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REVIEW OF LITERATURE

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STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

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CONCLUSIONS

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- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

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BRICS EQUITY MARKETS LINKAGES: EVIDENCE FROM PRE- AND POST- GLOBAL FINANCIAL CRISIS

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ABSTRACT

This study investigates both the static and dynamic interdependence among the stock markets of BRICS countries, that of Brazil, Russia, India, China, and South Africa, with the global financial crisis of 2007-09 as the focal point. Using data from 2003 to 2014, the study employs correlation and co-integration analysis to describe the behavior of the above markets, both before and after the global financial crisis. The study finds that there is no significant increase in integration of the markets, implying potential for diversification for investors.

KEYWORDS

BRICS Equity Markets, Global Financial Crisis.

INTRODUCTION

Global financial markets have increasingly become more integrated with the floating of exchange rates, and lifting of barriers to the flow of capital across countries. Advances in technology, which have increased both the accessibility to world news and the speed of information transmission, have also helped to accelerate financial market integration. Stock markets are no exception, with stock composite indices across countries becoming increasingly correlated with each other over time.

Stronger co-movement between the markets implies enhanced information flows, and hence greater market efficiency and reduction in diversification opportunities, which is a concern for investors. The issue of stock market linkages is also relevant from a policy perspective in an environment where moves towards greater regional economic integration are being promoted. Increased linkages between stock markets is a component of regional or international capital market convergence, which is in itself important for the integration of the goods and services markets to be effective.

Most of the research on international stock market linkages has been concentrated on the major world stock markets (US, Japan, UK and Germany), although there has also been some work on the smaller developed country markets and Asian markets (Hong Kong, Singapore, etc.).

The purpose of this study is to examine stock market linkages in the BRICS emerging economies, over a period from 2003 to 2014, with the global financial crisis as the focal point. We choose these countries because they represent fast developing economies that are linked by some common business conditions. Brazil, Russia, India, China, and South Africa represent the BRICS nations. These markets are usually classified as emerging markets because they are, relatively, small in size and young in age. The economies of these countries are considered to be developing rather than developed.

The time frame of the study is divided into two sub-periods, covering the pre- and post- Global Financial Crisis (GFC) period ranging from 2007 to 2009. The main question this study attempts to answer pertains to the likely effects of the GFC on the BRICS equity markets and the linkages between them.

BACKGROUND

The British Broadcasting Corporation (BBC) has documented the GFC in detail on its website[1], which is alternatively referred to as a credit crunch, or subprime crisis - "Between 2004 and 2006 US interest rates rose from 1% to 5.35%, triggering a slowdown in the US housing market. Homeowners, many of whom could only barely afford their mortgage payments when interest rates were low, began to default on their mortgages. Default rates on sub-prime loans - high risk loans to clients with poor or no credit histories - rose to record levels. The impact of these defaults were felt across the financial system as many of the mortgages had been bundled up and sold on to banks and investors".

The scale of the crisis emerged on August 9 2007, when France's largest bank BNP Paribas told investors they will not be able to take money out of two of its funds because it cannot value the assets in them known as collateralised debt obligations (CDOs), or packages of sub-prime loans, owing to a "complete evaporation of liquidity" in the market.

By the next month the rate at which banks lent to each other had risen to its highest level since December 1998. Several banks across the world which were exposed to the subprime loans either announced losses or started to crumble. Northern Rock, RBS and Lloyds TSB (England), UBS (Switzerland), Bear Stearns, Citigroup and Merrill Lynch (USA), etc. leading up to September 15, 2008, when Lehman Brothers filed for Chapter 11 bankruptcy protection, becoming the first major bank to collapse since the start of the credit crisis.

The US economy officially declared a recession on December 1, 2008. UK and other European and Asian economies followed and it had become a global recession which, in this study, has been marked as ending on October 18, 2009 (the European Debt Crisis started on October 19, 2009).

The remainder of this article is organized as follows: Section 2 provides the review of the literature on stock market linkages. Section 3 presents the data and methodology of the study. The empirical results and discussion are provided in Section 4, and Section 5 presents concluding remarks.

REVIEW OF LITERATURE

Arshanapalli and Doukas (1993) study the linkages among stock prices in major world stock exchanges such as Germany, the United Kingdom, France, Japan and the United States, using daily closing data from January 1980 through May 1990. They also examine the relationship of stock price indices before and after the October crash and find significant interdependence among the countries post-crash.

