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Dynamic Linkages among South Asian Stock Markets with Special Reference to Sri Lanka, Pakistan and India

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Abstract

This paper aims to examine the dynamic nature of equity market integration of key South Asian stock markets to determine and spotlight diversification potential by analyzing the linkages among three major South Asian Equity Markets; Karachi Stock Exchange (KSE), Bombay Stock Exchange (BSE), Colombo Stock Exchange (CSE). Ten years of monthly equity market index data were analyzed for long and short-term relationships through correlation, co-integration, granger causality, VAR model, Variance decomposition, and Impulse response analysis. It was found that the key South Asian stock markets are closely linked with each other depicting a long-run relationship. Also, it shows that the impact of shocks on regional markets, requires around two to five weeks for the shocks to be adjusted. There are diminishing diversification benefits for international investors by diversifying their portfolio among South Asian stock markets. But from tracking market indices can result in arbitrage or speculative profit, owing to weak adjustments in markets between the countries. South Asian stock markets are rapidly evolving and considered as a lucrative avenue by global investors owing to their immense growth and weak correlation with international markets.

Keywords: Correlation, Equity markets, Integration, Stock Exchanges, South Asia

1. INTRODUCTION

In recent years, international investment has been flourishing among private and institutional investors due to the benefits of global portfolio diversification. Capital flows are considered beneficial for both the source country and the host country.

International portfolio diversification was identified by (Grubel, 1968) as a form of economic advantage from global economic connections. Many investors would prefer international portfolio diversity over domestic portfolio diversification since investment returns in the domestic stock market is impacted by natural and artificial variables, economic cycles, and government regulations whose effects are limited to the domestic stock market. Hence, it was discovered that investment portfolios limited to one country have individual security returns that tend to move in a highly synchronized way, resulting in minimal Diversification benefits. Accordingly, the importance of international portfolio diversification was highlighted which is conditional upon the degree of interlinkage among these stock markets (Grubel, 1968). Studying the interdependence of international stock

markets became wide popular among scholars as it determines the extent of diversification benefits for investors. Apart from stock investors, managers would need to assess capital investment in various countries. If capital markets are subdivided, investment projects with comparable risks must be managed differently. (Shahzad, 2016). On the other hand, integrated financial markets advantage via efficient capital allocation, a lower likelihood of asymmetric shocks, increased opportunities for risk diversification and more robust market frameworks (Fung et al., 2008). Furthermore, a foreign investor from outside the region would find it simpler to invest in a regional stock exchange that is interconnected (Shahzad, 2016).

Many scholars have highlighted the importance of understanding the level of co-integration among international equity markets (Engle and Yoo, 1987) (Clements and Hendry, 1995). A possible correlation of stock markets suggests that the markets imply a long-run equilibrium connection that prohibits anyone from deviating too far from the norm, at least for a prolonged period of time. Despite early empirical findings indicating a minimal link between stock market returns (Hilliard, 1979), recent literature shows that the correlation among international markets has been improving since the mid-1990s. (Beirne et el, 2010); (Kizys and Pierdzioch, 2006); (Reid and Click, 2005). According to a study done by (Lucey and Zhang, 2010), there is a notable increase in stock market co-movement among geographically concentrated countries.

Despite the fact that many research has concentrated on developed and European markets (Reilly & Brown, 2005), the studies on interdependence among Asian stock markets are scarce. Several studies on financial convergence in Asia's capital markets focused primarily on Japan and the so-called Asian tigers or emerging Hong Kong, Singapore, Taiwan, and Korea. Some of these researches are; (Eun & Shim, 1989), (Hung, B. and Y.L. Cheung, 1995), (Kwan, Sim, & Cotsomitis, 1995). Very few inquiries, though, target equity markets in South Asia like Sri Lanka. For Sri Lankan investors, the field of South Asia is much more relevant for their domestic and global stock marketsand for their diversification of foreign resources.

Different studies have extensively studied the correlation between national stock markets. But there is still confusion about national equity markets correlation since mixed results have been produced from empirical studies. (Eduardo and Selvanathan, 2001) and the convergence of share price fluctuations between countries was found far less prevalent than within a country. In addition, this research shows that these equity markets are not substantially linked in the long term. Nevertheless, all ASEAN equity markets have substantially connected with each other in the short term except for Indonesia.

There is an increased importance of further studying the south Asian stock markets as it is considered as an important source of investment for international investors owing to their massive growth and weak correlation

with international stock markets. Furthermore, the interconnection of stock markets influences regional stock market responses to shared shocks impacting markets within the region. Moreover, this study was conducted considering the major emerging stock markets of south Asia, i.e., Sri Lanka, India, and Pakistan in terms ofsize in the region. The motive for the South Asian region is due to the geographical proximity of these regional equity markets and the close economic, political, and social connection among these countries. These verdicts of the research will be vital for Sri Lankan investors such as Banks, Institutional investors, Pension funds like Employees' Provident Fund (EPF), Employee Trust Fund (ETF) and other high net worth individuals. Given the importance and expansion of these markets, this study aims to estimate both the static and dynamic integration of south Asian equity markets and the effect of one equity market movement to another.

