The Relationship Between Asian Stock Markets: A Co-Integration Approach

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Abstract: *Today's world capital markets are becoming closely interdependent with each other. This study tests the interdependency and long-term relationship among five Asian financial markets. The results suggest that investors can make their investment portfolio between these financial markets because risk can be diversified in these financial markets. Granger causality test result indicates SSE, HSE and BSE have interdependency on PSE, but CSE has not interdependency on PSE. PSE has not interdependency on SSE and BSE, but PSE has interdependent on HSE and CSE. Granger causality results suggest investor can get the short-run benefit for the international investment portfolio. Cointegration result indicates PSE has a long-term relationship between BSE, HSE, CSE, and SSE. The findings suggest that long-term benefit is limited.*

keywords: Granger Causality, Cointegration, Asian Markets.

1. INTRODUCTION

The finance theory forecast that high return can be achieved by the diversification of risk. The diversification is only possible when stock exchanges are not correlated with each other. Few of the researchers, for example, Hassapis and Kalyvitis (2002), financial experts provide evidence about the correlation and interdependencies of the share prices index. Prior studies focus on the world's major stock exchanges, and some of the studies focus on the emerging markets (Chen, Firth, & Rui, 2002). The present world market has become to be more strongly correlated and jointly dependent ultimately. Cointegration has unexpected volatility during a downturn time (Lyócsa & Horváth, 2018)

Thai baht financial shrinkage stated in 1997. This effect transferred from Thailand to the East Asian region. The stock markets of these countries affected after some time partially recover.

These types of events badly affected by portfolio management. The Thai market describes the long-term behavior of the stock return (Techarongrojwong & Pariyaprasert, 2018).Hassapis and Kalyvitis (2002) found the change in foreign and domestic returns. The linkage information and correlation between the markets are significant for decision making about investment and risk management, fund managers and policymakers. The occurrence of low correlation among the different national stock markets has been used usually to defend the international diversification of the portfolio. Another foundation for an investor to think about the global investment is return improvement. This study examines the Asian stock market relationship between five stock exchanges. Reason for selecting these stock exchanges that investors can access easily due to the geographical area.

2. LITERATURE REVIEW

Globalizations decreases the limitation of international cross-listing. It enhances the capital flow between the economies and creates opportunities for trading securities around the world.
Prior studies have been discussed the correlation among international stock exchanges. For example, Copeland and Copeland (1998) and Janakiramanan and Lamba (1998) documented the relationship between stock markets and also discussed the US influence on the international stock market. The shock can be transferred from one market to another market due to an extra linkage (Dewandaru, Masih, & Masih, 2016). Longin and Solnik (1995) suggested that covariance return is more important, especially in the down period. This study also recommends that striking activities of the one capital market effect on other capital markets. Manning (2002) developed the relationship between East Asian countries from 1992 to 1997. The findings of this study suggested that the stock markets of this region were volatile during the crisis. The cross-market correlation depends upon the time scale and country (Lin, Wang, Xie, & Stanley, 2018; Wang, Xie, Lin, & Stanley, 2017).
Prior researchers have been focused on the equity markets relationship. These studies return for correlation among stock exchange (Agmon, 1972; Jaffe & Westerfield, 1985; Panton, Lessig, & Joy, 1976). Further research focuses on the emerging market portfolio for the development of diversification. For example, Ajayi and Mehdian (1995) and Bowman and Comer (2000) discussed the international portfolio management. Eun and Shim (1989) found the cross-country relations. This study also suggested that US markets have an influence on other markets. This study used the VAR. King and Wadhwani (1990) argued that ''contagion effect' it effect transfer to one market to another market. Baillie and Bollerslev (1989) used the stock prices to find the dependency of the stock prices. This study used the cointegration approach. They also suggested that international diversification cannot provide more benefit when the stock markets are cointegrated with each other. Low cointegration recommends that these stock exchanges have no long-term relationship, but the cointegration suggest to investor there are some available for investment.

3. DATA AND METHODOLOGY

In this paper, five Asian stock exchanges, namely Pakistan stock exchange (PSE), Bombay stock exchange (BSE), Shanghai stock exchange (SSE), Hong Kong stock exchange (HSE), and Colombo stock exchange (CSE) are selected for checking the linkage between stock market. Table 1 is described as more information. For this purpose, ten years of data were collected from different websites from year 2010 to 2019. This data was analyzed with the help of EViews 11. Three different time-series analyses are used to test the linkage between the Asian stock market.

Table 1: Stock Exchanges used in the study

Stock exchange	Index
Pakistan stock exchange	PSE
Colombo stock exchange	CSE
Bombay stock exchange	BSE
Shanghai stock exchange	SSE
Hong Kong stock exchange	HSE

Granger Causality Test

The (Granger, 1969) test represent the X causes on Y, and it represents the historical value of y. It can provide more detail on the lagged value. Y can support the Granger cause if x forecast or steadily, the lagged coefficient of x is significant. The two interactions commonly cause: "x Granger causes y and y Granger causes x".

$$y_1t = \sum_{i=1}^{p} \alpha i.\, y\, t - i + \sum_{j=1}^{q} \beta j.\, x\, t - j + ut ------(1)$$

$$y_2t = \sum_{i=1}^{p} \alpha i.\, y\, t - i + \sum_{j=1}^{q} \beta j.\, x\, t - j + ut ------(2)$$

Where "u_t" represents the noise, p indicates the lag for y, and q denotes the lag of order for x. "The null hypothesis that x does not Granger cause y is that for $j=1, 2…$ is that for $i=1, 2…p.\ q.$ Likewise, the null hypothesis that y does not Granger cause x".