Allen and MacDonald (1995) analyse the benefits available from international equity diversification to Australian investors for the period 1970–92 using monthly index data for 16 countries. The co-integration framework is utilized and results from the standard Engle—Granger two-step ordinary least squares procedure are compared with those from the Johansen (1988) maximum likelihood procedure. It is found that the two techniques lead to different conclusions in certain cases, and there is evidence of co-integration among a subset of the indices considered.

Roca, Selvanathan, and Shepherd (1998) investigated the extent and structure of price linkages among five ASEAN markets (Malaysia, Singapore, Philippines, Indonesia and Thailand), both in the long run and in the short run using co-integration based on the Johansen (1988) procedure, Granger causality and variance decomposition and impulse response analyses. The authors found no long term linkages among the markets. However, in the short term, with the exception of Indonesia, all the ASEAN markets had significant linkages with each other.

Chen, Firth, and Rui (2002) investigated the interdependence of the major stock markets in Latin America over the period 1995-2000, employing co-integration analysis. Their results suggested limited potential for risk diversification, by investing in different Latin American markets.

[1] http://news.bbc.co.uk/2/hi/business/7521250.stm, "Timeline: Credit crunch to downturn".

Daly (2003) employed correlation and co-integration analysis to investigate interdependence of the stock markets of Indonesia, Malaysia, the Philippines, Singapore, Thailand, and the advanced stock markets of Australia, Germany, and the United States. Although there is evidence of integration between the Southeast Asian stock markets, overall the results suggested no significant increase in the integration between the Southeast Asian stock markets over the pre- and post- October 1997 Asian financial crisis period.

DATA AND METHODOLOGY

The data-set in this study consists of daily stock price indexes in US dollars for the sample countries from January 1, 2003 to June 30, 2014. All data are daily closing prices, obtained from Bloomberg. The precise indices used are the Ibovespa (Brazil), MICEX (Russia), CNX Nifty (India), SSE50 (China), and the JSE Top40 (South Africa). Some information about each of these indices is given in the box as an Appendix.

In the case of China, the series were backward spliced for upto a year because the SSE50 index series began from January 2004, while our series were starting a year prior to that. We spliced SSE50 and SSE180 together to get prices comparable to SSE50 for the period January 2003-December 2003.

The dataset has been divided into two sub-periods. The pre-crisis period ranges from January 1, 2003 to August 8, 2007; and the post crisis period from October 19, 2009 to June 30, 2014. We use correlation analysis and Johansen's co-integration test, to investigate dependencies in stock returns of the emerging economies. The correlation analysis is performed to ascertain the degree of association among the emerging stock markets, and co-integration test to verify whether long-term relationship exists.

EMPIRICAL RESULTS

We begin by examining summary statistics for daily percentage returns of the country market indices over the sample period, for both the pre- and post-crisis periods. Table 1a shows the summary statistics of the sample countries for the pre-crisis period, and table 1b shows the summary statistics for the sample markets for the post-crisis period.

In the pre-crisis period, the highest mean daily return is observed in the case of Brazil (0.00184%) with the lowest being observed for South Africa (0.00107%). As far as volatility is concerned, again Brazil has the highest volatility (0.02447%), closely followed by Russia (0.01979%). The lowest volatility is observed in the case of China (0.01465%).

All the sample countries have negative skewness, and exhibit leptokurtosis. The Jarque-Bera (JB) test indicates that all stock market returns are non-normal as attested by the significant p-values.

We also report the Ljung-Box (LB) statistic up to ten orders in levels and squared of returns for the sample markets. The results clearly indicate that there is serial correlation in levels with the exception of Brazil, China, and South Africa. All the sample markets exhibit serial correlation in squared terms suggesting the existence of volatility clustering.

TABLE 1A: SUMMARY STATISTICS OF THE RETURNS SERIES – PRE CRISIS

	BRAZIL	CHINA	INDIA	RUSSIA	S.AFRICA
Mean	0.00184	0.00123	0.00133	0.00161	0.00107
Std. Dev.	0.02115	0.01465	0.01513	0.01979	0.01484
Skewness	-0.37222	-0.03231	-1.02964	-0.61966	-0.43469
Kurtosis	4.09944	7.74145	10.44855	7.11545	4.59889
Jarque-Bera	87.1934	1112.0950	2953.7280	913.6369	163.8191
Prob.	[0.000]**	[0.000]**	[0.000]**	[0.000]**	[0.000]**
Q	15.546	17.264	27.193	19.528	12.297
Prob.	[0.113]	[0.069]	[0.002]**	[0.034]**	[0.266]
Q2	115.310	64.269	553.490	215.860	178.670
Prob.	[0.000]**	[0.000]**	[0.000]**	[0.000]**	[0.000]**
ARCH test	10.050	5.445	492.969	39.598	14.521
Prob.	[0.002]**	[0.020]**	[0.000]**	[0.000]**	[0.000]**
Obs	1187	1187	1187	1187	1187