This paper extends and enhances the current body of work on stockmarket integration. Specifically, this study adds to the literature byconcentrating solely on stock market integration in the SouthAsian region. At the same time, this finding contributes to the limited body of studies on emerging markets (Berger et el, 2011). Also, past studies have focused on examining the integration of developed markets and its impact to emerging and frontier markets whereas this study will purely examine the dynamic linkages of south Asian emerging stock markets in boththe short term and long term.

The remainder of this study is organized as follows. Section 2 summarizes the extant literature on stock market integration. Section 3 is about data and methodology. The results and discussion of findings are presented in section 4. The lastsection concludes the paper with implications.

2. REVIEW OF LITERATURE

Most of the economist, policy decision makers, politicians and portfolio managers are highly concerned about the interdependency of the national economies. The main reason for this concern is that the economic movement of one country will affect the other regional economies due to the close relationship of regional countries. Initially, the close relationship among the economies can be examined through their stock markets. In 1997, we could see this situation in East Asian Region countries. Due to the East Asian financial crisis, most of the equity market was crashed and spread toother regional markets.

Accordingly, many researchers have conducted studies on the independence of markets, interdependency of markets, correlation among the markets, co-movements of the markets,short term, and long-term relationship of the markets and linkages of national equity markets in a broader context. Mostof this research covered on East Asian region, Europe, and other developed markets. However, very few of these researches have concentrated on the South Asian stock markets.

2.1 Inter – Linkages among the stock markets

Research findings on the integration and interdependence of stock markets began with Grubel's landmark study in 1968. (Grubel, 1968) empirical research was concerned with the spectrum of possible advantages that US investors may obtain through international diversification. Later, the topic caught interest of many researchers worldwide. (Lessard, 1974), (Hilliard, 1979), (Hamao et el, 2006) and (Becker et el, 1990) did some of the initial foundation works on the subject. They concentrated on the stock markets of developed countries such as the United States, the United Kingdom, Germany, and Japan. (Lamba, 2004) investigated the markets of India, Pakistan, and Sri Lanka in South Asia, as well as the main developed markets, and concluded that the Indian market was not the leader among South Asian nations. (Narayan, Smyth, & Nandha, 2004), as well as (Prakash & Kumar, 2014), attempted to investigate the amount of links between the stock markets of South Asian nations, indicating the presence of long- run relationships as well as the prevalence of short-run linkages. (Khan and Aslam, 2014) researched the co-integration of Pakistan's stock exchange with the other major stock exchanges in South Asia and found evidence of co-integration between Pakistan's stock exchange and the markets of India, Indonesia, Malaysia, and Singapore. (Mukherjee and Bose, 2006) assessed the integration of Asian stock markets with developed-country stock markets and reported the existence of information leadership flowing from the US market towards Asian markets. (Dahl, 2009) attempted to capture the influence of the 2008 global financial crisis on market integration and discovered that the global crisis had a strong moderating effect on the long-run coefficients relevant to regional and worldwide market integration. (Tripathi & Sethi, 2010) discovered Indian stock market to be integrated with the US stock market and in their other paper, they discovered that both the short run and long run integration of the Indian stock market with advanced emerging markets has enhanced over the period of study. (Tripathi, Seth, & Kumar, 2013) performed a research in which they discovered spillover effects on the Indian economy while evaluating the short run inter-linkages and long run co-integration among India and some of the world's major economies, namely, the United States, Europe, other emerging markets, and the global economy.

2.2 Are the ASEAN Equity Markets Interdependent?

Eduardo, Antony, and William (1998) use co-integration methods depend on the Johansen (1988) process, granger causality and variance decomposition, and impulse response analysis to discover the degree and structure of price linkages among five Southeast Asian Nations (ASEAN) markets (Malaysia, Singapore, Philippines, Indonesia, and Thailand) in the long and short run. According to the analysis, these markets are not significantly linked in the long run. Nevertheless, with the exception of Indonesia, all ASEAN markets are inextricably intertwined

in the near run. Malaysia is the most significant market, while Singapore and Thailand have the greatest connections to other markets. Indonesia has no ties to any of the other ASEAN markets. As a result, the ASEAN markets provide excellent opportunities for long-term portfolio diversification. Due to the obvious leads and lags impacts of these markets, such markets provide a chance for arbitrage investors in the short term. Co-integration relationships between these markets have been discovered by (Azman-Saini, Azali, Habibullah, & Matthews, 2002) and (Liew, Lee, & Lim, 2009). (Chien, Lee, Hu, & Hu, 2015) and (Click & Plummer, 2005) both highlighted that ASEAN economies are moving toward financial integration. (Thiam, 2002), on the other hand, said that there was no long-term link between ASEAN members from 1988 to 1997. It is clear from the literature that there is conflicting data on stock market integration. This might be because separate research looked at different marketplaces over different time periods and used different methodology.

