CO-INTEGRATION AMONG THE WORLD STOCK MARKETS: A CASE OF BRICS

[1]**Maroof Ahmad Mir**
Research Scholar FMSR, AMU Aligarh, India
[2]**Prof. Javaid Akhter**
Professor-FMSR, AMU Aligarh, India

Abstract: Financial market is the backbone of any economy and the stock markets represent the functional platform of majority of the financial activities of a country. A number of studies have been carried out in the world to investigate the stock price movements across international stock markets and the change in the relationship over the years. An attempt has been made in this work to understand the level of cointegration among the BRICS countries. Johansen Co integration and granger causality methodology has been used to understand the association between the leading stock indices of the BRICS countries during 1997 and 2014. Although no significant long term association is found between the countries under study but most of the countries show short term association. The results may be useful for construction of global portfolio for investment purpose.

Index Terms - Johansen Co integration, Granger Causality, Unit root test and correlation

---

I. INTRODUCTION

Increasing Cross border investments, liberalization and global trade has made financial integration an ever burning research topic and a lot of research has been conducted to understand the phenomenon of financial integration and the spillover effect with one of the core intentions to develop a portfolio which can generate better returns. Developing countries in the last few decades have made increasing efforts toward liberalization and deregulation of their capital markets. As a result, capital flows to developing counties, including Foreign Direct Investments (FDI), have seen increasing trend in recent years. The increase of capital flows to developing countries has been accompanied by a significant rise in the degree of integration of world capital markets. India being no exception, has seen substantial change in the liberalization policies since the major liberalization in 1991. The financial integration has thus seen a substantial increase over the past years between India and rest of the world financial markets.

Brazil, Russia, India, China and South Africa form a small group of countries called as BRICS. The group consists of the few of the most emerging developing nations of the world which have already gained a lot of academic attention because of their importance in the world economies and thus understanding their financial integration is all the more important in terms of the present investment opportunities and the possible future prospective financial and economic investment avenues.

II. REVIEW OF LITERATURE

There have been several studies on the impact of integration of the countries with rest of the world on their stock markets. Various methodologies have been adopted to explain this phenomenon by different researchers. Hillier & Loncan (2017) while analyzing the Japanese market found that integration, as proxied by foreign ownership, has a positive impact on the financing side by reducing cost of capital. On the output side, they found that integration increases corporate investment, but only for well-governed firms. Ghosh & Kanjilal (2016), examined cointegration among oil prices, exchange rate and Indian stock market and employed threshold cointegration, found that the Indian stock market becomes integrated with the international events 2009 onwards and the TY version of causality tests reveals that global oil price is determined exogenously. He et al. (2015), while analyzing the Stock market interdependence between China and the world, found that China increased its stock market interdependence with the world after its accession to WTO. Teulon et al. (2014) modelled the financial integration of Singapore in ASEAN-5 region and used a conditional ICAPM with c-DCC-FIAPARCH parameters and their results indicated that Singapore is integrated with world markets and this integration is mainly explained by the level of trade openness. Lehkonen (2014) studied the dynamics of stock market integration and its consequences during financial crisis for twenty-three developed and sixty emerging markets and found that integration increased slightly for emerging markets but decreased for developed countries during the crisis. Moreover, they argue that the high degree of integration propagated the crisis across the global financial markets at the beginning of the crisis, but it had little effect during the crisis. They also found that integration is mostly affected by financial openness, the institutional environment, and global financial uncertainty but that these determinants vary slightly between emerging and developed markets. Horvath & Petrovski (2013) while analyzing the Stock market comovements of Western Europe vs. Central and South Eastern Europe found that the degree of comovements is much higher for Central Europe and the correlation of South Eastern European stock markets with developed markets is essentially zero. Caporale & Spagnolo (2012) estimated a trivariate VAR-GARCH (1,1) model to examine volatility linkages between the stock markets of three Central and Eastern European countries (CEECs), namely the Czech Republic, Hungary and Poland and their empirical. Their findings suggest that following the EU accession, regional linkages have become even stronger, and that therefore portfolio diversification within the region has become an even less effective investment strategy. Büttner &Hayo (2011) analyzed the determinants of stock market integration among EU member states for the period 1999–2007 and found a significant trend toward more stock market integration enhanced by the size of relative and absolute market capitalization and also found that the Foreign exchange risk and interest rate spreads depress integration whereas the Business cycle synchronisation increases stock market integration. Karagoz and Ergun (2010) found presence of market integration in the Balkan region and the least causality was found with Turkey stock market. Among developed markets, UK was the most influential market compared to Japan and US market.