In the post-crisis period, the highest mean daily return is observed in the case of Brazil (10.34357%) with the lowest being observed for Russia (3.85472%). Brazil also has the highest volatility (0.22807%), with the lowest volatility observed in the case of South Africa (0.08893%).

Brazil and South Africa's returns are skewed negatively and the three other countries have positive skewness in their stock returns. Only Russia's stock returns exhibit leptokurtosis. The Jarque-Bera (JB) test indicates that all stock market returns are non-normal as attested by the significant p-values. The LB statistics clearly indicate that there is no serial correlation in levels with the exception of China. All the sample markets, except China, exhibit serial correlation in squared terms suggesting the existence of volatility clustering.

Figure 1 shows the time series plots of the returns for the five national stock markets across the entire sample period. All the graphs show high volatility, especially on and/or around October 2008 (referenced by point 1500 on the horizontal axis) which pertains to period during the global financial crisis. However, as seen in the graph, South Africa's returns are more negative than the other markets. Volatility clustering is also evident from the graphs. The graphs add to the summary statistics and confirm the quite common characteristics of financial time series – asymmetries, fat tail, and non-normality.

TABLE 1B: SUMMARY STATISTICS OF THE RETURNS SERIES – POST CRISIS

	BRAZIL	CHINA	INDIA	RUSSIA	S.AFRICA
Mean	10.34357	5.65168	4.68618	3.85472	8.23105
Std. Dev.	0.22807	0.11209	0.11277	0.12431	0.08893
Skewness	-0.390883	0.392928	0.120711	0.555182	-0.511134
Kurtosis	1.938457	2.635202	2.589527	3.154980	2.600031
Jarque-Bera	87.771	37.908	11.452	63.475	60.853
Prob.	[0.000]**	[0.000]**	[0.003]**	[0.000]**	[0.000]**
Q	6.232	21.065	5.665	7.101	12.979
Prob.	[0.795]	[0.021]**	[0.843]	[0.716]	[0.225]
Q2	167.960	14.118	247.930	98.600	240.910
Prob.	[0.000]**	[0.168]	[0.000]**	[0.000]**	[0.000]**
ARCH test	33.509	0.247	6.419	36.652	11.385
Prob.	[0.000]**	[0.000]**	[0.000]**	[0.000]**	[0.000]**
Obs	1212	1212	1212	1212	1212

Correlation and Co-integration

A simple test for integration is to look at correlation coefficients across daily returns of the national stock market indices. By comparing pre- and post-crisis periods, it can be determined whether the stock markets have become increasingly integrated. Table 2 reports the correlation coefficients for the pre- and post-crisis periods. The top diagonal displays the correlation coefficients for the pre-crisis period, with the lower panel displaying the corresponding correlations for the post-crisis period. A comparison of the average (mean) correlation coefficients across the pre- and post-crisis periods reveals that the average correlation

coefficients for each market with the rest of the combined market indices increased significantly in the post-crisis period, as compared to the pre-crisis values. This indicates that the BRICS markets have become more integrated since the global financial crisis. This is, however, a static test, revealing only short term integration, if any, between the stock markets.