2.3 South Asian Stock Market Linkages

(Daly, 2003) explores the steady and transient interconnectedness of the stock markets of Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Australia, Germany, and the United States. The study utilizes both correlation and co- integration analysis to examine the behavior of the aforementioned markets following the initial 1997 Asian Financial Crisis, employing data from 1990 to 2001. Applying correlation analysis, assessing stock returns demonstrates a rise in interdependence across South Asian financial markets in the aftermath of the crisis. For all of the aforesaid stocks, multivariate and bilateral co-integration tests were performed. Since there is evidence of integration across South Asian stock markets, the findings show that there has been no major growth in integration between South Asian stock markets over the post-crisis period. With a few outliers, there is minimal evidence to suggest the presence of any co-integrating vectors in either the multivariate or pairwise co-integration tests.

From the literature presented above, following conclusions can be drawn. Most of the above studies utilized weekly stock market data from different markets over a period of five years or more and analyzed the data using econometric models. Increased investor attention in the South Asian region calls for a comprehensive assessment of equity market integration. Also, limited research has been done on South Asian emerging markets with contradictory findings. An insight into the static and dynamic linkages among these south Asian emerging markets will provide valuable inputs to local as well as international investors to create an optimal investment portfolio.

3. METHODS

This study is an empirical analysis of the short and long-run relationship among south Asian stock markets. The study includes stock market indices of three main stock markets in the south Asian region representing

Sri Lanka (CSE), India (BSE) and Pakistan (KSE). Monthly closing stock price indices are used which were gathered from Bloomberg. The aim of using monthly data is to prevent some of the non-synchronicity of high-frequency data. According to Warren et el, 1990, high frequency data appear to contain "too much noise". The indexes are expressed in US dollars since the majority of global investors utilize the US dollar as their base currency (Click & Plummer, 2005); (Driessen & Laeven, 2007). This research spans the years January 2009 to December 2018. Period after 2019 is excluded from the sample to isolate the significant market shocks happened in the CSE during 2019 to 2021. Before any tests are run, all indices are transformed to natural logs.

This study adopted quantitative research methods. Before analyzing the data, the variables had to be checked for stationarity while deciding the respective lag rates. Two accepted test methods, Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) test, were used to measure the stationarity of the data. Further testing was carried out based on the results of the unit root test. A correlation analysis was conducted to analyze the direct correlation between the equity markets while the long-term relationships were observed based on the results of co-integration analysis. Results were then scrutinized for granger causality, Vector Auto Correlation (VAR), variance decomposition and impulse response analysis. The results from the VAR model were used to perform the study of the decomposition of variances and the reaction of impulses.

3.1 Unit Root Testing

Before analyzing a data series in an econometric model, it is required to assess its comparability. The most common tests for determining series stationarity are the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. This study employed ADF and PP to determine whether or not the data is stationary in the same order. The ADF assumption is that the variance of the error term is constant, and that the error term is the independent variable. ADF has been generalized into PP.

3.2 Correlation Coefficient

Base objective of this research is to identify the correlation between South Asian equity markets. Accordingly, the study should test the hypothesis "South Asian equity markets have a high correlation". In a matrix type, the correlation displays only the association of different variables. The fundamental association measured in this study is based without making any changes on the raw data. Nonetheless, association does not indicate sector causality and trends when analysing South Asian equity market integration.

The coefficient of correlation calculates the degree and magnitude of statistical interaction between two variables. A coefficient of significance can be of a maximum value of 1 and a minimum value of -1. A coefficient of association greater than zero indicates a strong causal relationship between the two variables. A zero-correlation coefficient means that the two

variables do not have a liner association. Correlation is a linear association test between two factors, although it may not always be effective. Two variables may have a strong relationship between variables, but the relationship cannot be proven in the actual situation.

3.3 Cointegration

The Engle-Granger's two-step testwas conducted to examine the long-term relationship of south Asian stock markets. Market indexes were transformed into log form to get the residual series of a regression and created a new regression equation. This regression equation was constructed by taking CSE as the dependent variable, and other two markets as the independent variables. Following which, it checks the unit root of the residual series of the regression.

3.4 Granger Causality Test

The Granger Causality Test was used to investigate the causal links between the variables of the research. The study's time series variables may have unidirectional or bidirectional interactions with one another [Chen et al. (2002), Gilmore and McManus (2012), Gurcharan and Pritam (2016)]. This test is designed to investigate the bidirectional and unidirectional lead and lag connection to identify the effect of one stock market on the other.

3.5 Vector Auto Regression (VAR)

VAR model essentially checks whether a change of one market can influence the movement of another market by using different levels of lags. VAR model is therefore useful in checking the link between markets and in determining the leader and followers in regional equity markets

3.6 Variance Decomposition

The Variance Decomposition is used to compare equities market movements caused by its ownshocks to movements caused by other market shocks. It depicts the Variance Decomposition for each stock market underconsideration in this study. The study's dynamic changes in the stock markets were examined using Variance Decomposition analysis, which determined if the dynamic changes in the stock markets were caused by their movements or by other stock markets. This method allows toexamine the movements of dependent variables due to their own shocks, as opposed to shocks due to the other variables. All other assessment techniques, however, do not provide this own shock analysis, so this is a goodevaluation technique to identify the resilience of the individual markets Variation decompositions estimate howmuch of the a-step-ahead forecast error variance for a particular variable is explained by variances.