But there are also studies which did not find any significant integration effect. Marashdeh and Shrestha (2010) found that there was no major integration among the GCC stock markets. Similarly, no integration was found between Indian stock market and the Chinese stock market by Siddiqui and Seth (2010). Arouri and Nguyen (2010) found existence of significant but small co-movements among the Gulf

markets, indicating weak linkages between the stock markets of this region. Zhang (2009) concluded that USA greatly affected the Asian markets but the Chinese mainland market was least affected by other markets. Menon et al. (2009) found that there was no cointegration found between Indian, American and Hong Kong stock market though there was strong cointegration between Indian and Singapore stock market. Lucey and Voronkova (2005) concluded that the US and the UK markets were less influenced than European markets and have tended to display relatively more variability in deviations from the common trend. Ahmad et al. (2005) examined that No long-term relationship of Indian equity market was found with that of the US and Japanese equity market. It was further concluded that the Nasdaq and the Nikkei had a strong causal relationship in 1999-2001 which became either very weak or disappeared in 2002-2004. There seemed to be a disassociation in the movements of the Nasdaq and Nikkei with that of the Sensex and Nifty. Wang et al. (2003) concluded that the regional integration between most of African stock markets was weakened after the 1997-1998 crisis. The degree of global integration of African stock markets was found to be very limited with the exception of South African market and the influence of the US market on African market was not much strengthened after the financial crisis. Elyasiani et al. (1998) found no significant interdependence between the Sri Lankan market and its major trading partners. They argue that the Small capitalization, lack of liquidity, high concentration in blue chips, and unilateral investment barriers on Sri Lankan investors was possible causes for lack of interdependence.

Yi and Tan (2009) found in their study that the level of integration of domestic markets with external markets was higher when regional and global data were used as compared to when the individual country data were used to proxy regional and global markets. Earlier studies like Jawadi and Arouri (2008) found strong indication of integration between France and American stock markets and the stock market integration process was found to be non-linear, time varying and strengthened over time. Kazi (2008) concluded that cointegration was found between Australia and the UK, Canada and Germany out of which the UK was more dominating. Boujir and Lahrech (2008) concluded that the tariffs, taxes, restriction on trade in foreign assets or information costs which impede the free flow of foreign capital of the US market in Morocco resulted in weak stock market linkages between Moroccan and US equity markets. Tai (2007) found that the stock markets in India, Korea, Malaysia, Philippines, and Thailand were segmented from the world capital markets before their liberalization dates, but all six markets have become fully integrated since then and as for the contagion effects, strong positive impact of return shocks originating from the domestic stock market to its foreign exchange market during the crisis was found. Hardouvelis et al. (2006) found that the stock markets of the Euro zone countries did not reflect a significant increase in the degree of integration with the world market in comparison to that with the EU market. Strong and significant financial integration was found between markets of Malaysia, South Korea and Thailand by Ameer (2006). Kurihara and Nezu (2006) found that the US stock prices have significantly influenced Japanese stock prices and a long-term stable relationship existed between Japanese and US stock market prices. Jeon and Jang (2004) examined that the US stock market plays a leading role over the Korean market. While, the reverse direction of influence, from Korea to the USA, was not found. Chatterjee et al. (2003) found a significant close relationship between the returns of Hong Kong, Korea, and Singapore since the crisis whereas it was not so in returns of Indonesia, Philippines, and Thailand, and Malaysia, Singapore and Taiwan. Smith et al. (1993) concluded that granger unidirectional causality was found from the USA to the other countries after the October 1987 world-wide crash, except for the linkages from the USA to the German market. Hamao et al. (1990) found the evidence of price volatility spillovers from US and UK to Japanese stock market and from US to UK stock market for post October 1987 period, which shows the existence of international financial integration.

