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CO-INTEGRATION OF STOCK MARKETS OF SAARC COUNTRIES - A STUDY

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Abstract: *The SAARC policies aim to promote welfare economics, collective self-reliance among the countries of South Asia, and to accelerate socio-cultural development in the region. The study is conducted to analyze how the countries are interrelated in terms of stock market. For this various statistical techniques like unit root test, Pearson co-relation and Johansen co-integration test have been applied to determine the relationship of the stock indices of the SAARC countries. According to the study there is a possible co-integration and positive co-relation among the stock markets of SAARC countries and hence investors will be having less opportunity of diversifying their portfolio in these markets.*

Keyword*: SAARC countries , stock market, unit root , Johansen co integration , Pearson co-relation, Portfolio.*

Jel Classification: *G10, G 14*

INTRODUCTION

The South Asian Association for Regional Cooperation (SAARC) is an economic and geopolitical organization of eight countries that are primarily located in South Asia. There is a good scope for investment as well as development among the countries in future **(Devanthran, 2009).** Various factors like reforms of financial markets in early 1990s, advent of floating exchange rate in 1973 and Asian currency crisis in 1997-1998 have established a strong pitch for the dynamic relationship between stock and foreign exchange markets of SAARC countries. It is generally believed that integrated financial stock markets benefit through efficient allocation of capital, greater opportunities for risk diversification. At the same time, integration would help in improving the capacity of economies to absorb crisis and foster development. Although many financial markets in SAARC countries are at developing stages, there exists a greater potential to become a regional financial hub. Past study by **Khan and Sajid (2007)** examined the interest rate linkages among four SAARC countries with respect to USA by taking monthly data from 1990 to 2006.The result suggested possible co integration between interest rates of

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these countries. Study by **Narayan *et al.* (2004)** examined the dynamic linkages as well as impulse response reactions among the stock markets of India, Bangladesh, Sri Lanka and Pakistan over the period 1995–2001 and found that stock prices in Pakistan is granger-cause by stock prices of Sri Lanka, Bangladesh and India in the long run but in short run there is unidirectional Granger causality running between stock prices in different markets. As investors are now looking towards emerging south Asian economies for getting better returns, this study will further examine the co integration and correlation between these stock markets. If markets are highly co-integrated with each other then the investors will be having no opportunity of diversifying their portfolio.

LITERATURE REVIEW

Evanor and Palac (1997) examined the co integration of ASEAN stock markets using the unit root and the co integration tests. The results of co integration test suggested that with the exception of Indonesia all the markets are linked with each other. But for investors, the results suggested good scope for efficient portfolio diversification across these markets. **Mansor (2000)** used bivariate and multi variate co integration to analyze the interaction between stock prices and exchange rates in Malaysia. For analysis three exchange rate measures were used: the real effective exchange rate, the effective exchange rate and the RM/US$ rate. The result from bivariate models indicated no long run relationship between stock market index and any of the exchange rates. The result of multivariate test showed a unidirectional causality from stock market to exchange rates. **Alam *et al.* (2001)** examined the co integration between real exchange rate and real short run interest rate using a panel data set for 10 Asian countries. The study covered the data for 10 Asian countries from the period 1971-2000.The results indicated co integration between real exchange rate and real short run interest rate differential in the case of nine out of ten Asian countries. **Wong *et al.* (2005)** investigated the short- and long-term relationship between India and three developed markets USA, UK and Japan for a period from January 1, 1991 through December 31, 2003. The result suggested long run integration between India and these developed markets and in short run both USA and Japan granger causes Indian stock market. **Dimitrova (2005)** studied the relationship between stock price indices and exchange rates by taking data from the period January 1990 through August 2004 by applying Durbin-Watson test, Granger Causality test and Dickey Fuller test. It was found that the depression in the currency depresses the stock market. **Husain and Qayyum (2006)** investigated the characteristics of the South Asian stock markets and the effect of the liberalization on these markets. The study included minimum 4 SAARC countries and also investigation was done with the help of regression test. The result suggested significant growth in the stock markets of this region but development of these markets has not much impact on the real economy.