3.7 Impulse Response Analysis

The impulse response function is used to examine the dependent variable's reaction to dynamic changes in each variable under consideration. Therefore, it provides very valuable information to determine the regional market leaders, and the time it takes to disperse these shocks to other markets.

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics

Table 1 summarizes several descriptive statistics for the countries' stock markets under investigation. In the table, the Mean comprises the average monthly return, maximum and minimum indicates maximum and minimum monthly return, standard deviation specifies the risk, and skewness suggests that the data is positively or negatively skewed. Therefore, the countries stock markets with higher average monthly returns and low standarddeviation are fruitful for investments. Here in table 1, Pakistan and India indicates higher maximum return of 10.83% and 10.56% respectively. Sri Lanka (CSE) displays a lower maximum return of 8.96% and a risk of 0.33%. The stock indices understudy all the stock indicesare negatively skewed.

4.2 Correlation Matrix

The research employed a correlation matrix to identify the relationship in the South Asian Stock market indices. Depending on the linear strength of the variables the correlation varies from-1 to 1. The correlation between the two stock markets may be positive or negative. The positive relationship shows that when one variable return increases, the other will also increase, and the negative relationship depicts vice versa. If the result is 1, it explains that the two variables will have a higher positive correlation. If it is closer to zero, there will be no correlation between the two variables. If it is closer to -1, there will be a higher negative correlation between the two variables. The results of the correlation metrics are presented in table 2. This table summarizes the correlation coefficients among the main South Asian markets' monthly share prices for the period of 10 years from 2009- 2018. A strong relationship is witnessed between India and Pakistan.

According to the results shown in Table 2 following conclusions can be made about the correlation of the South Asian markets. First, there is a higher positive correlation between KSE and BSE markets, the estimated figure is around 0.92. Secondly, a positive correlation was found between BSE and CSE, however it is not a very high positive correlation as prevailed between KSE and BSE. The estimated correlation coefficient between these two countries were observed at 0.68. Finally, CSE and KSE markets also demonstrated a positive correlation, but this is the lowest correlation when compared with the other two correlations in the region. The calculated correlation value of CSE and KSE was observed at 0.65.

In conclusion, it appears that BSE and KSE have a more positive correlation than CSE and BSE. However, perhaps these results may not depict the correct picture due to the simplicity of the model. Nevertheless, the regression results give more credible outcomes than this. The correlation matrix shows a point- to-point relationship of the markets. However, in a realistic market, it takes some time to adjust to the trend of the regional market indexes according to the other market movement. Therefore, this is not a good estimator to interpret the correlation among the

countries. Instead of point-to-point correlation, it gives more predictive values if it would have taken a lag value.

4.3 Unit Root Test

The co-integration test is used to explore the long-run and short-run relationship among stock markets. The co-integration test requires that the data be non-stationary and of the same order of integration. This study applies two tests to determine whether or not the data is steady in the same sequence. Moon (2001), Chen et al (2002), Gilmore and McManus (2002), Fernández & Sosvilla (2002) performed the Augmented Ducky Fuller (ADF) and Philips Parron (PP) tests. The findings of the Unit Root Tests are summarized in Table 3. The table comprises two sections, Augmented Dicky Fuller test (ADF) And Philips Peron test (P.P.), to identify that the data is stationary at level or maybe at 1st difference for the eight emerging and developed stock markets. This indicates that the information is stationary at 1st difference from both the tests. The results of the ADF and PP tests indicate that all of the variable data is non- stationary in the first difference. As a result, it is obvious that the cointegration test may be used to analyze the long-run relationship.

According to the results, unit root for variables indicates that all variables have less than the critical table value of 2.86 (at significant level of 5 percent), therefore it must accept the unit root test hypothesis. It can thus conclude that all of these series are as non-stationary series. Furthermore, all variables become stationary at the 1st difference as the level variables values are higher than the critical table value of 2.86.

4.4 Cointegration

Cointegration between south Asia equity markets will be analyzed using Engle-Granger's two-step approach to measure the long- term relationship of South Asian equity markets. Market indexes were transformed into log form to get the residual series of a regression and created a new regression equation. This regression equation was constructed by taking CSE as a dependent variable, and other two markets as independent variables. Following this, it checks the unit root of the residual series of the regression. After running this cointegration equation, a separate residual series was created and tested the stationary and non-stationary characteristics of the residual series. If the residual series becomes constant, then this means that the variables have a long-term relationship. ADF unit root test was performed on the residual series to check the unit root position. The result of ADF is given in Table 4, and the residual series is shown in Figure 1 as a graphical presentation. The results depicted that the residual series of the regression are stationary as the calculated ADF unit root value is greater than the critical value of 2.86. Therefore, the unit root hypothesis was rejected as the residual series of these variables were stationary. Thus, it provides evidence of a long-term relationship between BSE, CSE and KSE stock markets. The stationarity of the variables can also be witnessed in the graph's residual line as it crosses the mean value quite often.

