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Stock Market Linkages: Examining the case of Emerging South Asian Markets

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Abstract

This study examines the linkages among emerging stock markets belonging to the South Asian Association for Regional Cooperation (India, Pakistan, Sri Lanka and Bangladesh) and the Global economy. The study employs daily closing prices of eminent market indices from a time period 2004-2013. A Johansen Cointegration-Error Correction procedure was employed to check for long and short equilibrium relationships among the markets. Increasing liberalisation and deregulation of these markets may have lead to significant linkages. The results points to the existence of inter linkages among all the markets as well as with the Global economy in the short and long run. The study finds relevance for co-ordinated monetary policies as fluctuations in important macroeconomic variables could be transmitted to the other markets.

Keywords:

Stock Market Linkages, SAARC, coordinated monetary policies, cointegration,VECM

Introduction

In the subject matter of International and Financial Economics, the financial integration of markets holds a special place. The term is used to describe the process of interlinking of regional as well as global financial markets. This integration can take place in the form of sharing of technology, information, financial practices and products among member nations as well as financial institutions. Liberalization of market economies and removal of restrictions on the trading of financial assets has promoted financial integration in present times. However the degree of integration is limited to the degree of imperfections in these markets. The national stock markets have served as a conduit for capital flows and integration of the economies. In this respect, the cross border capital flows have been induced by the investor's needs. Financial integration has been perceived to bring about a better mode of development, saving, investment and asset pricing. In contrast, the risks associated with these include associated interruption and spillover of disturbances among the nations. The process of Globalisation, Liberalisation and Privatisation led to the formation of several economic blocs (trade blocs) and associations is a testimony to this. The EMU (European Monetary Union), EFTA (European Free Trade Association) and the ASEAN (Association of Southeast Asian Nations) are some examples. Among these the South

Asian Association for Regional Cooperation (hereafter known as SAARC) has gained eminence in the recent past. The establishment of SAARC in December 1985 by Ziaur Rahman was done with the objective of fostering the "economic, technological, social and cultural development" of the member nations. This was meant to benefit native as well as foreign investors. The founding members included India, Pakistan, Bangladesh, Nepal, Sri Lanka, Bhutan and the Maldives. Afghanistan was incorporated in 2005. The nations have agreed on 16 areas of cooperation out of which Trade and finance holds relevance in the present study.When we look at foreign participation, the South Asian nations received FDI inflows to the tune of $43 billionin 2011 as reported by the UNCTAD's Global Investment Trends Monitor. According to the UNCTAD International Finance report of 2013, the net FDI flow of the South Asian nations in 2012 was 33,511 million dollars. It points to the lucrative potential of these countries for investments. Increasingly integrated and coordinated policies transmit disturbances the among markets. The degree and rate of this transmission would depend upon the degree of integration or segmentation. In this backdrop,the dynamic linkages among these markets as well as with the global economy will present us with an overview of the working of the stock markets in these countries. This will further enable modifications in investor behaviour for optimum portfolio allocation and diversification for the minimization of risk. The study looks into the case of four emerging nations, namely, India, Pakistan, Sri Lanka and Bangladesh, for ease of comparison with the global economy.