Cointegration

For checking the merging and ordinary trends in the cointegration, context needs the separate market index should be integrated into one order for five Asian stock markets. The (Dickey & Fuller, 1981) can be concluded of five Asian stock markets test.

$$\Delta p_{i,t} = a_{0i} + a_{1i}t + \beta_i p_{i,t-1} + \sum_{j=1}^{n} \delta_{ji} \Delta p_{i,t-j} + \varepsilon_{i,t} ----------- (3)$$

Where Δpi, denotes stock market return and t shows the trend. The n represents the autoregressive process. Δpi, t-j indicates the error in the serial correlation. The cointegration matrix in the multivariate test estimate by using the VAR representation (Johansen, 1991):

$$\Delta PT = \Gamma\, L\, \Delta Pt + \Pi Pt\, \text{-}k + \mu + \varepsilon t ----------------- (4)$$

Pt is $n \times 1$ represent the vector of the logarithms of total market indices of five Asian stock markets. Π shows the long-run relationships of the cointegrating vectors, $\Gamma(L)$ is a polynomial of order $k-1$ to capture the short-run dynamics of the system, and εt are independent Gaussian errors with zero mean and covariance matrix Ω. The reduced rank $(0 \leq \text{rank}(\Pi) = r < n)$ of the

long-run impact matrix is formulated as follows:

$$\Pi = \alpha\beta' \quad \text{-------------------------------- (5)}$$

Where "β is the n × r" matrix represent the cointegrated vectors and "α is the n × r" matrix represent the correction. Five Asian stock exchanges from [1, -1] represent the long-term trends for individual markets.

4. EMPIRICAL RESULTS

This paper is containing time series tests on the monthly return of the stock market indices. Five Asian stock exchanges data is collected from different websites and yahoo finance from 1st January 2010 to 31st December 2019.The EViews software was used for all estimation. Table 2 represents the summary of descriptive statistics. PSE and SSE standard deviation have greater than the other three stock exchanges. It means PSE and SSE are riskier as compared to the other three stock exchanges. HSE standard deviation has low as compared to the other four stock exchanges. It means HSE is lower risk as compared to the other four stock exchanges. PSE mean return is high as compared to four stock exchanges. SSE has a high standard deviation as compared to the PSE, but the return of the SSE has low as compare to PSE. It means an investor can make a portfolio in which five stock exchanges and diversification can be possible on these stock exchanges.

Table 2: Summary of Descriptive statistics

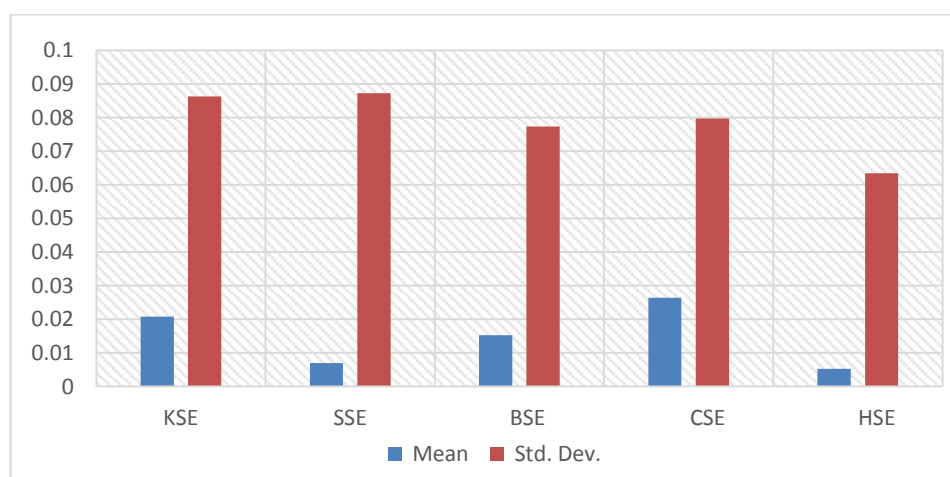| Particulars	PSE	SSE	BSE	CSE	HSE
Mean	0.020845	0.007003	0.015267	0.026457	0.00529
Std. Dev.	0.086289	0.087287	0.077371	0.079732	0.063461
Jarque-Bera	46.67003	3.808281	7.694466	3.576919	11.34749
Skewness	-0.49919	-0.22478	-0.23788	0.364499	-0.41623
Kurtosis	5.847735	3.735505	4.129167	3.408041	4.233347

Figure1: Comparison of Asian stock exchanges

Figure 1 represents the information about means and standard deviation between five Asian stock exchanges. SSE has a high risk of low return. PSE has a low risk as compared to the SSE but has a high return as compared to the SSE.CSE has a high risk compared to BSE but has a

high return as compared to the risk's has a high risk of low return.

