THE INTEGRATION OF INDIAN AND SAARC STOCK MARKETS – AN EMPIRICAL STUDY

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ABSTRACT

This study has attempted to find out relationships between BSE SENSEX and four SAARC Indices, namely, KSE 100, DSE 20, CSE Milanka and NEPSE indices both in the long-run and short-run, by using suitable statistical methods and Monthly indices data from April, 2007 to March, 2012. ADF and PP tests results showed that all variables have contained a unit root and are integrated of order one. Johansen and Juselius's cointegration test has pointed out at least one cointegration vector and long-run relationships between BSE SENSEX with some other markets. The Granger causality test has also found few short-run unilateral and bilateral causal relationships between BSE SENSEX with the SAARC indices..

Keywords: *BSE SENSEX; SAARC Indices; JJ Cointegration test; Granger Causality test; Long-run and short-run relationships.*

JEL Classification: *C1, G1.*

Introduction:

In South Asia, over 70% of the growth in the last two decades came from financial sector development and it is very important to pace up this momentum. The rapid growth of Indian economy and financial sector, the potential of growth in Pakistan, the peace dividend in Sri Lanka, the inclusive growth approach of Bangladesh, and the prospects of growth in Bhutan, Nepal and Maldives make great prospects for the South Asian (i.e., SAARC [South Asian Association of Republic Countries]) region and holds promise for the international investing community [Mishra (2012: 27-34)].

At the same time, the external economic and global stock markets environment has become increasingly challenging and uncertain. Although direct financial linkages, such as exposures to Euro Area banks, are limited, contagion from the European debt crisis has hit equity finance all round the globe. However, many regional stock markets including SAARC had retreated in concert with the rest of the world during the second half of the financial year 2011-12. While the external environment is expected to remain difficult, South Asian governments have limited space with which to introduce fiscal stimulus measures, mainly due to large fiscal deficits, and the possibility of monetary easing is constrained by sustained high inflationary pressures.

Integration of financial (including stock) markets is one of the most extensively discussed topics of financial literature. Various factors contributed in this regard, such as cross border investment flows, technological innovations in communications, scientific trading, and settlement systems, and the introduction of innovative financial products. Globalizations also played a pivotal role in increasing the interest in the study of dynamic inter-linkages among financial markets [Hasan, Saleem and Abdullah (2008: 52-62)].

Though there is no proper definition of stock markets integration, but, the literature is quite rich in investigating the inter-linkages among regional stock markets since such linkages have serious implications for portfolio diversification as well as macroeconomic policies of the countries concerned [Bose (2005: 84-124); Stulz (1999: 8-25)] argued that as stock markets become more integrated, the cost of capital decreases because of the removal of investment barriers allows for risk sharing between domestic and foreign agents. Investment Barriers like exchange rate risk, legal and tax differences, information availability, foreign

ownership restrictions, etc. can prevent markets from integrating [Errunza and Losq (1985: 105-124); Stulz (1981: 923-934)].

Thus, financial integration would benefit the region through more efficient allocation of capital, a higher degree of risk diversification, a lower probability of asymmetric shocks, and a more robust market framework [Pauer (2005: 144-151)]. However, intensified financial linkages in a world of high capital mobility may also lead to the financial instability in one country being transmitted to neighbouring countries more rapidly.

Amidst all these conflicting situations, it is relevant, essential and timely for both investors and academicians to be acquainted with the trend of various regional stock markets including SAARC. The issue is also necessary for policymakers to argue that if equity markets appear to be closely related, there is a chance that any uncertainty in one market can be spread to other interdependent markets. Keeping this in mind, this study has selected five SAARC stock markets, namely that of India, Pakistan, Bangladesh, Sri Lanka and Nepal to find out the short-run and long-run interdependence and integration in between them by using monthly data that span from April, 2007 to March, 2012. The other SAARC markets have been excluded from this study because of their lack of and irregular trading information.