Therefore, it is evident that there is no strong cointegration between the regional equity markets. However, this clearly shows some positive long-term relationships among the equity markets in South Asia.

4.5 Granger Causality Test

The Granger causality test was used in the research study to assess the unidirectional or bidirectional links between the time series variables under consideration. Previous research suggested that unidirectional or bidirectional interactions might exist [Chen et al. (2002), Gilmore and McManus (2012), Gurcharan and Pritam (2018)]. If the estimated value (F) is greater than 2.60, then we can reject the null hypothesis of the variables not possessing causality. Usually, if the measured "F" value is greater than 2.6, the variables have a granger causality. The test results are provided for the second lag, in Table 5.

According to Table 5, we come to the following decisions based on the Granger causality test.

1. Hypothesis of “CSE does not granger cause BSE” has to be accepted since the value of “F” is less than the critical value of 2.60. Therefore, it implies that the Colombo market is not granger caused to the BSE market, there is no effect of the CSE Index on the BSE index. However, BSE does not granger cause CSE and the hypothesis has to be rejected since "F" value is greater than the critical value of 2.60. Thus, it is evident that the BSE index has a major impact on the CSE index.
2. As per the analysis on the granger causality between KSE and BSE, the BSE index does not granger cause the KSE index, and there is no granger cause from KSE to BSE as well. Therefore, it is evident that the KSE market is not affected by the BSE market.
3. There is a granger cause from KSE to CSE since the "F" value is lesser than the critical value of 2.60, however, there is no granger cause from the CSE to KSE since F value is less.

4.6 Vector Autocorrelation (VAR)

This section looks at two main research hypotheses. First, regional market correlation, second, market correlation with leading market and lag markets orfollower markets Using VAR, 1st hypothesis is tested. Two tests are conducted under the VAR model. Namely, the test of variance decomposition and the analysis of impulse response. Variance decomposition measures the proportion of the movements in the dependent variable due to its own shock from other variables. Evaluation of the impulse response assesses the second hypothesis about identifying regional market leaders and market followers. It tracks the dependent variable's sensitivity due to a shock from other factors and the time it takes to react. The determination of the appropriate lag length for the variable was done using Akaike and Schwaiz model to perform the VAR test. VAR model calculates and gives the data in terms of "t" value, if the calculated "t" value is higher than 1.96, it implies a significant variable. The results of the

VAR estimation are given in the Table 6. These results were taken by lagging the variables two times.

According to the results of the VAR the following conclusions were obtained.

1. CSE market movement was highly depended upon its own market movements in the first lag, yet the dependency tends to decrease after the second lag. In the first lag, CSE is does not affect BSE or KSE since the calculated "t" values are less than the critical value of 1.96. However, in second lag it affects the KSE market.
2. For BSE, calculated "t" value for CSE and KSE is 1.37 and 0.09 respectively. Therefore, these variables are not significant at 5% confidence interval, or it is not greater than the critical value of 1.96. Hence, it can be concluded that the BSE market movements does not directly affect other two markets.
3. Evaluation of the VAR results of the KSE market shows that it also does not affect the BSE and CSE markets, since the calculated "t" value is lower than the critical "t" value of 1.96. Therefore, there is a no correlation and interdependency between the BSE and KSE stock markets.

4.7 Variance Decomposition

The equity market movements will be evaluated through their own shocks versus movement due to other market shocks. To check the primary hypothesis of "if one market shock affects other markets" and to determine the "regional market leader" Variance decomposition analysis was used. It determines how much of a given variable's step-ahead forecast error variance is explained to each explanatory variable by variances for s= 1,2. In practice, it is generally observed that own series of shocks explain most of the series of error variables in a VAR. The full details of the variance decomposition are given in Table 7. The results are shown for different lag levels for 10 weeks. As per the results of Table 7, the following conclusions on the variance decomposition analysis were made.

1. BSE and KSE market shocks do not exert major effects on the CSE market, 99% of the BSE market movement is affected by its own shocks even at 10th step it remains at 96%. CSE's market movements were highly depended upon its own shocks at initial stages as well as at latter stages. BSE and KSE market shocks are affected by only 3.39% and 0. 15% respectively. Therefore, it was concluded that the BSE and KSE market shocks do not affect the CSE market. Instead of other market shocks, the movement of the CSE market highly depends upon its own shocks.
2. In the BSE market context, 95%of the variance comes from its own shock at the first step. However, at the 10^{th} step, it decreases to 79%. At this stage, CSE and KSE market shocks affect the BSE market by 8.4 % and 12.1%. This result implies that BSE is sensitive to the KSE and CSE

market shocks, but it takes some time to adjust to the market movements according to the other markets movements.

