thailand and Korea and interdependence with Malaysia and co-movement with Singapore.

Asian regional equity markets' patterns were studied by Click & Plummer [6], finding the linkages of five stock markets of ASEAN countries including Indonesia, Malaysia, Philippines, Thailand, and Singapore. It was revealed that all markets are correlated and integrated economically and are not completely segmented by national borders. Wang et al. [14] studied the return and volatility spillover pattern of US and Japan equity markets towards the Indian, Pakistani and Sri Lankan stock markets. Singhania & Prakash [12] examined the volatility and cross-correlation in stock returns for SAARC countries and Global Stock Indexes. Volatility and cross-correlation from SAARC to global stock markets are high. Singhania & Anchalia [11] also studied the Asian stock markets in lieu of the global financial crisis. This attempt to study the returns volatility of Japan, India, Hong Kong and China for the period of 2005-2011 and the study shows that the volatility is high among the markets and that the negative shocks are also affecting the market.

Despite numerous studies that emphasis on return and volatility spillover regarding stock markets, there is still a need to further investigate the mechanism of return and asymmetric volatility among Asian emerging markets especially for the period after the subprime financial crisis of 2007-2008. Therefore, more research is needed to better understand Asian emerging financial markets, and this study is contributing towards it.

Data and Methodology

Data

Time series data of six emerging Asian stock markets have been collected for this study. They are ranging from 3rd January 2011 to 31st December 2018, to comprehensively analyze the post-crisis period, which originated in 2008. Following markets have been selected for the study: China (SSE), Hong Kong (HK50), Malaysia (KLCI), Japan （Nikkei 225）, Pakistan (PSX) and from South Korea (KS 11). Stock indices returns are calculated by using this formula, $R_t = LN (P_t / P_{t-1})$.

Methodology

EGARCH model, is used to measure the volatility spillovers between the markets because asymmetric volatility (negative shocks) spillover between two markets can be captured by using the EGARCH model. Dickey and Fuller (ADF) test and Phillips and Perron (PP) test used to check the stationary of data. ARCH effect needs to be examined because the data set with ARCH effect and heteroscedasticity is suitable for applying EGARCH model.

Finally, market volatility spillover needs to be examined from one market to another in two steps. Firstly, residuals of volatility from a specific EGARCH model for each country's stock index are generated separately. Secondly, generated residuals of the data sets are introduced to the variance equation of the model.

Equations for Volatility Spillover

$$R_t = c + \omega R_{t-1} + \gamma R_{t-1} + \varepsilon_t \tag{1}$$

$$h_t = \alpha_0 + \alpha_1 h_{t-1} + \sigma \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \alpha_2 \left| \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right| + \delta_{(RSI)} \tag{2}$$

Equation (1) and (2) are representing the mean equation and variance equation, respectively. In equation (1) R_t - return of stock prices: c - intercept, ω – measures the effect of last day returns on next day and γ - measures the return spillovers from one market to another. In equation (2) α_0- constant of volatility, $\alpha_1 h_{t-1}$ - function of volatility, $\sigma \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}}$ – captures asymmetric effect, $\alpha_2 \left| \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right|$ – measure volatility due to change in news, while $\delta_{(RSI)}$ measures the volatility spillover from one market to another market.

Empirical Results

Descriptive statistics in Table 1 reveals that the Pakistani stock market has the highest daily while the Chinese stock market showing the lowest. The highest mean standard deviation shown in China and the lowest standard deviation in Malaysia.

Table 1. Descriptive Statistics

	China	Hong Kong	Japan	Malaysia	Pakistan	South Korea
Mean* (%)	-0.00507	0.0047	0.0322	0.00404	0.0547	-0.00068
Maximum	5.6036	5.5187	7.4262	3.3222	4.4186	4.9
Minimum	-8.8732	-6.0183	-11.1534	-3.2368	-4.765	-6.4202
SD** (%)	1.3354	1.1218	1.3104	0.5624	0.9155	0.9176
Skewness	-0.999959	-0.332471	-0.62946	-0.405925	-0.38223	-0.450094
Kurtosis	10.29544	5.926661	9.481912	6.268934	5.879232	8.130613
Jarque-Bera	4968.878	782.1506	3785.94	985.1269	770.5914	2356.095
Prob	0.000	0.000	0.000	0.000	0.000	0.000

Source: Authors' calculations, * Mean daily return, ** Standard deviation

Mean Equation Analysis

Table 2 is representing the results of return spillovers. The equity markets of Malaysia and Pakistan show significant own past return spillovers, while insignificant in case of China, Japan, Hong Kong, and South Korea. Bidirectional return spillovers found between the markets of Hong Kong and South Korea, Japan and South Korea and, Japan and Malaysia. This reveals that the return spillovers of these markets are depending on each other. Moreover, the market of China shows unidirectional spillover towards Pakistan, from Malaysia to Hong Kong, Malaysia to South Korea and from Pakistan to Hong Kong, Japan, Malaysia and South Korea.