To find out both the short and long-run relationships in between them, this study has used descriptive statistics (to state the nature and normality of the data series), ADF [Dickey and Fuller (1979: 427-481; 1981: 1057-1072)] and PP [Phillips and Perron (1988: 335-346)] tests (to find out the stationary nature or unit root issues), Johansen and Juselius's (JJ) (1990: 169-210) cointegration technique and Granger's (1969: 425-435) causality test. All these results would be very useful for the policy makers, traders, investors and others concerned along with the future researchers.

The rest of the paper is organized as follows. A survey of the existing literature including empirical evidences on the nature of the long-run and short-run causal relationships between Indian and other SAARC stock markets is conducted in Section 2. Section 3 presents the data descriptions, variables undertaken for this study and discusses the research methodology to be employed for investigation and analysis purposes. Section 4 reports the empirical results and discussions including descriptive statistics, ADF and PP tests, JJ cointegration test and Granger causality test followed by conclusion in Section 5.

Literature Survey:

Over the past few decades, the interrelationships and co-movement among national stock markets has dominated both academic and practitioners literature. Previous empirical studies of interrelationships of the major world stock indices have not revealed consistent results. This is due to inconsistency in the sample period chosen, choice of markets, and frequency of observations (daily, weekly or monthly) and different research methodologies employed to investigate such interdependence of equity markets [Chen et al. (2002: 1113-1141)].

So, it is appropriate to review the literature available on the topic since conflicting signals emerge from the literature about the existence of such interrelationships. Thus, some of the most recent relevant and important studies focused on South Asian markets and in line with the research objectives have been presented here.

Naeem (2002) examined the linkages between stock price indices of the South Asian countries- Pakistan, India, Sri Lanka and Bangladesh and developed countries like the United States and United Kingdom by using Johansen bivariate and multivariate cointegration analysis for monthly data ranging from January 1994 to December 1999. The results provided the evidence of no cointegration among the South Asian equity market indices for the entire period but found cointegration for the pre nuclear test period (i.e., from January 1994 to April 1998). However, The South Asian equity markets were not cointegrated with the equity markets of the United Kingdom and of United States. This implied that there was a potential for risk minimization by investing in the equity market of either the U.K or the U.S. and any one of the South Asian equity market.

Narayan et al. (2004: 419-439) used selected daily data ranging from January 2nd, 1995 to November 23rd, 2001 by employing cointegration tests and Granger causality tests to examine the dynamic linkages between the stock markets of Bangladesh, India, Pakistan and Sri Lanka within a multivariate cointegration framework. In the short-run there is unidirectional Granger causality running from stock prices in Pakistan to India, stock prices in Sri Lanka to India and from stock prices in Pakistan to Sri Lanka. Bangladesh is the most exogenous of the four markets.

Lamba (2005: 383-402) conducted a study to investigate short-term and long-term relationships of a few south Asian stock markets (i.e., India, Pakistan and Sri Lanka) with some developed markets (i.e., US, UK and Japan). He looked at the correlations among different markets and elaborated the analysis using multivariate co-integration approach covering July 1997 – December 2003 data. He reported that the South Asian markets were relatively isolated from the developed stock markets but they are becoming more integrated with each other within the region at a very slow pace.

Gunasinghe (2005: 165-191) examined the integration across the stock markets of India, Sri Lanka, and Pakistan, after liberalization policies started in the

early 1990s. The multivariate cointegration provided no evidence of any long-run relation across these markets mean that these markets were not dependent on each another.

Mohsin and Qayyum (2005: 1-12) studied inward and outward capital mobility between five South Asian countries (Pakistan, India, Bangladesh, Sri Lanka and Nepal). They analyzed market integration from saving and investment prospective. Their findings did not support the hypothesis that there exists a perfect mobility of capital across the five countries, which indicates lack of economic integration. However, they observed that the capital mobility has improved after economic liberalization at least in Bangladesh and Nepal. They concluded that in general the financial markets in South Asia are not perfectly integrated among each other and with the rest of the world.