III. METHODOLOGY

3.1Data

The present study is based on the secondary data of closing prices of indices of BRICS countries over the period from 22-09-97 to 22-07-14. Table 1 shows the details of the stock indices taken for study. The data has been taken from Bloomberg terminal.

3.2Research Hypotheses

The principal objective of the study is to investigate into the degree of internal financial integration among BRICS countries by employing methods of time series econometrics. For this purpose, the following hypotheses have been developed based on theory and the existing literature:

Hypothesis 1: Stock Markets are not normally distributed
Hypothesis 2: Moderate to very high correlation exists among all markets
Hypothesis 3: There is existence of Unit Root (non-stationarity) in stock markets
Hypothesis 4: There is no co-integration among stock markets
Hypothesis 5: There is no causality between the BRICS countries

3.4 Research Design

The following methods have been used to test correlation, stationary of time series, co-integration and casualties between the stock market using the historical data

(A) The Jarque-Bera Test is used to test whether returns of stock markets follow the normal probability distribution.
(B) Pearson Correlation is used to find correlation between the stock market returns.
(C) Testing for stationary (unit root test) is done by using both the Augmented Dickey-Fuller and the Phillips-Perron Tests.
(D) Johansen Co-integration test is used for pinpointing the long run relationship among the markets under study.
(E) For Causality, Granger Test is used which identifies the direction of the influence from one series to another.

Table1: Stock indices under study

S.No	Country	Index
1	Brazil	IBOV Index
2	Russia	INDEXCF Index
3	India	NIFTY Index
4	China	SHCOMP Index
5	South Africa	JALSH Index