Literature Review

Increasing liberalisation and deregulation of financial markets has spurred a growth of literature on the subject of market integration and stock market linkages.The literature on Market integration has focused on the use of co integration techniques for conducting an analysis of the process. A study by Jochum, Kirchgässner and Platek (1999) focused on the effects of 1997-1998 stock market crisis on the Eastern European markets (including Russia). The study looks into the integration of the stock markets of Poland, Hungary, the Czech Republic, and Russia in the pre and post effects of the crisis. Co integration tests were used to examine the extent of market integration, in addition to preliminary tests including the ADF test (Augmented Dickey fuller test). The transmission of the financial disturbances to these markets wasfound. Another study conducted by Yang, Moosa and Pointer (2003) looked into the effects of the 1987 international stock market crash and capital control on the integration of the market with a number of other markets, including Japan, UK and Germany in the long run. Removal of capital flow barriers along with globalisation has fuelled market integration in these countries. The 1987 crash also did not significantly affect the long run relationships between the US and the international equity markets.The studies concerning Asian markets constituted a major portion by themselves. A study by Paul-McMiken (1997) examines the existence of a collective efficiency for all these nations and uses co-integration tests to examine the long run relationships among them. Barring Indonesia, the co-integration tests reveal that the markets are not collectively integrated. Studies relating to the Indian stock markets are diverse. A study by Mukherjee and Bose (2008) looks into the integration of the Indian markets with developed markets represented by US, Japan and Asia Pacific markets represented by Hong Kong, Korea, Malaysia, Singapore, and Taiwan. The paper uses Johansen Co integration tests followed by VECM analysis using the co integrating relations obtained from the former test. There is existence of information leadership from the US market to the Asian markets. Although a major part of the literature has focused on financial markets in contemporary times, the study by Darbar, Mcfarland and Mcmahon (1993) has looked at financial integration in the 1920s. The paper finds weak form of integration only among the French and Belgium markets, possibly due to lack of coordination of governmental policies.The study by Drakos and Kutan (2005) focuses on stock market integration and foreign exchange markets by looking at Greek and Turkish markets, and uses co integration and Vector Error Correction models (VECM). The short and long run co movements between the two markets have implications for asset pricing. Investor's benefits from portfolio diversification, thus becomes insignificant.The process of globalisation has been identified as one of the driving forces of market integration. In this backdrop, the study by Dhal (2009) focuses on market integration in view of the global financial crisis of 2008.It looks into emerging market economies (EMEs) such as Honk Kong, Singapore and India, with more focus on India. The main result arrived upon by the paper states integration of the Indian stock market with the global as well as the regional markets in terms in US dollars but not in terms of local currency. A possible explanation of this could be due to less participation of Indian investors and hence the process of financial integration may not be complete. Although the literature available for developed economies was extensive, the same cannot be said for emerging economies. However the study by Dhakar (2009), took up an empirical analysis of the efficient market hypothesis and risk-return relationship for emerging stock markets including India, Sri Lanka, Bangladesh and Pakistan. These markets have opened up to opened enormous opportunities of investment due to globalization and deregulation.It employs the use of Ljung Box to examine the cross correlation and various forms of GARCH models to determine the conditional volatility (T-GARCH).The Tokyo, London and New York stock indices were the main focus in Hamao, Masulis, Victor (1990). The

ARCH family of statistical models were used to explore these pricing relationships. The results from this study shows evidence of price volatility spillovers from New York to Tokyo, London to Tokyo, and New York to London. Lee, Livenson try to understand the correlation between stocks in order to develop new insights into modelling the behaviour of financial markets. For this purpose Multivariate stochastic volatility models can be used which model incorporates the impact of correlation effects between stocks. Forte , Manera (2002) on the other hand focused on ten European stock price indices, namely that of U.K., France, Germany, Italy, Belgium, Switzerland, Greece, Portugal, Spain and Holland. Wichard, Merkwirth, OgorzaÃlek (2004) developed a new method for the purpose of detecting the dependencies in the stock market. A cross prediction model is built which uses the normalized modelling error.

Needless to say, the existing literature yields interesting and diverse results when it comes to integration of financial markets for different countries. The Asian markets, specifically the South Asian markets have themselves been subjects of extensive research. However when we look at the process of market integration, it makes sense to look at countries that have formally entered into an association to integrate themselves. The SAARC is one such example. Gaps in literature therefore exist in terms of formal grouping of the countries in contemporary times.