Sharma and Bodla (2010: 29-40) studied India, Pakistan and Sri Lanka covering daily data from January 1st, 2003 to June 30th, 2010 as these three countries are the most dominant ones in terms of trade and polity in the region. They found that the Indian stock market Granger causes Pakistani and Sri Lankan stock markets and no other indices is found to Granger cause any other indices. The study also conducted variance decomposition analysis and reported that the stock markets in South Asia (represented by those three indices) were not much influenced by each other. They concluded that there exist opportunities for investors to diversify their investment among South Asian countries.

Subhani et al. (2011: 117-121) analyzed co-integration for Asian stock markets that includes stock indices from four SAARC countries (India, Pakistan, Bangladesh and Nepal). They employed multivariate co-integration between Pakistani stock market and the rest and failed to accept the hypothesis of no co-integration in the equity market in South Asian region. However, when co-integration was analyzed on one to one basis between Pakistani stock market and the rest, the finding suggested that Pakistani and Bangladeshi markets were co-integrated but with Indian and Nepalese markets there was no cointegration.

Kharka, Turan and Kaushik (2012: 8-20) used weekly data from January, 2006 to December, 2011 period of Bhutan, India, Nepal, Bangladesh, and Pakistan stock markets. They analyzed long-term relationship between regional indices on one to one basis using pair wise cointegration test and market integration as a whole by employing multivariate approach. They found that all indices are stationary at I(1) by ADF tests and confirmed no long-term relationship between Bhutanese with Indian and other regional stock markets. In fact they found no market integration either on one to one basis or for the south Asian markets as a whole.

This study would further develop the existing literature by investigating the nature of interdependence and integration of the SAARC stock markets till 2012.

Data, Variables and Research Methodology:

Data:

I have used monthly data from April, 2007 to March, 2012 to examine the relationships between the BSE SENSEX Index (i.e., B-SENSEX) (used as a proxy to Indian stock markets) with other SAARC stock markets indices, namely, KSE 100 Index (K-100), DSE 20 Index (D-20), CSE Milanka Index (C-MILANKA) and NEPSE Index (NEPSE) representing Pakistan, Bangladesh, Sri Lanka and Nepal stock markets respectively. The stock markets of Bhutan and Maldives have not been considered under this study for their minimal transactions and mostly non-operational nature. The data were obtained from the Annual and Monthly Reports of Bombay Stock Exchange (BSE) (India), Karachi Stock Exchange (KSE) (Pakistan), Dhaka Stock Exchange (DSE) (Bangladesh), Colombo Stock Exchange (CSE) (Sri Lanka) and Nepal Stock Exchange (NEPSE) (Nepal), and also from monthly bulletins of Securities and Exchange Board of India (SEBI) and Reserve Bank of India (RBI), World Bank bulletins, South Asian Federation of Exchanges (SAFE) and World Federation of Exchanges (WFE) Bulletins, Bloomberg, etc.

Variables:

BSE SENSEX Index (B-SENSEX):

BSE Ltd. formerly known as Bombay Stock Exchange (BSE) is a stock exchange located on Dalal Street, Mumbai and is the oldest stock exchange in Asia as it traces its origin way back in 1850. In 1956, the BSE became the first stock exchange to be recognized by the Indian Government under the Securities Contracts Regulation Act, 1956. The BSE developed the BSE SENSEX Index in 1986, giving the BSE a means to measure overall performance of the exchange. The BSE SENSEX Index, also called 'BSE 30', is a widely used market index in India and Asia. BSE SENSEX Index is significantly correlated with the stock indices of other emerging markets, namely the BRICS. The equity market capitalization of the companies listed on the BSE was US$1 trillion as of December 2011, making it the 6th largest stock exchange in Asia and the 14th largest in the world. The BSE has the largest number of listed companies in the world. The BSE SENSEX Index value reached 17404.20 by March 2012. The equity market capitalization of the companies listed on the BSE SENSEX Index was approximately Rs. 14,591.41 billion by that time. Also, as of March 2012, the number of listed companies were 5,133.