3. At initial stage, other markets shocks do not affect much on the KSE market. However, at the 10th stage, 93% of variance were due its own shocks and 4.41% is due to CSE market shock and remaining 1.63% is attributable to the BSE.

4.8 Impulse Response Analysis

The impulse analysis often tests the theory of "whether a shock in one stock market impacts the other two markets" The other important aspect of a study of the impulse response is assessing the length of the time taken to disperse a shock to other markets. Very often, the same results are given by the Impulse response and the decomposition of variance. Therefore, impulse response test is used to examine the time taken by other markets to witness the impact of these shocks. The data was converted to stationary series by taking the 1st difference of the variables to evaluate the length of the impulse response period.

The results of impulse response analysis are presented graphically in Figure 2. These graphs show how market shocks affect the movements of its own market and the other markets. The diagonal of the graphs shows each country shock for their own response.

The findings of the impulse response analysis have been divided into four major sections.

i. Market response for its own shocks

When a shock in BSE occurs morethan 95 percent of the shock will be self-corrected within 1st week and will not extend into the future. Shocks in the CSE and KSE markets are, however, in complete opposition to the BSE market. When a shock occurs in CSE, in the next week around 60 per cent of the shocks will be corrected but the effect will prevail for another 4 to 6 weeks. A similar pattern occurs also in the KSE market, but the dominant duration is less than the CSE (about 4 weeks).

ii. Reactions of CSE and KSE to shocks in BSE market

When there is a shock in the BSE market, both CSE and KSE respond to that shock immediately. This effect prevails in the CSE for about 5-6 weeks but there is no significant movement in CSE. However, the effect reaches the maximum in the second week on the KSE market but disappears after 5 weeks.

iii. Reactions of BSE and CSE for shock of KSE market

The findings will have no impact on CSE or BSE when there is a shock in KSE, but some effect prevails in both BSE and CSE markets for about 2-3 weeks. Also in this situation, in the second week the effect is increased, and it will be minimized and disappeared within 2-3 weeks afterwards.

iv. Reactions of BSE and KSE to Shock in CSE market

A CSE shock slightly impacts both exist for two weeks.

4.9 Hypotheses

To achieve the objectives of the study, a variety of standard models were used from the published literature. Several important results concerning the correlation of South Asian equity markets emerged as a result of these models. Table 8 summarizes the results of the set hypotheses ofthe study.

5. CONCLUSION

The study is based on time series secondary data of South Asian stock market indices represented by Pakistan (KSE 100), Sri Lanka (ASPI), India (BSE 200). The sample size is based on monthly data of stock market indices from 2009 to 2018. By employing the econometric tools, this study achieved the objectives of finding short-run, long-run and causal relationships among stock marketindices. This study finds a positive correlation between south Asian markets along with a more prominent long-term relationship. BSE and KSE, but it doesn't even About causality and market movements among south Asian markets, there was a unidirectional relationshipbetween BSE and CSE, while KSE and CSE neither affected the other two markets. Overall, the conclusion is that the diversification benefits in these stock markets under investigation are limited for international investors, while short-run diversification benefits may exist.

As the current study is only focused on three south Asian stock markets future researchers can investigate stock market integration for all the South Asian markets. The sample period of thisstudy was also bound to ten years due to time constraint and the future researchers can perform the analysis for much longer whichwould provide more reliability to the results. Further, this study can also be performed using different tests like Arch and Garch to evaluate the risk during portfolio selection and minimize risk in portfolio diversification.

APPENDIX

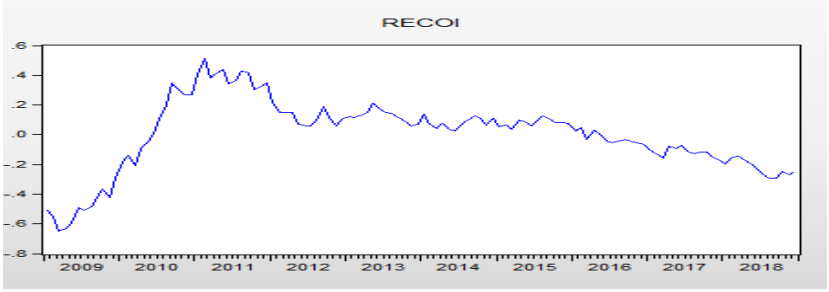

Figure 1: Graphical presentation of the Residual series of the Co integrationtest