Table 2. Mean Equation Results (Return Spillovers)

Coefficients↓	China	Hong Kong	Japan	Malaysia	Pakistan	South Korea
c	8.56E-05 (0.0002)	9.99E-05 (0.0002)	0.0004* (0.0002)	-1.96E-05 (0.0001)	0.00047*** (0.0002)	-3.31E-05 (0.0002)
ω	-0.0020 (0.0229)	0.0245 (0.0228)	-0.0131 (0.0248)	0.1087*** (0.0216)	0.1953*** (0.0216)	-0.0196 (0.0234)
$\gamma - China$		-0.0292 (0.0212)	0.0164 (0.0158)	0.0353 (0.0397)	-0.0397* (0.0224)	-0.0200 (0.0264)
$\gamma - Hong\ Kong$	0.0134 (0.0164)		0.2416 (0.0151)	0.0119 (0.0329)	0.0013 (0.0231)	0.0647** (0.0273)
$\gamma - Japan$	0.0067 (0.0199)	0.0183 (0.0236)		0.0703* (0.0382)	0.0067 (0.0199)	0.0526* (0.0303)
$\gamma - Malaysia$	-0.0121 (0.0091)	0.0346*** (0.0101)	0.0826*** (0.0076)		0.0074 (0.0091)	0.0467*** (0.0122)
$\gamma - Pakistan$	-0.0133 (0.0108)	0.0420*** (0.0144)	0.0520*** (0.0120)	0.1355*** (0.0267)		0.0707*** (0.0168)
$\gamma - South\ Korea$	-0.0221** (0.0107)	0.0431*** (0.0153)	0.2163*** (0.0100)	0.0199 (0.0288)	-0.0134 (0.0143)	

Source: Authors' calculations, Standard errors are shown in brackets,
***, ** and * represents p<1%, 5% and 10% respectively.

Variance Equation Analysis

In Table 3 volatility spillover is significant at 1% in all cases. Volatility transmission is highest for Pakistan and lowest for Hong Kong. Asymmetric volatility spillover is significant in all selected stock markets except of China. Volatility transmission is bidirectional between the stock markets of Hong Kong and Japan, Hong Kong and Malaysia, Hong Kong and Pakistan, Japan and Malaysia, Japan and South Korea, Pakistan and Malaysia and, Malaysia and South Korea which provides the evidence that the markets are correlated. Unidirectional volatility transmission effects can be seen from the markets of China towards Malaysia and South Korea and Japan, from Hong Kong towards South Korea, Pakistan towards Japan and South Korea which shows that shocks created in one market transferred to other market, but the market receiving shocks does not react back to the market that is originating shocks.

Table 3. Variance Equation Results (Volatility Spillovers)

Coefficients↓	China	Hong Kong	Japan	Malaysia	Pakistan	South Korea
α_0	-0.1239*** (0.0128)	-0.2741*** (0.0355)	-0.6745*** (0.0641)	-0.3882*** (0.0436)	-0.9817*** (0.0885)	-0.3404*** (0.0349)
α_1	0.1218*** (0.0089)	0.0803*** (0.0091)	0.2150*** (0.0141)	0.1313*** (0.0115)	0.2228*** (0.0194)	0.1018*** (0.0125)
σ	-0.0061 (0.0053)	-0.0624*** (0.0070)	-0.1114*** (0.0074)	-0.0993*** (0.0104)	-0.1858*** (0.0143)	-0.0973*** (0.0085)
α_2	0.9958*** (0.0013)	0.9764*** (0.0036)	0.9418*** (0.0067)	0.9724*** (0.0040)	0.9151*** (0.0087)	0.9724*** (0.0032)
$\delta_{(China)}$		-0.1583 (0.4064)	-1.7599** (0.8653)	-1.4607*** (0.5391)	0.8441 (1.1947)	-2.8080*** (0.6164)
$\delta_{(Hong\ Kong)}$	0.0000 (1.1371)		-4.7089*** (1.2028)	-6.7389*** (1.0725)	-3.7172*** (1.0814)	-7.9717*** (0.8903)
$\delta_{(Japan)}$	0.0000 (1.6141)	-9.7006*** (0.9501)		-8.7796*** (1.3393)	-4.8352 (1.4629)	-18.7451*** (1.4442)
$\delta_{(Malaysia)}$	0.0000 (1.6123)	-9.5055*** (0.9364)	-7.1996*** (1.6720)		-4.7349*** (1.4411)	-18.6502*** (1.4387)
$\delta_{(Pakistan)}$	0.0000 (1.6123)	-9.5058*** (0.9364)	-7.1998*** (1.6721)	-8.5632*** (1.3147)		-18.6340*** (1.4342)
$\delta_{(South\ Korea)}$	0.0000 (0.4053)	-0.1618 (0.4174)	-1.8059** (0.8864)	-1.4862*** (0.5534)	0.9027 (1.2256)	

Source: Authors' calculations, Standard errors are shown in brackets, ***, ** and * represents p<1%, 5% and 10% respectively.

Conclusion and Implications

Empirical findings reveal that the markets mostly have significant bidirectional volatility spillover and therefore it can be determined that these markets are highly integrated. The bidirectional volatility effects are the highest in case of Malaysian stock market and lowest in case of Chinese stock market. Volatility spillovers of asymmetric nature have been found between the markets which means that the effects from negative news are also captured in this study.

This study has a great implication for investors, portfolio managers and policy makers. Transfer of volatility from one market to another may offer them an edge in expecting the performance of one market by having the information of the other market. Economic policymakers, when having the information of volatility spillover, can formulate such policies that can safeguard the financial markets from financial crises that are originating from the other countries. Individual and institutional investors can select diversified portfolios to spread their risk and increase returns. Fund managers continue to benefit from high returns and low volatility and for global investors stock markets from the selected countries present an opportunity for further diversification.

Acknowledgment

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