KSE 100 Index (K-100):

The Karachi Stock Exchange (KSE) is a stock exchange located in Karachi, Sindh, Pakistan. Founded in 1947, KSE is the oldest, biggest and most liquid exchange in Pakistan. On November 1st, 1991 the KSE 100 Index was introduced and remains to this day the most generally accepted measure of the Exchange. KSE 100 index is used as a benchmark to compare prices overtime and companies with the highest market capitalization from each sector are selected and included in it to ensure full market representation. The KSE 100 Index value reached 13761.76 by March 2012. The equity market capitalization of the companies listed on the KSE 100 Index was approximately US$ 40 billion approximately by March 2012. Also, as of March 2012, the number of listed companies were approximately 700.

DSE 20 Index (D-20):

Dhaka Stock Exchange (Generally known as DSE) is the first and main stock exchange of Bangladesh. First incorporated as East Pakistan Stock Exchange Association Ltd. on April 28th, 1954 it started formal trading in 1956. Post-liberation, in 1976 trading restarted in Bangladesh and on September 16th, 1986 DSE started its journey. The DSE 20 Index symbolises the top companies of Pakistan in terms of trading and market capitalisation. The DSE 20 Index value reached 3777.20 by March 2012. The equity market capitalization of the companies listed on the DSE 20 Index was approximately US$ 23.75 billion by that time. Also, as of March 2012, the number of listed companies were approximately 232.

CSE Milanka Index (C-MILANKA):

The Colombo Stock Exchange (CSE) established formally in 1985 is the main stock exchange of Sri Lanka. It is one of the most modern exchanges in South Asia, providing a fully automated trading platform. The Milanka Price Index (MPI) is one of the most prominent indices of CSE. The CSE Milanka Index value reached 4891.60 by March 2012. The equity market capitalization of the companies listed on the CSE Milanka Index was approximately US$ 20 billion by that time. Also, as of March 2012, the number of listed companies were approximately 280.

NEPSE Index (NEPSE):

The Nepal Stock Exchange Limited popularly called NEPSE is the only Stock Exchange of Nepal. NEPSE opened its trading floor on January 13th, 1994. The NEPSE Index is primarily an all equity market index of NEPSE. It is regulated by the Securities Board of Nepal. The NEPSE Index value reached 298.90 by March 2012. The equity market capitalization of the companies listed on the NESPE Index was approximately US$ 2,82,067.59 million by that time. Also, as of March 2012, the number of listed companies were 215.

Research Methodology:

Stationary Tests:

A data series is called a stationary series if its mean and variance are constant over a given period of time and the covariance between the two extreme time periods does not depend on the actual time at which it is computed but it depends only on lag amidst the two extreme time periods.

This study has tested the stationarity of the time series data of the above mentioned variables most systematically to rule out the likely spurious results. Since the testing of the unit roots of a data series is a precondition to the existence of cointegration relationship, originally, the Augmented Dickey-Fuller (ADF) tests are widely used to test for stationarity [Dickey and Fuller (1979: 427-481; 1981: 1057-1072)]. Thus, this study has employed the ADF tests to verify the stationarity issue.

In order to test for unit root through ADF tests, the following equation is used:

$$\Delta y_t = \alpha_0 + \lambda y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \qquad (1)$$

In the above equation, the null hypothesis of $\lambda = 0$ against the alternative hypothesis of $\lambda < 0$ is tested. So, the null hypothesis of non-stationarity would be rejected if λ is negative and significantly different from zero.

Phillips and Perron (PP) (1988: 335-346) used non-parametric statistical methods to take care of the serial correlation in the error terms without adding lagged difference terms. The test regression for the PP test is the AR (1) process in which the following equation is used:

$$\Delta Y_t = b_0 + \beta Y_{t-1} + e_t \qquad (2)$$

Johansen and Juselius's (JJ) Cointegration Test:

Whether the data is stationary at levels or non-stationary at levels but stationary when differenced, i.e., I(1), determination of the proper multivariate time series analysis technique has to be done. The VAR method requires the variables to be stationary at levels to obtain proper estimates of the coefficients. If the series are non-stationary at levels but stationary when differenced once, i.e., the series are integrated to the order 1 [i.e., I(1)], the use of cointegration analysis and the VECM is more appropriate [Goswami and Jung (1997)].