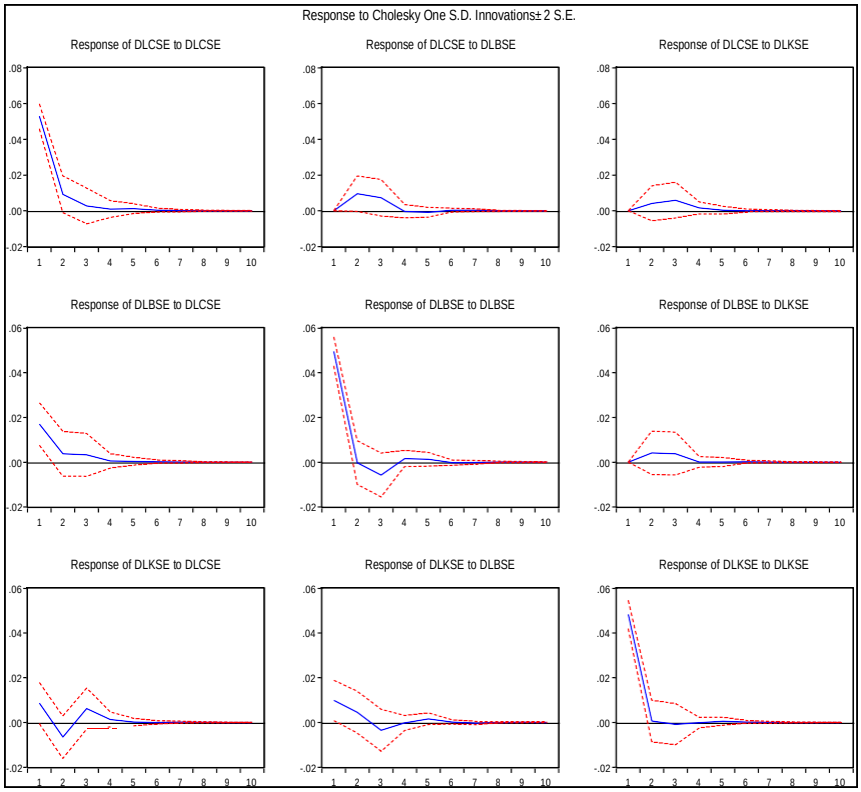

Figure 2: Graphical presentation of the impulse response analysis

Table 1: Summary descriptive statistics of the monthly index returns of eachstock market

Distributional Properties	LBSE	LCSE	LKSE
Mean	10.01	8.63	9.97
Median	9.96	8.74	10.15
Maximum	10.56	8.96	10.83
Minimum	9.09	7.40	8.59
Std. Dev.	0.30	0.33	0.62
Skewness	-0.35	-2.22	-0.33
Kurtosis	3.02	7.36	1.74
Jarque-Bera	2.41	193.44*	10.20*
N	120	120	120

Table 2: Summary results of the correlation metrics

Country	BSE	CSE	KSE
BSE	1.0000	0.6833	0.9260
CSE	0.6833	1.0000	0.6559
KSE	0.9260	0.6559	1.0000

Table 3: Summary Results of the unit root test based on ADF and PP

Variables	Augmented Ducky Fuller		Philips Parron	
	Level	1st diff	Level	1st diff
	T Stat	T Stat	T Stat	T Stat
CSE	-4.44	-8.86	-4.30	-9.26
BSE	-2.49	-8.13	-2.50	-10.75
KSE	-2.82	-10.46	-2.82	-10.45

Table 4: Engel and Granger's two Step Cointegration Residual Test Result

ADF Test Statistic		-3.013748	5% critical value	2.8666
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
RECOI (-1)	-0.065334	0.021679	-3.013748	0.0032
D (RECOI (-1))	0.03304	0.089122	0.370727	0.7116
D (RECOI (-2))	-0.090469	0.088312	-1.024427	0.3079
D (RECOI (-3))	0.142304	0.087192	1.63207	0.1056
D (RECOI (-4))	0.264213	0.088043	3.000966	0.0033
C	0.003857	0.004704	0.819905	0.4141
R-squared	0.169968	Mean dependent var		0.002982
Adjusted R-squared	0.131893	S.D. dependent var		0.053579
S.E. of regression	0.04992	Akaike info criterion		-3.106008
Sum squared resid	0.271634	Schwarz criterion		-2.962794
Log likelihood	184.5955	Hannan-Quinn criter.		-3.047878
F-statistic	4.464054	Durbin-Watson stat		2.036304
Prob(F-statistic)	0.000972			

Table 5: Results of the granger causality test

Pairwise Granger Causality Tests			
Date: 12/18/19 Time: 04:51			
Sample: 2009M01 2018M12			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
DLCSE does not Granger Cause DLBSE	117	0.78845	0.4571
DLBSE does not Granger Cause DLCSE		2.78539	0.066
DLKSE does not Granger Cause DLBSE	117	0.55611	0.575
DLBSE does not Granger Cause DLKSE		0.21985	0.803
DLKSE does not Granger Cause DLCSE	117	1.73704	0.1808
DLCSE does not Granger Cause DLKSE		2.13466	0.1231