Data and Methodology

The data collected for analysis consists of stock market indices of each of the emerging economies. This has been used as a proxy for the stock markets. The sample used consists of daily closing prices of the indices. The time period considered for the purpose of the paper is 2004-2013. Due to lack of availability of data as well as for easy comparability, the stock market indices of four emerging markets have been taken. The data sources for each index has been summarised in table 1

Table 1:Data sources for the stock indices

Country	Index	Data Source
India	S&P CNX Nifty	Yahoo finance, NSE website
Sri Lanka	CSE	Yahoo finance, www.cse.lk
Pakistan	KSE 100	Yahoo finance
Bangladesh	DSE – General Index	DSE website
Global Market	S&P Global 1200	S&P website

The statistical package used for the study consisted of EViews version 7.0. In addition to this the Microsoft Excel software was also used for the analysis.The initial data set comprised of the daily closing prices of the stock price indices of the respective countries, as listed above. Using this data, the log return was calculated for each of the indices. This was done by the following relation:

$$R_t = [\text{Log}(P_t) — \text{Log}(P_{t-1})]*100 \ldots\ldots\ldots\ldots..(1)$$

The computed log return series then form input for further analysis. The data was subjected to initial stationarity tests to test for the presence of unit root. The ADF unit root test and the panel unit root test were employed. The result of the test is interpreted as follows:If the test statistic is lesser than the critical value, the H_0 is rejected, and there is no unit root. If the test statistic is higher than the critical value, the H_0 is failed to be rejected, and there is a unit root present.Once the test statistic was found to be significant, confirming the presence of autocorrelation, the series were subjected to co-integration tests, namely the Johansen Cointegration procedure. In case of non-stationary series, the relationship between two variables can be estimated through simple OLS or the Ordinary least squares method of regression. However if they happen to be stationary, then this method becomes redundant. In such a case, the variables will have equilibrium relationships between them. These relationships are called co integrating vectors. These vectors can be estimated using the Johansen Co integration test It was developed by Granger (1983), Granger and Weiss (1983) and Engle and Granger (1987). If the test indicates the presence of co-integration, it points to the presence of common trends among the stock markets.If the test shows the presence of co integrating vectors or equations, the next step is the application of the Vector Error Correction Model. This evaluates the relations among them in the short run, in the case of such a co integrated series. In this, the changes in each of the stock markets have been expressed in terms of the lagged changes in the returns of the other four markets as well as the Vector Error Correction term. If the Johansen procedure reveals co-integrating relationships in the long run, then, the mode of adjustment undertaken by the markets in order to align with the other markets , will be reflected in

their changes .This shows the amount of time taken for the error to correct itself.

Analysis and Interpretation

The log return series of all the five market indices were first subjected to stationarity tests that is, the unit root ADF test and the panel unit root tests.The ADF equations for the variables namely the stock returns can be specified as follows:

$$\Delta CSE_t = \alpha + \beta t + \Upsilon CSE_{t-1} + \delta_1 \Delta CSE_{t-1} + \ldots\ldots\ldots\ldots + \delta_{t-p+1} + \varepsilon_t \ldots\ldots\ldots (2)$$

$$\Delta DSE_t = \alpha + \beta t + \Upsilon DSE_{t-1} + \delta_1 \Delta DSE_{t-1} + \ldots\ldots\ldots\ldots + \delta_{t-p+1} + \varepsilon_t \ldots\ldots\ldots (3)$$

$$\Delta KSE_t = \alpha + \beta t + \Upsilon KSE_{t-1} + \delta_1 \Delta KSE_{t-1} + \ldots\ldots\ldots\ldots + \delta_{t-p+1} + \varepsilon_t \ldots\ldots\ldots (4)$$

$$\Delta NSE_t = \alpha + \beta t + \Upsilon NSE_{t-1} + \delta_1 \Delta NSE_{t-1} + \ldots\ldots\ldots\ldots + \delta_{t-p+1} + \varepsilon_t \ldots\ldots\ldots (5)$$

$$\Delta SP_t = \alpha + \beta t + \Upsilon SP_{t-1} + \delta_1 \Delta SP_{t-1} + \ldots\ldots\ldots\ldots + \delta_{t-p+1} + \varepsilon_t \ldots\ldots\ldots (6)$$

The ADF test statistic was found to be significant at all critical levels i.e. 1%, 5 % and 10%. This was true for both ADF with constant and ADF with constant and trend. The results for the different stock market indices as well as the global economy has been summarised below. The null hypothesis states that the returns have a unit root, whereas the alternative states that they do not have a unit root. The results show the rejection of the null hypothesis, implying that the series are stationary.