To explore long-run relationships between the BSE SENSEX Index and other SAARC stock markets indices, Johansen and Juselius's (1990: 169-210) cointegration technique has been used. This technique

resolved most of the problems attached with Engle and Granger technique. This technique gives maximum Eigen Value and Trace Value test statistics for determining the number of cointegrating vectors.

In order to fulfill the above objective, the following VECM-specific equation is used:

$$\Delta x_t = A_0 + \sum_{j=1}^{k-1} \Gamma_j \Delta x_{t-j} + \Pi x_{t-k} + \varepsilon_t \quad (3)$$

Where:

$$\Gamma_j = -\sum_{i=j+1}^{k} A_j \quad \text{and} \quad \Pi = -I + \sum_{i=j+1}^{k} A_j \quad (4)$$

[Sohail and Hussain (2011: 66-74)]

The Trace and the Maximum Eigen Value test could be used to find the number of cointegrating vectors. As the Trace [Likelihood Ratio (LR)] statistic is more robust than the Maximum Eigenvalue statistic [Cheung and Lai (1993: 103-112)], therefore, this study has used the former method in order to establish the long-run relationships among the variables.

Also, if the test statistic is greater than the critical value from the Johansens's tables, this study would reject the null hypothesis that there are r cointegrating vectors in favour of the alternative hypothesis under the said test in line with Brooks (2002).

Model:

To explore long-run relationships between the BSE SENSEX Index and SAARC stock markets indices variables, this study has employed the following econometric model:

$$\textbf{BSE SENSEX} = \beta\ \textbf{K-100} + \beta_1\ \textbf{D-20} + \beta_2\ \textbf{C-MILANKA} + \beta_3\ \textbf{NEPSE} + \varepsilon_t \quad (5)$$

Granger Causality Test:

Granger's (1969: 425-435) causality test is used here to establish short-run relationships between stock prices of Indian stock market and other selected SAARC markets. It also measures the precedence and information content but does not itself has causality in the more common use of the term.

Under the Granger causality test, the null hypothesis is $\Sigma\alpha_i = 0$ for all values of i. To test this hypothesis, the F-test is applied, as shown below:

$$F = \frac{(RSS_R - RSS_{UR}) / m}{RSS_{UR} / (n - k)} \quad (6)$$

[Gujarati (2004 : 698)]

If the computed *F*-value exceeds the critical *F*-value at the chosen level of significance, the null hypothesis is rejected. This would imply that the Indian stock market as represented by the BSE SENSEX Index 'Granger causes' or improves the prediction in stock prices of other SAARC markets and vice versa.

Empirical Results and Discussions:

Descriptive Statistics Results:

Table 1: Descriptive Statistics

	B-SENSEX	K-100	D-20	C-MILANKA	NEPSE
Mean	16164.89	10904.69	2964.004	4246.427	589.8675
Median	16935.41	11261.99	2533.485	3566.850	563.1500
Maximum	20509.10	15125.29	5204.980	7552.700	1175.380
Minimum	8891.610	5377.420	1392.550	1631.300	298.9000
Standard Deviation	2949.858	2404.103	930.1319	1703.720	219.8514
Skewness	–	–	0.575317	0.399304	0.508714
Kurtosis	1.001446	0.333026	2.247328	1.977662	2.387354
Jarque-Bera	3.464303	2.555107	4.726184	4.207371	3.526240
Probability	10.56789	1.603890	0.094129	0.122006	0.171509
	0.005072	0.448456			
Observations	60	60	60	60	60

Table 1 represents the summary statistics of the variables under this study. The average monthly index for BSE SENSEX is 16164.89 during the study period (April, 2007 – March, 2012) with a high standard deviation (i.e., 2949.858) implying a volatile stock market. On similar grounds, the volatility factor is also true in all other SAARC stock markets except NEPAL may be. The value of skewness of the above variables has pointed out that all of them had extreme values during the study period. It indicates a deviation from normal distribution of the data and volatility in those parameters. The value of kurtosis has pointed out that B-SENSEX had leptokurtic distribution (i.e., >3) with values concentrated around the mean and thicker tails. This means high probability for extreme values which is observed from the above table. The kurtosis value of all other variables indicated platykurtic distribution (i.e., <3) and the values are wider spread around the mean. Jarque-Bera test statistic measures the difference of the skewness and kurtosis of the data series with those from the normal distribution.