Syriopoulos (2007) studied long and short run stock market behaviour of developed nations ie. US and Germany and major nations of Central European for pre and post EMU sub-period. Co integration vector resulted into long term integration between studied variables. US market showed a leading effect and European market shows stronger linkage with other countries. **Harri *et al.* (2009)** studied the relationship between oil, exchange rates, and commodity prices by taking monthly observations ranging from the period January 2000 to September 2008. The models used in the study were the Johansen model, Augmented Dickey-Fuller Test (ADF), Corrected Akaike Information Criterion (CAIC) and the Schwarz Bayesian Criterion (SBC). The results showed that there is a strengthened relationship between corn & oil and interrelation was found between corn, exchange rates, and oil. **Kui *et al.* (2009)** used the vector error correction model to examine long term and short term dynamic linkages between China and international main stock market. The data has been collected for weekly closing price for stock market indices during the period December 1992 to December 2008. It was found that in long term there was co-movement between China and international stock markets and in short term the stock market in China has been directly or indirectly been impacted by international main stock markets which varies under different regimes. **Ershad and Dayal (2009)** analyzed the challenges of preferential trade liberalization and regional integration in South Asia by examining regional and international trade structures of South Asian countries through conventional trade measures. It was found with the existing low level of bilateral and intra-original trade shares and low trade with South Asian countries, the gains from free trade arrangements in this region are likely to be minimal. **Hosseini *et al.* (2011)** studied linkages between stock market and four macro level variables ie. crude oil, inflation rate, money supply and industrial production in case of India and China. The multivariate co integration and vector error correction model techniques resulted into linkage between stock market indices and macro variables in long and short run. **Sujit and Kumar (2011)** investigated the dynamic relationship among gold price, stock returns, exchange rate and oil price during the peiod January 1998 to June 2011 by applying vector autoregressive, unit root tests, granger causality test .The result suggested direct influence of exchange rates on gold prices, oil prices and stock market index. **Kollias *et al.* (2012)** examined the linkages between exchange rates and stock prices in the case of the euro-dollar rate and two composite European stock market indices: the FTSE Euro top 300 and FTSE. All-Share Index using daily data from 2/01/2002 to 31/12/2008. The causality between the corresponding markets was carried out through the application of rolling unit root, co integration and granger causality tests. On the basis of the rolling co integration analysis, it was found, there was no long-run relationship between exchange rates and stock markets. The results from the rolling Granger causality tests indicated time-varying causality. **Tripathi (2012)** studied inter linkages of the Indian Stock Market with some emerging markets viz., Hungary, Brazil, Taiwan, Poland, South Africa and