FIGURE 1: TIME SERIES PLOTS OF STOCK RETURNS

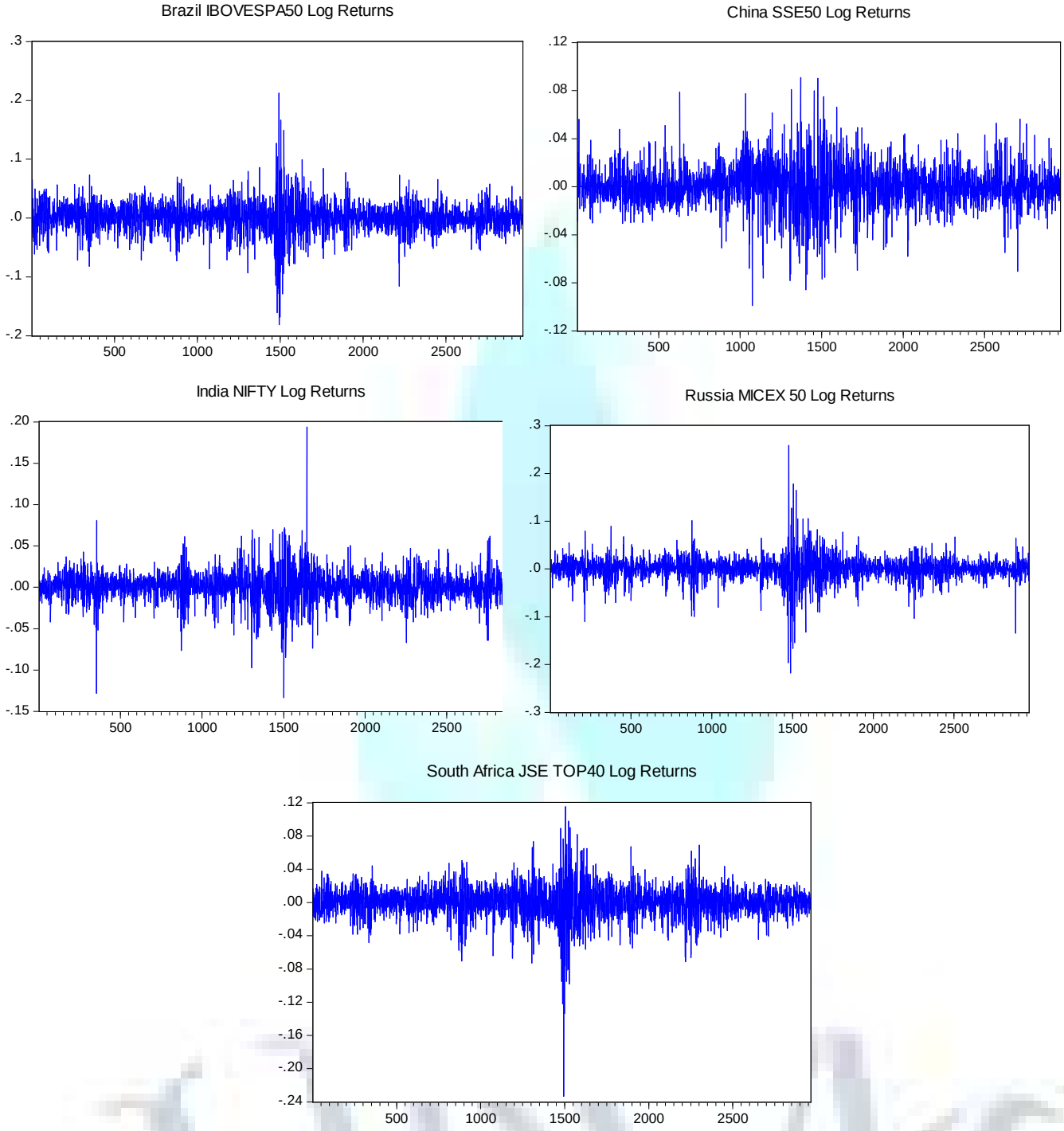

TABLE 2: CORRELATION MATRIX, PRE- AND POST GLOBAL FINANCIAL CRISIS

	Brazil	China	India	Russia	S. Africa	Mean (pre-crisis)
Brazil	1	0.09	0.16	0.23	0.40	0.22
China	**0.18**	1	0.08	0.05	0.09	0.08
India	**0.29**	**0.26**	1	0.27	0.27	0.19
Russia	**0.46**	**0.25**	**0.43**	1	0.37	0.23
S. Africa	**0.65**	**0.24**	**0.43**	**0.66**	1	0.28
Mean (Post-crisis)	0.40	0.24	0.35	0.45	0.50	

Note: The top diagonal displays the correlation coefficients for the stock market indices over the pre-crisis period, while the bottom diagonal (in bold) represents the corresponding post-crisis correlations

In order to gain more insight into the integration of the above markets, we apply co-integration techniques to determine the presence of any long-run relationships that may exist over the sample period. First, we test whether the variables are stationary. We use the Augmented Dickey-Fuller (ADF) test, and the Phillips-Perron (PP) test to check for stationarity. The results are given in Table 3.