Correlation Results:

Table 2: Correlations Results

		B-SENSEX	K-100	D-20	C-MILANKA	NEPSE
Pearson Correlation	B-SENSEX	1.000	.598	.594	.741	-.392
	K-100	.598	1.000	.169	.334	-.028
	D-20	.594	.169	1.000	.896	-.719
	C-MILANKA	.741	.334	.896	1.000	-.754
	NEPSE	-.392	-.028	-.719	-.754	1.000

Table 2 has pointed out the different correlations as was existed between BSE SENSEX Index and other SAARC stock markets indices during the period of this study. Some

of such relationships were very significant in the context of the BSE SENSEX movement and also in their interdependent co-movements. It is observed that B-SENSEX has significant positive relationships with Sri Lankan stock market and positive relationships with Pakistan and Bangladesh stock markets. However, NEPSE Index had a negative relationship with Indian stock markets. Similarly, it has also been found that all the SAARC stock markets (except Nepal) have positive and sometimes very significant integration with other peers.

ADF and PP Tests Results:

Table 3.1: Augmented Dickey-Fuller (ADF) Tests with Intercept and no Trend

Variables	Level	1st Difference	Conclusion
B-SENSEX	–1.770648 (–3.5457)	–5.380437* (–3.5478)	I(1)
	–1.770648 (–2.9118)	–5.380437 (–2.9127)	
	–1.770648 (–2.5932)	–5.380437 (–2.5937)	
K-100	–1.460924 (–3.5457)	–5.252661* (–3.5478)	I(1)
	–1.460924 (–2.9118)	–5.252661 (–2.9127)	
	–1.460924 (–2.5932)	–5.252661 (–2.5937)	
D-20	–1.410822 (–3.5457)	–5.391831* (–3.5478)	I(1)
	–1.410822 (–2.9118)	–5.391831 (–2.9127)	
	–1.410822 (–2.5932)	–5.391831 (–2.5937)	
C-MILANKA	–0.844497 (–3.5457)	–3.827841* (–3.5478)	I(1)
	–0.844497 (–2.9118)	–3.827841 (–2.9127)	
	–0.844497 (–2.5932)	–3.827841 (–2.5937)	
NEPSE	–0.978760 (–3.5457)	–4.553684* (–3.5478)	I(1)
	–0.978760 (–2.9118)	–4.553684 (–2.9127)	
	–0.978760 (–2.5932)	–4.553684 (–2.5937)	

*** Critical value at 1% significance level.**

Table 3.2: Phillips-Perron (PP) Tests with Intercept and no Trend

Variables	Level	1st Difference	Conclusion
B-SENSEX	–1.897720 (–3.5437)	–7.351659* (–3.5457)	I(1)
	–1.897720 (–2.9109)	–5.380437 (–2.9118)	
	–1.897720 (–2.5928)	–5.380437 (–2.5932)	
K-100	–1.339792 (–3.5437)	–6.616371* (–3.5457)	I(1)
	–1.339792 (–2.9109)	–6.616371 (–2.9118)	
	–1.339792 (–2.5928)	–6.616371 (–2.5932)	
D-20	–1.647148 (–3.5437)	–7.210272* (–3.5457)	I(1)
	–1.647148 (–2.9109)	–7.210272 (–2.9118)	
	–1.647148 (–2.5928)	–7.210272 (–2.5932)	
C-MILANKA	–0.910681 (–3.5437)	–6.691423* (–3.5457)	I(1)
	–0.910681 (–2.9109)	–6.691423 (–2.9118)	
	–0.910681 (–2.5928)	–6.691423 (–2.5932)	
NEPSE	–1.073012 (–3.5437)	–7.045104* (–3.5457)	I(1)
	–1.073012 (–2.9109)	–7.045104 (–2.9118)	
	–1.073012 (–2.5928)	–7.045104 (–2.5932)	

*** Critical value at 1% significance level.**

In order to check the unit roots in the above data series, the ADF and PP tests have been applied at levels and first difference. Table 3 has indicated the results of ADF and PP tests, i.e., stationary level of all non-stationery variables with intercept and no trend. We know that, all non-stationary variables should have the same level of integrating factor for cointegration analysis. According to my results, all variables of this study have the same order [i.e., I(1)].