Mexico by taking daily data for 1992-2009. Johansen co-integration and Granger's causality test used for study found inter linkages of the Indian Stock Market with these markets has increased over the study period in short run and long run. **Samanta and Zadeh (2012)** analysed the co-movements of various macro variables in the world economy. The result indicated possible existence of co-movements among the variables in world economy but all of them do not move together. The stock prices and gold prices move on their own but the exchange rates get changed by other variables. **Sanjeet and Gagandeep (2012)** examined the linkage between stock markets of BRIC countries. Co integration and unit-root tests were applied to check the stationary nature of the series. Granger's causality model, vector auto regression model and decomposition analysis were applied to find out the linkages between markets. The results revealed Russian, Indian and Brazilian stock exchanges affects each other but none of these affect Chinese stock exchange whether they all get affected by Chinese stock exchange. **Aviral *et al.* (2013)** used the methodology of wavelet multiple correlation and multiple cross-correlation examined the integration of nine Asian stock markets. The study revealed that Asian stock markets are highly integrated at all frequencies. However, multiple cross-correlations showed that cross- correlation increases with lower frequencies but decreases with lags at all frequencies. and studied the return patterns in equity stock markets. **Jakpar *et al.* (2013)** examined the long run relationship of volatility between China and ASEAN-5 countries stock markets by using monthly price data from year 2000 to 2009 from China, Malaysia, Singapore, Thailand, Indonesia and Philippines by using co integration test, granger causality techniques and found that China and ASEAN countries have relationship in the stock market volatility. **Walid *et al.* (2014)** studied the relationship between emerging stock markets of the BRICS countries (Brazil, Russia, India, China and South Africa) and major global factors using the quantile regression approach for the period from September 1997 to September 2013.The result suggested dependence of these markets with global factors. **Gürıþ and Kiran (2014)** studied the relationship between gold prices and the US dollar/Turkish lira exchange rate between 1990–2011.The co-integration results indicated threshold co-integration relationship between the them and granger causality test found evidence of bi-directional causal relationship between these two variables. The results suggested gold to be only partial hedge against the exchange rate. **Arbes and Hoetoro (2014)** studied the effect of oil price, dollar exchange rate, and stock exchange index on gold price in U.S.A for a period of 2006-2012 using error correction model. A significant positive impact of U.S Dollar exchange rate on gold prices was found while stock exchange index was found to have inverse effect on gold prices in the short run .But long run impact of these three variables on gold price was insignificant. **Papadamou and Markopoulos (2014)** examined the interrelationship between returns of major exchange rates like EUR/USD,GBP/USD,JPY/USD and precious metals like gold & silver using a vector autoregressive model in a multivariate asymmetric GARCH framework

on the intraday frequency. The result indicated a unidirectional volatility transmission from the currencies like EUR/USD,GBP/USD to precious metals. **Sadorsky (2014)** examined the relationship between emerging market stock prices and the prices of copper, oil and wheat using VARMA-AGARCH and DCC-AGARCH models to estimate the volatility dynamics and conditional correlations. It was found oil to be the cheapest hedge for emerging market stock prices while copper is the most expensive one. **Dasgupta (2014)** investigated the integration and dynamic linkages of international stock markets with different time-horizon. The study used Jarque-Bera test, ADF test, Z-Test, VAR test, Engle-Granger test. The findings of the study revealed that long run relationship exists between the BRIC and US stock markets. It was also found that there is no scope of long-term equilibrium relationship between the Indian and Brazilian stock markets. The most dominant role has been taken by the Chinese stock market in impacting the other BRIC stock markets more than others. It was concluded that in the coming future BRIC stock markets are the most favourable destination for global investors.

OBJECTIVES OF THE STUDY

- To study the co integration between the stock markets of SAARC countries.
- To study the correlation between the stock markets of SAARC countries.

DATA AND METHODOLOGY

The data for stock indices has been taken for four countries: India, Pakistan, Bangladesh, and Sri Lanka (as data for other countries was not sufficiently available), by taking past monthly data of stock indices for the countries from the period 1st January 2001 to 31st December 2014. To check the stationary property of all the variables used in the study, Augmented Dicky-Fuller unit root test (ADF) **(Dicky and Fuller, 1979)** has been applied. Johnson co-integration test has been applied to find out the presence of co-integration among the stock indices. Also Karl Pearson coefficient of correlation has been used to check the correlation among the stock indices.

HYPOTHESIS OF THE STUDY

Hypothesis 1

Ho: Unit root exists in the data series.

Ha: Unit root does not exist in the data series.

Hypothesis 2

Ho: There is no co integration between stock markets of India and other SAARC countries

Ha: There is co integration between stock markets of India and other SAARC countries

Hypothesis 3

Ho: There is no correlation between stock markets of India and other SAARC countries

Ha: There is correlation between stock markets of India and other SAARC countries