Table 2: ADF unit root test with constant

ADF with constant	CSE	DSE	KSE	NSE	SP
Null Hypothesis	CSE has unit root	DSE has unit root	KSE has unit root	NSE has unit root	SP has unit root
ADF t statistic	-48.92591	-31.73414	-43.74197	-46.75190	-39.15031
Prob*	0.0001	0.0000	0.0000	0.0001	0.0000
Test critical value					
1%	-3.433049	-3.433757	-3.432965	-3.432943	-3.432914
5%	-2.862618	-2.862932	-2.862581	-2.862572	-2.862559
10%	-2.567390	-2.567558	-2.567370	-2.567365	-2.567358

**MacKinnon (1996) one-sided p-values*

Table 3: ADF unit root test with constant and trend

ADF with constant trend	CSE	DSE	KSE	NSE	SP
ADF t statistic	-48.91835	-31.73195	-43.73289	-46.76704	-39.15327
Prob*	0.0000	0.0000	0.0000	0.0000	0.0000
Test critical value 1%	-3.962108	-3.963115	-3.961989	-3.961959	-3.961917
5%	-3.411798	-3.412290	-3.411739	-3.411725	-3.411704
10%	-3.127787	-3.128079	-3.127752	-3.127743	-3.127731

**MacKinnon (1996) one-sided p-values*

Additionally a panel unit root test was conducted to examine the collective stationarity of the data across each cross section. The individual unit root unit tests have limited power, hence the panel root test emerges from the time series unit root tests. Specifically the Levin-Lin-Chu Test and Im, Pesaran and Shin (IPS) Test. The sample data has five cross sections. The null hypothesis is that all the individuals have a unit root. The analysis shows that the test statistic (Levin, Lin & Chu as well as the Im, Pesaran and Shin W statistic) is significant, thus rejecting the null and implying the existence of stationarity in the collective sample.

Table 4: Panel unit root test

	Statistic	Prob.**	Cross-sections
Levin, Lin & Chu t*	-49.7599	0.0000	5
Im, Pesaran and Shin W-stat	-51.2303	0.0000	5
ADF - Fisher Chi-square	1053.04	0.0000	5
PP - Fisher Chi-square	123.372	0.0000	5

The results hence indicate the presence of stationarity at level for all the data series. The series are therefore integrated of the order I(0). That being said, the presence of stationarity in the series, allows for the analysis of the data for long run equilibrium relationships among the variables, namely the stock returns of the respective nations as well as the with the global economy. The existence of such relationships among the returns would imply the existence of a certain degree of market integration, both global and regional. The data was hence subjected to the Johansen Cointegration test. If x^i represents the stock return of country i and x^j represents that of country j, then the Cointegration relationship can be represented by the equation:

$$x^i_t = c + dx^j_t + z_t \ldots\ldots\ldots (7)$$

The data was examined through the Trace test as well as the Maximum Eigen value test. The results of analysis can be summarised as follows:

Table 5: Cointegration Trace test

Hypothesized		Trace Statistic	0.05 Critical value
No. of CE (s)	Eigen Value		
None*	0.197580	398.2032	33.87687
At most 1*	0.182265	364.0006	27.58434
At most 2*	0.173528	344.7751	21.13162
At most 3*	0.168164	333.0720	14.26460
At most 4*	0.155514	305.7711	3.841466

Table 6: Max Eigen value test

Hypothesized		Trace	0.05 Critical
No. of CE (s)	Eigen Value	Statistic	value
None*	0.197580	1745.822	69.81889
At most 1*	0.182265	1347.619	47.85613
At most 2*	0.173528	983.6182	29.79707
At most 3*	0.168164	638.8431	15.49471
At most 4*	0.155514	305.7711	3.841466

Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level*
***MacKinnon-Haug-Michelis (1999) p-values*

Both the trace as well as the Max Eigen value tests shows significance for the presence of 5 co integrating equations at 5% significance level. It implies that there are cointegrating relationships among each of the markets with the other. It holds true for both regional as well as global market integration. Each of the four regional emerging markets is integrated with the neighbouring markets as well as with the global economy. A possible explanation of such integration could be the magnitude and nature of foreign investments to these countries. Following this, the data was then subjected to the Vector error correction mechanism. If a co integrating relationship of the form exists:

$$x^i_t = c + dx^j_t + z_{t;}$$

then there exists a error correction representation of the following form is possible :

$$x_t^i - x_{t-1}^i = \alpha_o + \alpha_1 z_{t-1} + B_1(L)(x_t^i - x_{t-1}^i) + B_2(L)(x_t^j - x_{t-1}^j) + e_{1t}$$

$$x_t^j - x_{t-1}^j = \alpha_2 + \alpha_3 z_{t-1} + B_3(L)(x_t^i - x_{t-1}^i) + B_4(L)(x_t^j - x_{t-1}^j) + e_{2t} \ldots\ldots(8)$$

The VECM model can be interpreted as follows: A change in x_j as well as the error term or disturbance of the previous period produces a short run effect. The error term represents the adjustment in the long run to past deviations. Hence the VECM provides a picture of the nature and speed of this adjustment. This is important for understanding the cross border EMH, since is implies adjustments between two stock markets. Existence of co integration means, that the changes in the stock prices in one market could be predictable by the changes in another market. Hence such market linkages would imply inefficiency. Having identified the number of co integrating vectors among the markets, we can say that the results point to the existence of market linkages in the long run. Each of the market is linked to the other in a long run path. However the short run linkages can be examined using the co-efficient of the Error term in the VECM equations. The results can be summarised as follows:

Table 7: Vector Error Correction Estimates

Variables	D(CSE)	D(DSE)	D(KSE)	D(NSE)	D(SP)
CointEq1	-0.095707	-0.141007	-0.014712	-0.089233	0.065145
	(0.01450)	(0.00750)	(0.01033)	(0.00834)	(0.00667)
	[-6.59868]	[-18.8049]	[-1.42361]	[-10.7035]	[9.76283]
D(CSE(-1))	-0.636079	0.084874	-0.000781	0.074803	-0.048022
	(0.02407)	(0.01245)	(0.01715)	(0.01384)	(0.01108)
	[-26.4227]	[6.81952]	[-0.04556]	[5.40593]	[-4.33601]
D(DSE(-1))	0.309959	-0.192672	0.105404	0.204749	-0.187546
	(0.05659)	(0.02926)	(0.04032)	(0.03253)	(0.02604)
	[5.47696]	[-6.58518]	[2.61392]	[6.29422]	[-7.20319]
D(KSE(-1))	0.006005	0.024267	-0.602596	-0.032600	0.006586
	(0.03154)	(0.01631)	(0.02247)	(0.01813)	(0.01451)
	[0.19038]	[1.48827]	[-26.8145]	[-1.79825]	[0.45387]
D(NSE(-1))	0.195626	0.216368	0.061831	-0.486373	-0.065251
	(0.04318)	(0.02232)	(0.03077)	(0.02482)	(0.01987)
	[4.53045]	[9.69219]	[2.00965]	[-19.5960]	[-3.28462]
D(SP(-1))	-0.223343	-0.289485	0.000856	-0.167768	-0.607902
	(0.05592)	(0.02891)	(0.03985)	(0.03215)	(0.02573)
	[-3.99367]	[-10.0124]	[0.02147]	[-5.21908]	[-23.6273]
C	0.001756	-0.000429	0.001044	0.000950	0.000827
	(0.08020)	(0.04146)	(0.05714)	(0.04610)	(0.03690)
	[0.02190]	[-0.01036]	[0.01827]	[0.02061]	[0.02241]
R-squared	0.375643	0.406951	0.294506	0.352691	0.444913
F-statistic	98.39663	112.2250	68.27145	89.10909	131.0848