Cointegration

Before applying the cointegration. It is necessary to check the integration of five stock exchanges. ADF test was applied to all of the five stack exchanges return. All stock exchange returns were not stationary at level, but they were stationary at 1st differences. Table 3 reveals that the Johnson cointegration test between PSE and the other four Asian stock exchanges. PSE is cointegrated with HSE because Trace statistics is greater than Critical value and Max-Eigen value is greater than critical values.

Table 3: Johnson cointegration test between PSE and other four Asian stock exchanges

PSE, HSE	Eigen value	T-Statistic	Critical Value(0.05)	Prob.**
None *	0.204418	44.1891	15.49471	0.0000
At most 1 *	0.135672	17.20472	3.76432	0.0000
Unrestricted Cointegration Rank Test (Maximum Eigen value)				
None*	0.204418	26.98438	14.2646	0.0003
At most 1 *	0.135672	17.20472	3.76432	0.0000
PSE, SSE				
None *	0.160477	30.91508	15.49471	0.0001
At most 1 *	0.083387	10.27429	3.76432	0.0013
Unrestricted Cointegration Rank Test (Maximum Eigen value)				
None *	0.160477	20.64079	14.2646	0.0043
At most 1 *	0.083387	10.27429	3.841466	0.0013
PSE ,BSE				
None *	0.198977	45.93231	15.49471	0.0000
At most 1 *	0.154131	19.75217	3.76432	0.0000
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
None *	0.198977	26.18014	14.2646	0.0004
At most 1 *	0.154131	19.75217	3.76432	0.0000
PSE CSE				
None *	0.189586	42.17398	15.49471	0.0000
At most 1 *	0.136875	17.36914	3.841466	0.0000
Unrestricted Cointegration Rank Test (Maximum Eigen value)				
None *	0.189586	24.80484	14.2646	0.0008
At most 1 *	0.136875	17.36914	3.76432	0.0000

The results indicate that PSE has long-term cointegrated with HSE. PSE has cointegrated with SSE. Moreover, the result describes that the trace statistics is greater than the critical value, and Max-Eigen values are greater than critical values. It means that PSE has long-term cointegrated with SSE and PSE has cointegrated with BSE and CSE. It means that PSE has long-term cointegrated with BSE and CSE. Further, the vector error correction model is applied to integrated stock exchanges. Detail results are not reported to save space. The result shows that long-term relationships at the equilibrium point.

Granger Causality Test

Testing the direction of Granger causality between the return of five Asian stock markets Table 4 shows that the Granger causality test result between the five stock exchanges. There is SSE, HSE and BSE have Granger causality on PSE, but CSE has not Granger causality on PSE. It means that SSE, HSE, and BSE have interdependency on PSE but CSE has not interdependency

on PSE. PSE has not Granger causality between SSE and BSE but has Granger Causality between HSE and CSE. It means PSE has not interdependency on SSE and BSE but PSE has interdependency on HSE and CSE.

Table 4: Pairwise Granger Causality Test

Null Hypothesis:	F-Statistic	Prob.
SSE does not Granger Cause PSE	0.001	7.32316
PSE does not Granger Cause SSE	0.19083	0.82650
PSE does not Granger Cause HSE	5.06049*	0.0078
BSE does not Granger Cause PSE	4.10219*	0.019
PSE does Cause BSE not Granger	1.77008	0.1749
CSE does not Granger Cause PSE	2.11164	0.1257
PSE does not Granger Cause CSE	5.64954*	0.0046

Note: *Represent at 5% significant level

5. CONCLUSIONS

The stock market integration has been increased all over the world during the last two eras. This situation makes the liberalization and increases financial innovation. It also enhances the opportunities for the international investor. This study shows the vibrant interdependency among the five Asian stock markets. The summary of statistics indicates PSE and SSE risk is high as compared to the other stock exchanges, but HSE risk is low as compared to the other four stock exchanges. PSE mean return is high as compare to SSE but risk also high. In which five stock exchanges diversification is possible, it means an investor can make an investment portfolio between five stock exchanges. Granger causality result indicates SSE, HSE and BSE have interdependency on PSE but CSE has not inter-dependency on PSE. PSE has not inter-dependency on SSE and BSE but PSE has interdependency on HSE and CSE. The results of Granger causality suggest that international investor can get more benefits for making the investment portfolio and diversification. Cointegration result shows that PSE has a long-term relationship between BSE, HSE, CSE, and SSE. The findings of the cointegration suggest that international investors can get limited benefit from the long-term relationship. This study provides several contributions to international investors. The stock exchanges can be used for portfolio management.

This study provides the guideline to the international investor of diversification of risk. This study has several limitations. First, this study focuses on five Asian stock markets and ignore the other Asian stock market. Second, it used data from 2010 to 2019 and did not a separate analysis of the financial crisis. This study opens the broad avenue for the future researcher in two ways. First, this research can be extended if the researcher uses other than Asian stock markets if data is available. Second, the researcher would be extended if the researcher focuses on the whole Asian stock markets.

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