RESULT AND ANALYSIS

ADF UNIT ROOT TEST

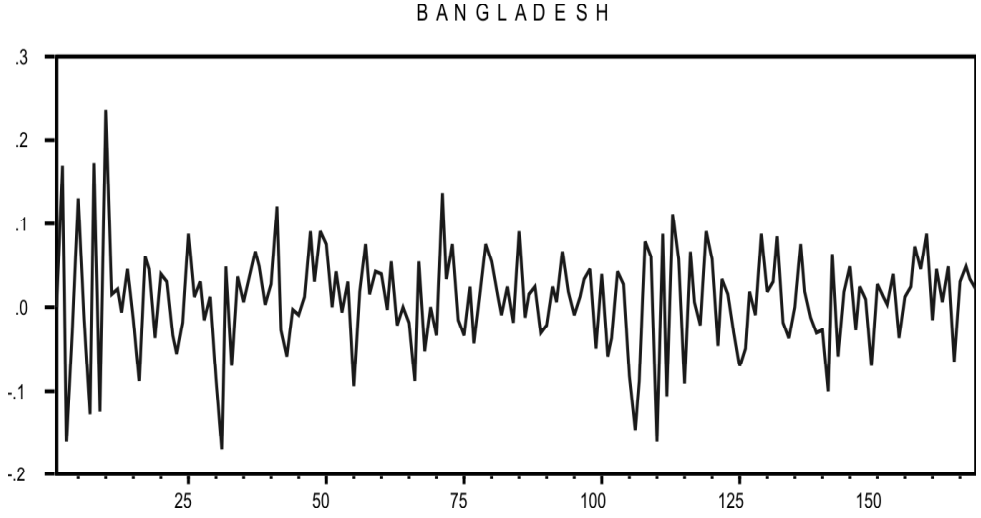
Table 1
Bangladesh Level Intercept

Null Hypothesis: BANGLADESH has a unit root

Exogenous: Constant
Lag Length: 12 (Fixed)

		t-Statistic	*Prob.**
Augmented Dickey-Fuller test statistic		-3.224284	0.0204
Test critical values:	1% level	-3.472813	
	5% level	-2.880088	
	10% level	-2.576739	

*MacKinnon (1996) one-sided p-values.
Source: Authors' Calculations



Source: Authors Compilation

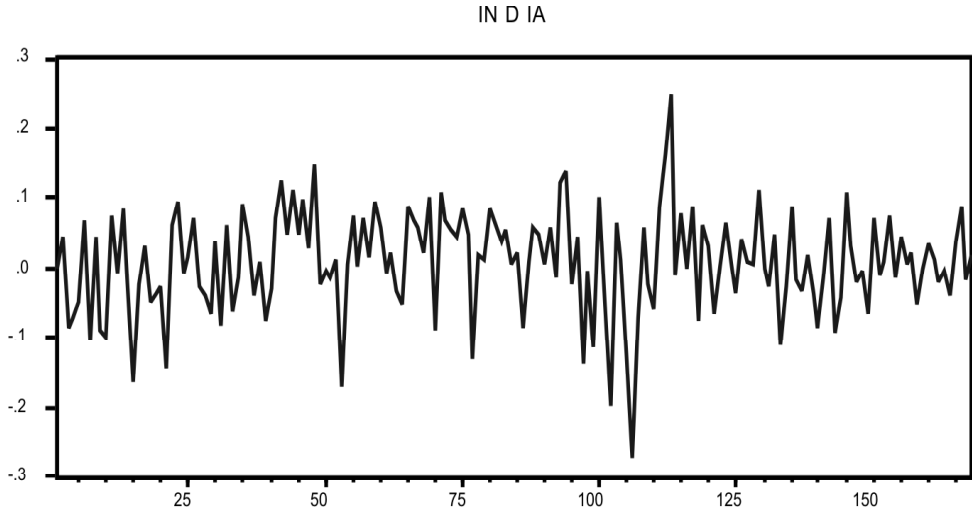
Table 2
India Level Intercept

Null Hypothesis: INDIA has a unit root

Exogenous: Constant
Lag Length: 12 (Fixed)

		t-Statistic	*Prob.**
Augmented Dickey-Fuller test statistic		-3.354596	0.0141
Test critical values:	1% level	-3.472813	
	5% level	-2.880088	
	10% level	-2.576739	