The value of the co-efficients represents deviations of the markets from the long run equilibrium path. Addionally the speed of adjustment of these stock markets can also be estimated from the ECT (error correction term) coefficient values. Table 7 summarises these values for each of the stock markets. The results point to the fact that all the stock markets of the SAARC; namely, India, Pakistan, Sri Lanka and Bangladesh showed a negative response to the vector error correction term. On the other hand the S&P 1200 index which represents the global economy was the only one that showed a positive response to the VEC term. The VECM model implies that the presence of co-integration causes the stock markets to adjust themselves in order to align with those of the other countries. This adjustment is reflected in the changes in the stock returns. Additionally the speed of adjustment of the stock markets to return to the long run equilibrium path can be estimated. For the Indian stock market represented by the NSE CNX NIFTY index, the coefficient reveals that the about 11 days is required to revert back to its potential long run path. For the Bangladesh stock market represented by the DSE-G index, the speed of adjustment is estimated to be 7 days. Similarly, the speed was estimated at 10, 71 and 15 days respectively for CSE, KSE and S&P 1200 respectively. The Indian stock market took the longest time to align with the lagged returns of the Colombo stock exchange and the Karachi stock exchange. CSE took the longest amount of time to adjust to the changes in KSE with lagged value of 1. The largest amount of time taken is by KSE to the changes in the global stock market index. On the other hand, the response of the each of the markets to the VECM term of the other markets has been summarised in table 8.

Table 8: Response of each of the markets to the lagged returns of the other markets

	CSE	DSE	KSE	NSE	S & P 1200
CSE(-1)		Positive	Negative	Positive	Negative
DSE(-1)	Positive		Positive	Positive	Negative
KSE(-1)	Positive	Positive		Negative	Positive
NSE(-1)	Positive	Positive	Positive		Negative
S &P 1200(-1)	Negative	Negative	Negative	Negative	

The Sri Lankan stock exchange showed a positive response to the VEC term of all the markets except the global economy. The same can be said for the Dhaka stock exchange. The Karachi stock exchange responded positively to the Dhaka stock exchange and the Indian stock exchange, and negatively to the Sri Lankan and global markets. Interestingly, the S & P 1200 index representing the global market, responded positively only to the Karachi stock exchange.

Conclusion

The study focussed on examining the nature and extent of market integration among the emerging nations as well as with the global economy. The CNX NIFTY, DSE-G, KSE-100, CSE-ASPI and S & P 1200 indices were subjected to the Johansen co-integration approach. The series were found to be integrated of the order I(0). The results pointed to the existence of five co-integrating equations among the markets, indicating stock market linkages at the regional SAARC level as well as the global economy. This implies that the number of common trends driving these markets is quite high. It shows there is interdependence among the prices, implying that efficient portfolio diversification cannot take place. The significance of the co-integration tests points to the existence of long term relationships among the stock market returns.Next, the VECM results were reported for individual daily return series, for examining the relationship in the short run. The VEC term showed a positive response for the Global market, whereas a negative relation with all other market indices. Also, the speed of adjustment was estimated for each of the indices to the lagged returns of the other indices. Addionally the co-integrating relationship was found to be significant not only in the long run, but in the short run as well. The formal grouping of these nations hence may have produced secondary effects in terms of significant market linkages. The SAARC was incorporated in 1984, with the objective of socio-economic-politico cooperation. The nations formally agreed upon bilateral trade and economic agreements, providing room was market linkages.Decision makers in these nations need to take into account the extent of market efficiency in order to improve on market conditions with minimum state interference. Capital flows to and from the regional as well as the global markets have triggered fluctuation in foreign exchange rate, money supply, as well as a change in investor behaviour and portfolio

management. The significance of market linkages points to the fact that the markets are inefficient. The returns in any one market can be predicted by using the past information in the other markets That being said, policy framers and decision makers have to account for impact of these linkages while deciding on monetary policies and to improve market conditions.

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