Johansen and Juselius's (JJ) Cointegration Test Results:

The results of stationarity tests are given in Table 3. The results depicted that the variables involved in this study are integrated of order one, i.e., I(1). Therefore, the Johansen and Juselius's (1990: 169-210) cointegration technique has been applied to examine the long-run relationships between the BSE SENSEX Index and other SAARC stock markets indices. In multivariate cointegration analysis using JJ technique, the first step is the appropriate lag selection for the variables. The Akaike Information Criteria (AIC) [Maddala and Kim (2000)] and Schwarz Information Criteria (SIC) have been widely used in the time series analysis to determine appreciative length of the

distributed lag. One lag length has been selected equal in this study on the basis of both AIC and SIC (see Table 4).

Table 4: Akaike Information Criteria (AIC) and Schwarz Information Criteria (SIC)

AIC Value	SIC Value	Lag
–2115.939	–2114.883	(1 1)
–2063.048	–2061.095	(1 2)
–2012.225	–2009.357	(1 3)
–1952.174	–1948.377	(1 4)

Note: This criteria is used to determine the lag length - the smaller the value of the information criteria, the 'better' the model is.

Test statistics are calculated allowing for an intercept and no trend term in the cointegrating equation (CE) and test the VAR.

Table 5: Results of JJ Cointegration Test Likelihood Ratio (Trace) Test for Cointegrating Rank

Variable	Eigenvalue	Likelihood Ratio (LR)	5% Critical Value	1% Critical Value	Hypothesized No. of CE(s)
B-SENSEX	0.389131	78.47905	77.74	85.78	None*
K-100	0.324330	49.89240	54.64	61.24	At most 1
D-20	0.240439	27.15351	34.55	40.49	At most 2
C-MILANKA	0.164094	11.20267	18.17	23.46	At most 3
NEPSE	0.013814	0.806809	3.74	6.40	At most 4

***(**) denotes rejection of the hypothesis at 5% (1%) significance level.**

LR test indicates 1 co-integrating equation(s) at 5% significance level.

The results of the Johansen and Juselius's Trace test are shown in Table 5. At the 5% significance level the Trace test suggests that the variables are cointegrated with $r \neq 0$. It indicates that there is at least one cointegration vector, i.e., one CE in order to establish the long-run relationships among the variables.

Model (Long-run relationships) Results:

After the normalization of the first cointegrating vector on BSE SENSEX, normalized cointegrating coefficients are estimated as reported in Table 6.

Table 6: Normalized Cointegrating Coefficients (statistically significant results at $\alpha = 0.05$)

B-SENSEX	K-100	D-20	C-MILANKA	NEPSE
1.000000	–	1.127336	–1.502727	–
S.E.	0.860014	(0.94590)	(0.49878)	11.85686
t-value	(0.15415)	–0.525	4.250	(2.91467)
	3.779			1.732

The first normalized equation is estimated as below:

BSE SENSEX = 0.860014 K-100 – 1.127336 D-20 + 1.502727 C-MILANKA +11.85686 NEPSE + ε_t

According to the first normalized equation, Indian stock prices (i.e., the BSE SENSEX) has shown significantly positive relationships with the Pakistan, Sri Lanka and Nepal stock markets in the long-run which has suggested that Indian stock market's cointegration with those markets. This finding is in line with Naeem (2002) and Lamba (2005: 383-402), but contradicts the findings of Gunasinghe (2005: 165-191), Sharma and Bodla (2010: 29-40), Subhani et al. (2011: 117-121) and Kharka, Turan and Kaushik (2012: 8-20).