*MacKinnon (1996) one-sided p-values.
Source: Authors' Calculations



Source: Authors' Calculations

Table 3
Srilanka Level Intercept

Null Hypothesis: SRILANKA has a unit root

Exogenous: Constant
Lag Length: 12 (Fixed)

		t-Statistic	*Prob.**
Augmented Dickey-Fuller test statistic		-3.104435	0.0283
Test critical values:	-3.472813	-3.472813	
	-2.880088	-2.880088	
	-2.576739	-2.576739	

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

S R I L A N K A

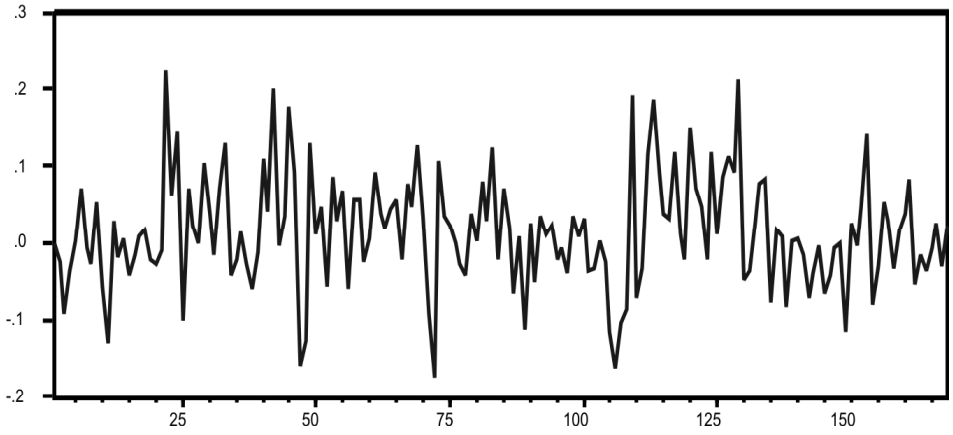


Table 4
Pakistan Level Intercept

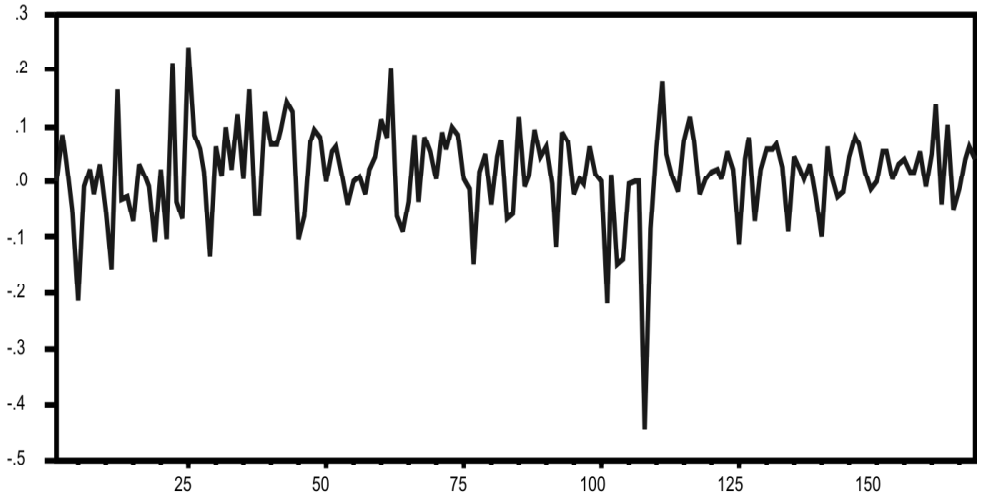
Null Hypothesis: PAKISTAN has a unit root

Exogenous: Constant
Lag Length: 12 (Fixed)

		t-Statistic	*Prob.**
Augmented Dickey-Fuller test statistic		-3.094291	0.0290
Test critical values:	-3.472813	-3.472813	
	-2.880088	-2.880088	
	-2.576739	-2.576739	

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

P A K IS T A N



Interpretation

The result obtained by using non stationary data can be unauthentic. So to check whether the data is stationary or not, ADF test has been applied. The results of ADF test shows the p value is less than .05 hence the data is stationary. So null hypothesis (i.e. data series is not stationary) will be rejected and alternate hypothesis (i.e. data series is stationary) will be accepted.