Table 6: Result of VAR calculation

Vector Autoregression Estimates			
Date: 12/10/19 Time: 22:07			
Sample (adjusted): 2009M03 2018M12			
Included observations: 118 after adjustments			
Standard errors in () & t-statistics in []			
	LCSE	LBSE	LKSE
LCSE (-1)	0.987277	-0.005221	-0.229192
	-0.09418	-0.09047	-0.09519
	[10.4828]	[-0.05772]	[-2.40772]
LCSE (-2)	-0.061128	-0.061089	0.207743
	-0.09093	-0.08734	-0.0919
	[-0.67226]	[-0.69940]	[2.26042]
LBSE (-1)	0.136138	0.802167	-0.00904
	-0.09927	-0.09536	-0.10034
	[1.37135]	[8.41202]	[-0.09010]
LBSE (-2)	-0.089129	0.055504	-0.061358
	-0.09697	-0.09315	-0.09801
	[-0.91910]	[0.59585]	[-0.62602]
LKSE (-1)	0.006383	-0.008417	0.926124
	-0.09391	-0.09021	-0.09492
	[0.06797]	[-0.09331]	[9.75713]
LKSE (-2)	-0.026631	0.080736	0.086151
	-0.09658	-0.09278	-0.09762
	[-0.27573]	[0.87023]	[0.88252]

C	0.37799	1.290322	0.786655
	-0.25879	-0.24859	-0.26157
	[1.46059]	[5.19054]	[3.00745]
R-squared	0.973979	0.973942	0.993588
Adj. R-squared	0.972573	0.972533	0.993241
Sum sq. resids	0.265351	0.244841	0.271073
S.E. equation	0.048893	0.046966	0.049418
F-statistic	692.466	691.4504	2866.514
Log likelihood	192.311	197.0572	191.0523
Akaike AIC	-3.140865	-3.221309	-3.119531
Schwarz SC	-2.976502	-3.056946	-2.955168
Mean dependent	8.651584	10.02753	9.991576
S.D. dependent	0.295227	0.283385	0.601088
Determinant resid covariance (dof adj.)		0.0000000118	
Determinant resid covariance		0.00000000982	
Log likelihood		585.5827	
Akaike information criterion		-9.569199	
Schwarz criterion		-9.076111	

Table 7: Results of the variance decomposition test

Variance Decomposition of LCSE:				
Period	**S.E.**	**LCSE**	**LBSE**	**LKSE**
1	0.04889	100.0000	0.0000	0.0000
2	0.07003	99.1932	0.80488	0.00196
3	0.08417	98.756	1.23462	0.00942
4	0.09461	98.3819	1.5946	0.02347
5	0.10265	98.0265	1.93053	0.04293
6	0.10897	97.684	2.2505	0.06555
7	0.11401	97.3533	2.55726	0.0894
8	0.11805	97.0365	2.85052	0.11301
9	0.12132	96.7356	3.12915	0.13525
10	0.12395	96.4528	3.39185	0.15531
Variance Decomposition of LBSE:				
Period	**S.E.**	**LCSE**	**LBSE**	**LKSE**
1	0.04697	5.15205	94.848	0.0000
2	0.06013	5.03711	94.9583	0.00462
3	0.06857	4.26087	95.516	0.22316
4	0.0744	3.61901	95.5866	0.7944

5	0.07877	3.43095	94.7829	1.78616
6	0.08233	3.74947	93.0442	3.20637
7	0.08546	4.52441	90.4534	5.02224
8	0.08839	5.65203	87.1767	7.17124
9	0.09123	7.00726	83.4208	9.57192
10	0.09406	8.46676	79.3965	12.1368
Variance Decomposition of LKSE:				
Period	**S.E.**	**LCSE**	**LBSE**	**LKSE**
1	0.04942	0.27832	3.12241	96.5993
2	0.06785	1.86365	2.93563	95.2007
3	0.08252	2.72213	2.14281	95.1351
4	0.09534	3.32287	1.61376	95.0634
5	0.10685	3.76147	1.3025	94.936
6	0.11738	4.06811	1.16497	94.7669
7	0.12711	4.26843	1.16043	94.5711
8	0.13616	4.38177	1.25497	94.3633
9	0.1446	4.42459	1.42127	94.1541
10	0.15249	4.41125	1.63778	93.951

Table 8: Summary Results of the Hypothesis Testing

Hypothesis	**Conclusion**	**Testing method**
CSE is significantly correlated with BSE	✓	Correlation
BSE is significantly correlated with KSE	✓	Correlation
KSE is significantly correlated with CSE	✓	Correlation
As a regional giant, BSE drives other two markets and other two markets follow the BSE market	×	VAR Granger Causality Impulse Response Variance decomposition
Granger causality among the markets	×	Granger Causality
CSE granger cause to BSE	×	
CSE granger cause to KSE	✓	
BSE granger cause to CSE	×	
BSE granger cause to KSE	×	
KSE granger cause to BSE	×	
KSE granger cause to CSE		

Long run relationship among South Asian markets	✓	Cointegration
Effects of one market shock on the other		
BSE market shock on KSE	12.1%	
BSE market shock on CSE	8.4%	
CSE market shock on BSE	3.4%	Variance decomposition
CSE market shock on KSE	Minimal	
KSE market shock on BSE	1.6%	
KSE market shock on CSE	4.4%	

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