Granger Causality Test Results:

Table 7: Granger Causality Test Results

Null Hypothesis:	Observations	F-statistic	Probability
K-100 does not Granger Cause B-SENSEX	59	0.07845	0.78044
B-SENSEX does not Granger Cause K-100		5.89081	0.01846
D-20 does not Granger Cause B-SENSEX	59	0.07013	0.79212
B-SENSEX does not Granger Cause D-20		6.03842	0.01712
C-MILANKA does not Granger Cause B-SENSEX	59	1.43621	0.23580
B-SENSEX does not Granger Cause C-MILANKA		0.72273	0.39887
NEPSE does not Granger Cause B-SENSEX	59	3.58675	0.06341
B-SENSEX does not Granger Cause NEPSE		0.08571	0.77079
D-20 does not Granger Cause K-100	59	0.61173	0.43743
K-100 does not Granger Cause D-20		0.07281	0.78828
C-MILANKA does not Granger Cause K-100	59	2.78015	0.10102
K-100 does not Granger Cause C-MILANKA		3.93329	0.05225
NEPSE does not Granger Cause K-100	59	2.50309	0.11926
K-100 does not Granger Cause NEPSE		2.57705	0.11405
C-MILANKA does not Granger Cause D-20	59	13.2555	0.00059
D-20 does not Granger Cause C-MILANKA		1.23987	0.27025
NEPSE does not Granger Cause D-20	59	4.56278	0.03706
D-20 does not Granger Cause NEPSE		3.78887	0.05662
NEPSE does not Granger Cause C-MILANKA	59	4.37169	0.04109
C-MILANKA does not Granger Cause NEPSE		0.39760	0.53090

This study has applied Granger causality test as proposed by C. J. Granger (1969: 425-435) with 1 lag. Granger proposed that if causal relationship exists between variables, they can be used to predict each other. Results from Granger causality test are given in Table 7.

The results showed that BSE SENSEX Index prices (i.e., B-SENSEX) Granger causes the KSE 100 Index and the D-20 Index. This means that Pakistan and Bangladesh stock markets are integrated with Indian stock markets in the short-run. It is also found that Pakistan stock market has unidirectional Granger causality with Sri Lankan stock market which in turn granger causes D-20 Index. Nepal and Sri Lankan stock markets also have unidirectional granger causality. Bi-directional granger causality has also been found in between Nepal and Bangladesh stock markets. Overall, this study has found some significant unidirectional and bi-directional Granger

causality relationships between the selected SAARC stock markets indices and Indian stock markets.
Thus, the overall Granger causality test reveals significant short-run causal relationships between Indian stock markets (i.e., BSE SENSEX Index) and selected SAARC stock markets which ultimately is the evidence of integration of SAARC markets in the short-run.

Conclusion:

To conclude, the analysis has revealed that the Indian stock markets as proxied by the BSE SENSEX Index formed significant long-run relationships and integration with three out of four SAARC stock markets. The Johansen and Juselius's (1990: 169-210) co-integration test has suggested that the BSE SENSEX Index has been cointegrated with those markets. It is observed that in the long-run, the Indian stock prices are positively related to Pakistan, Sri Lanka and Nepal stock markets. However, correlation results contradict in NEPSE Index case. This study has also found some significant short-run interdependency between the BSE SENSEX Index and other SAARC stock markets indices as selected under this study by applying Granger causality test. This indicates SAARC stock markets integration in the short-run.
Most of the above SAARC stock markets are also integrated with other global and developed stock markets, especially the USA, BRICS, etc. Thus, future studies should also take into consideration the cointegration relationships in between them. Also, all stock markets are dependent on some local and global macroeconomic factors, situations and events. For example, financial environments and crises in the US, Europe, other parts of Asia, etc., capital inflows and outflows by the FIIs and others, etc. should also be considered in this kind of studies to provide reliable and concrete results.
Thus, inclusion of more world-related variables keeping in mind the domestic and international factors with a longer time-frame may improve the results of future studies.

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