SELECTION OF OPTIMAL LAG

Table 5
Lag Table

Lag	*Akaike Information Criteria*	*Schwarz Criterion*
LAG 1	-9.816725	-9.443312
LAG 2	-10.00740	-9.332514
LAG 3	-9.937851	-8.959008
LAG 4	-9.858323	-8.573012
LAG 5	-9.798080	-8.203755
LAG 6	-9.680726	-7.774802
LAG 7	-9.566502	-7.346359
LAG 8	-9.481219	-6.944200
LAG 9	-9.417106	-6.560516
LAG 10	-9.537183	-6.358286
LAG 11	-9.487278	-5.983302
LAG 12	-9.441142	-5.609271

Interpretation

Table 2 shows the lags from 1 to 12.The optimal lag no will be that which has low Akaike information criterion i.e. (-10.00740).So the minimum criteria lies with lag 2, which will be used in Johansen co-integration test for further analysis.

Table 6
Johansen Co-Integration Test Table

Hypothesized No. of CE(s)	*Max Eigen value*	*Trace Statistic*	*Critical value*	*Prob***
None	100.0963	223.9436	47.85613	0.0001
At most 1 *	53.87467	123.8472	29.79707	0.0000
At most 2 *	41.80554	69.97256	15.49471	0.0000
At most 3*	28.16703	28.16703	3.841466	0.0000

Interpretation

In the above table the trace test statistic values denotes the rejection of null hypothesis at 0.05 level and supports the alternative hypothesis i.e. there is a

evidence of co-integration between the stock market of four countries. Moreover trace statistic in Max-eigenvalue test is more than the critical value so the null hypothesis is rejected. The Max eigenvalue test and trace test gives at most four co-integrated equations. Using the Johansen method, it is found that returns of stock prices are co-integrated. Thus, there exists a long term relationship between stock prices in the financial markets of the India, Pakistan, Bangladesh and Sri Lanka. Statistical evidence based on the maximum eigenvalue test, also arrives at the same conclusion.

Table 7
Correlation between SAARC Countries

		Bangladesh	*Srilanka*	*Pakistan*	*India*
Bangladesh	Pearson Correlation	1	.842**	.951**	.942**
	Sig. (2-tailed)		.000	.000	.000
	N	168	168	168	168
Srilanka	Pearson Correlation	.842**	1	.795**	.878**
	Sig. (2-tailed)	.000		.000	.000
	N	168	168	168	168
Pakistan	Pearson Correlation	.951**	.795**	1	.890**
	Sig. (2-tailed)	.000	.000		.000
	N	168	168	168	168
India	Pearson Correlation	.942**	.878**	.890**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	168	168	168	168

**. Correlation is significant at the 0.01 level (2-tailed).

In the above table, there is a evidence of significant positive correlation between India, Sri Lanka, Pakistan & Bangladesh.

FINDINGS AND CONCLUSION

The study has explored the interrelationship between stock markets of SAARC countries The results of ADF test shows that the data is stationary and the result of correlation depicts that all the SAARC countries are highly correlated with each other. Further Johnson co-integration test shows co-integration between the stock indices of SAARC countries. Hence the study depicts that the members of SAARC countries stock market are highly co-integrated & correlated and changes in the stock market of one country effect the stock market of other country. Hence equity investors will not have much opportunity for diversifying their portfolio in these markets. Further future study can be done to examine the impact of other macro variables on these markets.