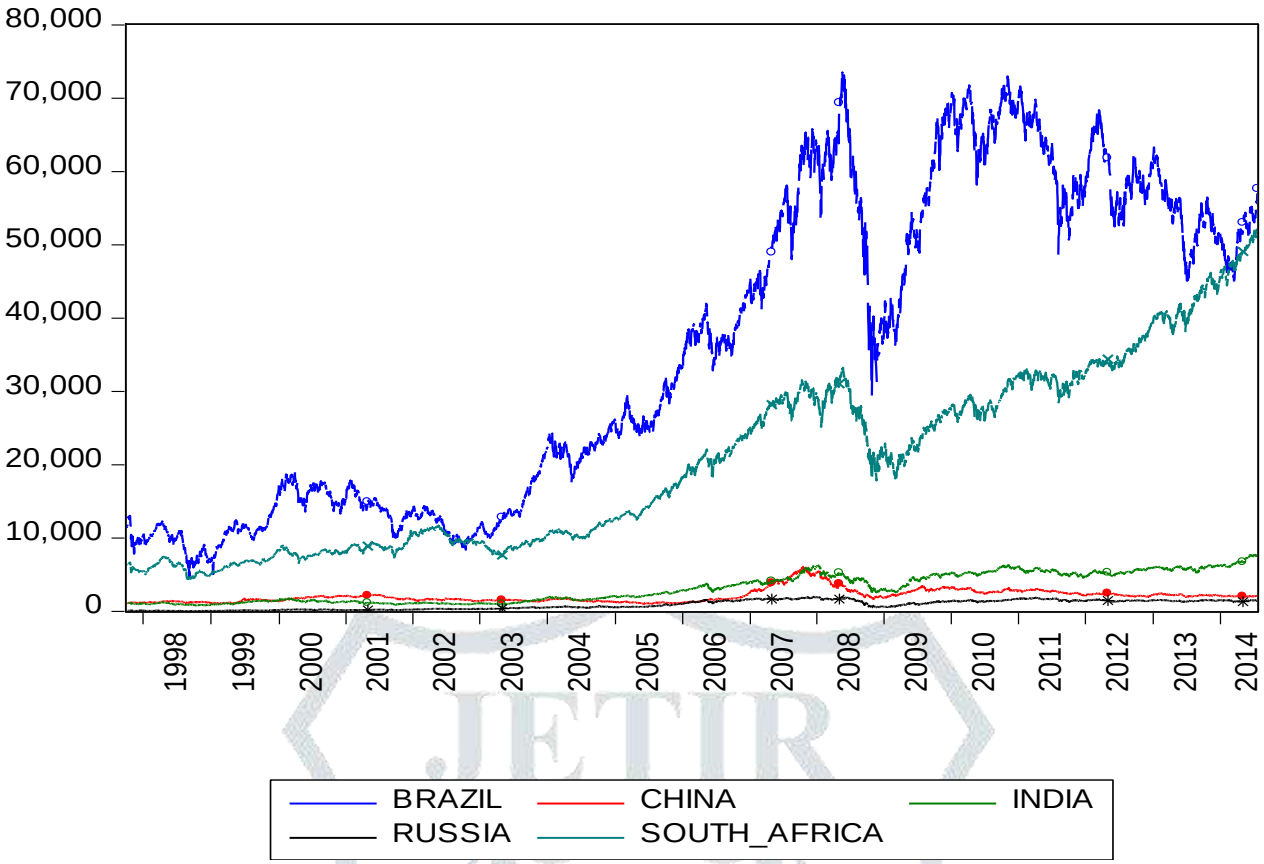

Fig1: Line graphs of the BRICS indices

IV. RESULTS AND DISCUSSION

4.1 Descriptive statistics

Table 2 and Table 3 provide the brief summary statistics of the BRICS countries of indices and the returns respectively. The Jarque-Bera test is used to check hypothesis about the fact that a given sample is a sample of normal random variable with unknown mean and dispersion. As a rule, this test is applied before using methods of parametric statistics which require distribution normality. The results show that the data both at the level and at first difference is not normally distributed as the null hypothesis of normality is rejected.

Table 2: Descriptive statistics of BRICS Indices

Descriptive statistics (Index values)	BRAZIL	CHINA	INDIA	RUSSIA	SOUTH_AFRICA
Mean	35581	2086	3179	878	20154
Median	35002	1953	2777	785	18753
Maximum	73517	6092	7787	1970	52077
Minimum	4761	1011	809	19	4308
Std. Dev.	21370	882	1965	611	12346
Skewness	0.16	1.68	0.30	0.03	0.54
Kurtosis	1.45	6.53	1.56	1.39	2.17
Jarque-Bera	461	4340	448	474	339
Probability	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	4397	4397	4397	4397	4397

Table 3: Descriptive statistics of BRICS Returns

Descriptive statistics (Returns)	RT_BRAZIL	RT_CHINA	RT_INDIA	RT_RUSSIA	RT_SOUTH_AFRICA
Mean	0.00036	0.00014	0.00045	0.00060	0.00047

Median	0.00082	0.00048	0.00107	0.00123	0.00088
Maximum	0.2882	0.0940	0.1633	0.2750	0.0727
Minimum	-0.1723	-0.0926	-0.1305	-0.2334	-0.1263
Std. Dev.	0.02	0.01	0.02	0.03	0.01
Skewness	0.35	-0.11	-0.25	-0.06	-0.52
Kurtosis	18	8	10	18	9
Jarque-Bera	43461	4509	10301	39011	7268
Probability	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	4396	4396	4396	4396	4396

4.2 Correlation

The correlation indicates the strength and direction of a linear relationship between two random variables. Correlation refers to the departure of two variables from independence. Table 5 shows the correlation matrix of the countries under study. The highest correlation is found between India and South Africa and the least is between South Africa and China

Table 4: Correlation matrix of BRICS Indices

Correlation	BRAZIL	CHINA	INDIA	RUSSIA	SOUTH_AFRICA
BRAZIL	1	0.71	0.95	0.94	0.88
CHINA		1	0.63	0.69	0.54
INDIA			1	0.92	0.97
RUSSIA				1	0.89

4.3 Unit Root Test

Unit root test is the test of stationarity and presence of unit root indicates Non-stationarity in a time series data. Augmented Dickey–Fuller test (ADF) is a test for a unit root in a time series sample. It is an augmented version of the Dickey–Fuller test for a larger and more complicated set of time series models. The augmented Dickey–Fuller (ADF) statistic, used in the test, is a negative number. The more negative it is, the stronger the rejection of the hypothesis that there is a unit roots at some level of confidence.