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APPENDIX-A

CO INTEGRATION TEST RESULT

Sample (adjusted): 4 168
Included observations: 165 after adjustments
Trend assumption: Linear deterministic trend
Series: BANGLADESH INDIA PAKISTAN SRI_LANKA

Lags interval (in first differences): 1 to 2
Unrestricted Cointegration Rank Test (Trace)

Hypothesized		*Trace*	*0.05*	
No. of CE(s)	*Eigenvalue*	*Statistic*	*Critical Value*	*Prob.***
None *	0.454823	223.9436	47.85613	0.0001
At most 1 *	0.278565	123.8472	29.79707	0.0000
At most 2 *	0.223817	69.97256	15.49471	0.0000
At most 3 *	0.156933	28.16703	3.841466	0.0000

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		*Max-Eigen*	*0.05*	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.454823	100.0963	27.58434	0.0000
At most 1 *	0.278565	53.87467	21.13162	0.0000
At most 2 *	0.223817	41.80554	14.26460	0.0000
At most 3 *	0.156933	28.16703	3.841466	0.0000

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

*Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):*

BANGLADESH	*INDIA*	*PAKISTAN*	*SRI_LANKA*
14.63309	7.891690	-20.52743	11.45444
-11.22750	27.01828	-4.933608	-17.25164
29.37623	-3.296734	2.107367	-9.893296
6.104883	4.864932	10.80786	10.35647

Unrestricted Adjustment Coefficients (alpha):

D(BANGLADESH)	-0.015514	0.006087	-0.026599	-0.008563
D(INDIA)	-0.012824	-0.029649	-0.006062	-0.020661
D(PAKISTAN)	0.050984	0.001527	-0.001921	-0.019930
D(SRI_LANKA)	-0.024770	0.016427	0.016858	-0.020145
[1] Cointegrating Equation(s):		Log likelihood	809.9491	

Normalized cointegrating coefficients (standard error in parentheses)

BANGLADESH	*INDIA*	*PAKISTAN*	*SRI_LANKA*
1.000000	0.539304	-1.402809	0.782777
	(0.16723)	(0.14169)	(0.14958)

Adjustment coefficients (standard error in parentheses)

D(BANGLADESH)	-0.227018	Log likelihood	836.8864
	(0.07480)		
D(INDIA)	-0.187653		
	(0.09282)		
D(PAKISTAN)	0.746054		
	(0.08852)		
D(SRI_LANKA)	-0.362457		
	(0.08764)		
[2] Cointegrating Equation(s):			

Normalized cointegrating coefficients (standard error in parentheses)

BANGLADESH	*INDIA*	*PAKISTAN*	*SRI_LANKA*
1.000000	0.000000	-1.065535	0.920778
		(0.11448)	(0.12285)
0.000000	1.000000	-0.625388	-0.255887
		(0.09447)	(0.10137)

Adjustment coefficients (standard error in parentheses)

D(BANGLADESH)	-0.295362	0.042036	Log likelihood	857.7892
	(0.09385)	(0.14322)		
D(INDIA)	0.145227	-0.902258		
	(0.10844)	(0.16549)		
D(PAKISTAN)	0.728912	0.443600		
	(0.11155)	(0.17023)		
D(SRI_LANKA)	-0.546892	0.248358		
	(0.10775)	(0.16444)		

[3] Cointegrating Equation(s):

Normalized Cointegrating coefficients (standard error in parentheses)

BANGLADESH	*INDIA*	*PAKISTAN*	*SRI_LANKA*
1.000000	0.000000	0.000000	-0.363623
			(0.11261)
0.000000	1.000000	0.000000	-1.009732
			(0.13690)
0.000000	0.000000	1.000000	-1.205405
			(0.15226)

Adjustment coefficients (standard error in parentheses)

D(BANGLADESH)	-1.076743	0.129726	0.232376
	(0.16018)	(0.13087)	(0.09798)
D(INDIA)	-0.032855	-0.882273	0.396741
	(0.20324)	(0.16605)	(0.12432)
D(PAKISTAN)	0.672467	0.449934	-1.058153
	(0.20971)	(0.17134)	(0.12827)
D(SRI_LANKA)	-0.051656	0.192780	0.462940
	(0.19712)	(0.16105)	(0.12057)