The testing procedure for the ADF test is the same as for the Dickey–Fuller test but it is applied to the model

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_p \Delta y_{t-p} + \varepsilon_t,$$

Where α is a constant, β the coefficient on a time trend and p the lag order of the autoregressive process. Imposing the constraints α = 0 and β = 0 corresponds to modeling a random walk and using the constraint β = 0 corresponds to modeling a random walk with a drift.

Table 5 and Table 6 shows the test results of unit root by applying ADF test and PP test respectively. The results indicate that the series are non-stationary at level and become stationary at 1st difference, thus the returns are not having a problem of unit root meaning that the data can be tested for cointegration.

Table 5: ADF test statistics of BRICS Indices & Returns

ADF test statistics	BRICS Indices		BRICS Returns	
Test Critical Value at 5% (2.8620)	t-Statistic	Prob.	t-Statistic	Prob.
BRAZIL	-1.0811	0.7254	-67.2588	0.0001
RUSSIA	-1.2383	0.6600	-65.5757	0.0001
INDIA	0.2107	0.9733	-61.3461	0.0001
CHINA	-1.8066	0.3777	-30.2542	0.0001
S. AFRICA	1.2635	0.9986	-64.5951	0.0001

Table 6: PP test statistics of BRICS Indices & Returns

PP test statistic	BRICS Indices		BRICS Returns	
Test Critical Value at 5% (2.8620)	t-Statistic	Prob.	t-Statistic	Prob.
BRAZIL	-1.0239	0.7469	-67.3840	0.0001
RUSSIA	-1.2383	0.6600	-65.5751	0.0001

INDIA	0.3068	0.9787	-61.2758	0.0001
CHINA	-1.6795	0.4417	-65.9104	0.0001
S. AFRICA	1.5316	0.9994	-64.8312	0.0001

4.4 Johansen Cointegration Test

This test is named after Soren Johansen, is a procedure for testing co-integration of several I(1) time series. This test permits more than one co-integrating relationship so is more generally applicable than the Engle–Granger test which is based on the Dickey–Fuller (or the augmented) test for unit roots in the residuals from a single (estimated) co-integrating relationship. Table 7 shows the trace test of cointegration and Table 8 shows the Maximum Eigenvalue cointegration test results. Both the tests indicate that there is no integration series found meaning that there is no long term association found between BRICS countries.

Table 7: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.005908	60.97748	69.81889	0.2066
At most 1	0.003488	34.95158	47.85613	0.4506
At most 2	0.002261	19.60429	29.79707	0.4501
At most 3	0.001984	9.664582	15.49471	0.3074
At most 4	0.000214	0.941479	3.841466	0.3319

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 8: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.005908	26.0259	33.87687	0.3192
At most 1	0.003488	15.34729	27.58434	0.7203
At most 2	0.002261	9.939705	21.13162	0.7503
At most 3	0.001984	8.723103	14.2646	0.3099
At most 4	0.000214	0.941479	3.841466	0.3319

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Both the Trace test and Max-eigenvalue test indicate that there is no cointegration at the 0.05 level which indicates absence of any long term association among the BRICS countries and thus we look into the short term association by using Granger causality test.

4.5 Granger Causality test

It is a test to find found short term relationship between the different markets. Granger causality test is a statistical hypothesis test for determining whether one-time series is useful in forecasting another. Ordinarily, regressions reflect "mere" correlations, but Clive Granger, who won a Nobel Prize in Economics, argued that there is an interpretation of a set of tests as revealing something about causality.

A time series X is said to Granger-cause Y if it can be shown, usually through a series of t-tests and F-tests on lagged values of X (and with lagged values of Y also included), that those X values provide statistically significant information about future values of Y.

Table 9 reflects the pair wise Granger causality results and any p value less that 0.05 indicates that the null is rejected and thus there is presence of causality, for instance, the Null hypothesis that 'BRAZIL does not Granger Cause CHINA' is rejected which means that Brazilian stock market changes cause changes in chines stock market in short run. The following relationships were found

1. BRAZIL causes short term impact on CHINA
2. INDIA causes short term impact on BRAZIL
3. BRAZIL causes short term impact on INDIA
4. BRAZIL causes short term impact on RUSSIA
5. BRAZIL causes short term impact on SOUTH_AFRICA
6. INDIA causes short term impact on CHINA
7. CHINA causes short term impact on INDIA
8. RUSSIA causes short term impact on CHINA
9. SOUTH_AFRICA causes short term impact on CHINA
10. RUSSIA causes short term impact on INDIA
11. INDIA causes short term impact on RUSSIA
12. SOUTH_AFRICA causes short term impact on INDIA

Table 9: Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
CHINA does not Granger Cause BRAZIL	**4395**	**0.74556**	**0.4745**
BRAZIL does not Granger Cause CHINA		**56.1446**	**8.00E-25**
INDIA does not Granger Cause BRAZIL	**4395**	**3.28733**	**0.0374**
BRAZIL does not Granger Cause INDIA		**102.286**	**4.00E-44**
RUSSIA does not Granger Cause BRAZIL	4395	2.14396	0.1173
BRAZIL does not Granger Cause RUSSIA		**112.062**	**3.00E-48**
SOUTH_AFRICA does not Granger Cause BRAZIL	4395	0.26264	0.769
BRAZIL does not Granger Cause SOUTH_AFRICA		**170.452**	**5.00E-72**
INDIA does not Granger Cause CHINA	**4396**	**19.6532**	**3.00E-09**
CHINA does not Granger Cause INDIA		**6.03939**	**0.0024**
RUSSIA does not Granger Cause CHINA	**4396**	**23.2199**	**9.00E-11**
CHINA does not Granger Cause RUSSIA		1.53986	0.2145
SOUTH_AFRICA does not Granger Cause CHINA	**4396**	**20.7027**	**1.00E-09**
CHINA does not Granger Cause SOUTH_AFRICA		1.22718	0.2932
RUSSIA does not Granger Cause INDIA	**4396**	**14.3133**	**6.00E-07**
INDIA does not Granger Cause RUSSIA		**6.05513**	**0.0024**
SOUTH_AFRICA does not Granger Cause INDIA	**4396**	**10.8868**	**2.00E-05**
INDIA does not Granger Cause SOUTH_AFRICA		2.11767	0.1204
SOUTH_AFRICA does not Granger Cause RUSSIA	4396	0.37448	0.6877
RUSSIA does not Granger Cause SOUTH_AFRICA		0.40598	0.6663

Conclusion

The present study examines the interlinkages between the BRICS countries by using the Johansen cointegration process and the data analysis reflects no long term association among the BRICS countries. While analyzing the short term association by using granger causality test, it was found that short term relationships exist between the stock markets of Brazil, Russia, India, china, and South Africa**.**

REFERENCES

[1] Ahmad, K.M., Ashraf, S. & Ahmed, S. 2005. Is the Indian market integrated with the US and Japanese markets? An empirical analysis. *South Asia Economic Journal*, 6 (2), 193-206.

[2] Ameer, R. 2006. Integration of the South and East Asian stock markets: how long to go? *Journal of Financial Reporting and Accounting*, 1(1), 61-102.

[3] Boujir, A. & Lahrech, A. 2008. Morocco & US equity markets linkage after FTA signature implications for international portfolio diversification. *International Research Journal of Finance and Economics*, 21,112-23.

[4] Büttner, D. & Hayo, B. 2011. Determinants of European stock market integration. *Economic Systems*, 35(4), 574-585.

[5] Caporale, G. M., &Spagnolo, N. 2012. Stock market integration between three CEECs. *Journal of Economic Integration*, 115-122.

[6] Chatterjee, A., Ayadi, O.F. and Maniam, B. 2003. Asian financial crisis: the pre- and post- crisis analysis of Asian equity markets. *Managerial Finance*, 29 (4), 62-86.

[7] Elyasiani, E., Perera, P. and Puri, T.N. 1998. Interdependence and dynamic linkages between stock markets of Sri Lanka and its major trading partners. *Journal of Multinational Financial Management*, 8 (1), pp. 89-101.

[8] Ghosh, S., &Kanjilal, K. 2016. Co-movement of international crude oil price and Indian stock market: Evidences from nonlinear cointegration tests. *Energy Economics*, 53, 111-117.

[9] Hamao, Y., Masulis, R.W. and Ng, V. 1990. Correlation in price changes and volatility across international stock markets. *The Review of Financial Studies*, 3 (2) 281-307.

[10] Hardouvelis, G.A., Malliaropulos, D. and Priestly, R. 2006. EMU and European stock market integration. *Journal of Business*, 79 (1) 365-92.

[11] He, H., Chen, S., Yao, S., & Ou, J. 2015. Stock market interdependence between China and the world: A multi-factor R-squared approach. *Finance Research Letters*, 13, 125-129.

[12] Hillier, D., &Loncan, T. 2017. Stock market integration, cost of equity capital, and corporate investment: Evidence from Brazil. *European Financial Management*.

[13] Horvath, R., &Petrovski, D. 2013. International stock market integration: Central and South Eastern Europe compared. *Economic Systems*, 37(1), 81-91.

[14] Jawadi, F. &Arouri, M.E.H. 2008. Are American and French stock markets integrated? *The International Journal of Business and Finance Research*, 2 (2), 107-16.

[15] Jeon, B.N. & Jang, B.S. 2004. The linkages between the US and Korean stock markets: the case of NASDAQ, KOSDAQ, and the semiconductor stocks. *Research in International Business and Finance*,18 (3) 319-40.

[16] Karagoz, K. & Ergun, S. 2010. Stock market integration among Balkan countries. *MIBES Transactions*, 4 (1), 49-59.

[17] Kazi, M.H. 2008. Is Australian stock market integrated to the equity markets of its major trading partners. *International Review of Business Research Papers*, 4 (5), 247-57.
[18] Kurihara, Y. &Nezu, E. 2006. Recent stock price relationships between Japanese and US stock markets", *Studies in Economics and Finance*, 23 (3), 211-26.
[19] Lehkonen, H. 2014. Stock market integration and the global financial crisis. *Review of Finance*, 19 (5), 2039-2094.
[20] Lucey, B.M. &Voronkova, S. 2005. Russian equity market linkages before and after the 1998 crisis: evidence from time-varying and stochastic cointegration tests, available at: http:// papers.ssrn.com/sol3/papers.cfm?abstract_id¼1002907 (accessed 31 January 2011).
[21] Marashdeh, H.A. & Shrestha, M.B. 2010. Stock market integration in the GCC countries. *International Research Journal of Finance and Economics*, 37, 102-14.
[22] Menon, N.R., Subha, M.V. & Sagaran, S. (2009). Cointegration of Indian stock markets with other leading stock markets. *Studies in Economics and Finance*, 26 (2), 87-94.
[23] Siddiqui, S. & Seth, N. 2010. Probing relations between S&P CNX Nifty, BSE 30 and Shanghai Composite. *Management Dynamics*, 10 (1), 71-9.
[24] Smith, K.L., Brocato, J. & Rogers, J.E. 1993. Regularities in the data between major equity markets: evidence from Granger causality tests. *Applied Financial Economics*, 3 (1), 55-60.
[25] Tai, C.S. 2007. Market integration and contagion: evidence from Asian emerging stock and foreign exchange markets. *Emerging Market Review*, 8 (4), 264-83.
[26] Teulon, F., Guesmi, K., & Mankai, S. 2014. Regional stock market integration in Singapore: A multivariate analysis. *Economic Modelling*, 43, 217-224.
[27] Wang, Z., Yang, J. &Bessler, D.A. 2003. Financial crisis and African stock market integration. *Applied Economics Letters*, 10 (9), 527-33.
[28] Yi, Z. & Tan, S.L. 2009. An empirical analysis of stock markets integration: comparison study of Singapore and Malaysia. *The Singapore Economic Review*, 54 (2), 217-32.
[29] Zhang, Y. 2009. Linkages of stock prices in major Asian markets and the United States. available at: www.apeaweb.org/confer/bei08/papers/zhang_y.pdf (accessed 7 February 2011).