TABLE 3: UNIT ROOT TEST RESULTS

Market	ADF test results*		PP test results**	
	Level	First Difference	Level	First Difference
Brazil	-2.74	-55.32	-2.81	-55.46
China	-1.40	-55.28	-1.39	-55.28
India	-2.23	-50.91	-2.22	-50.91
Russia	-2.61	-53.00	-2.61	-53.00
S. Africa	-2.12	-54.18	-2.10	-54.47
* Critical Value (5% level): -2.86 (H_0: unit root vs H_A: no unit root)				

As can be seen in Table 3, for each market, the null hypothesis of the existence of unit roots was not rejected at the level form of the data but was accepted at the first-differenced form, by both the ADF and PP tests. Hence, it may be concluded that each data series is stationary and integrated of order 1 or I(1).

The second stage in the co-integration analysis is to decide on the order of the underlying vector autoregression (VAR) model. The order of the VAR is determined by an inspection of the Schwarz information criterion (SC). We selected the order of the VAR by choosing in each case the lowest SC coefficients.

Since the unit root test results show that each of the data series is I(1), pairwise co-integration test based on the Johansen procedure is conducted on Eviews software. Table 4 displays the bivariate co-integration test results between various stock market indices. The table shows the maximum eigenvalue tests and trace tests for bivariate co-integration over the full sample period, and pre and post crisis periods. The tables are used to determine (r), the number of co-integrating vectors for each pair of stock market indices; in other words, the results inform us whether there exists a long-run equilibrium relationship between the two stock market indices. For each test, we compare the null hypothesis of no co-integration against the alternative of co-integration.

TABLE 4: BIVARIATE CO-INTEGRATION TEST RESULTS

Countries	Null	Alternative	Full Sample		Pre Crisis		Post Crisis	
			Eigenvalue	Trace	Eigenvalue	Trace	Eigenvalue	Trace
Brazil	r = 0	r = 1	8.446	10.648	17.6099*	18.4838*	11.312	13.438
China	r ≤ 1	r = 2	2.202	2.202	0.874	0.874	2.126	2.126
Brazil	r = 0	r = 1	11.231	18.034*	21.3459*	21.6967*	4.8728	5.3807
India	r ≤ 1	r = 2	6.803	6.803	0.350828	0.35083	0.508	0.508
Brazil	r = 0	r = 1	7.4874	11.5751	5.525	5.956	12.2119	14.4395
Russia	r ≤ 1	r = 2	4.088	4.088	0.4313	0.4313	2.228	2.228
Brazil	r = 0	r = 1	7.07805	9.48115	13.542	13.903	12.713	12.992
S.Africa	r ≤ 1	r = 2	2.4031	2.4031	0.3610	0.3610	0.2794	0.2794
China	r = 0	r = 1	5.65355	8.6762	19.125*	19.173*	6.6065	11.5133
India	r ≤ 1	r = 2	3.02264	3.02264	0.0481	0.0481	4.907	4.907
China	r = 0	r = 1	8.1562	11.8529	19.964*	19.966*	10.702	15.378
Russia	r ≤ 1	r = 2	3.6967	3.6967	0.0024	0.0024	4.676	4.676
China	r = 0	r = 1	4.6561	7.3409	19.805*	19.805*	14.589*	18.755*
S.Africa	r ≤ 1	r = 2	2.685	2.685	0.00	0.00	4.166	4.166
India	r = 0	r = 1	7.5425	12.9614	7.7032	8.1622	9.3906	14.2153
Russia	r ≤ 1	r = 2	5.419	5.419	0.4589	0.4589	4.8247	4.8247
India	r = 0	r = 1	14.381*	19.102*	11.6224	11.9098	10.566	14.232
S.Africa	r ≤ 1	r = 2	4.7204	4.7204	0.2874	0.2874	3.667	3.667
Russia	r = 0	r = 1	7.617	10.355	4.6142	5.0763	13.082*	15.743*
S.Africa	r ≤ 1	r = 2	2.739	2.739	0.4621	0.4621	2.661	2.661

** Significant at 95% level*

Looking at the results in Table 4, we can see that in the pre-crisis period, we can reject the null hypothesis of no co-integration between the stock indices of China with the other indices, at the 95 percent critical value since the trace statistics are greater than their respective critical values, but in the post-crisis period, the null is rejected only in case of China-South Africa. There is a long run co-integrating relationship between Brazil, China and India in the pre-crisis period, but not so in the post-crisis period. Russia and South Africa do not share a long-run relationship in the pre-crisis period but the results suggest these two markets became more integrated post-crisis. Overall, there is no significant increase in integration between the BRICS markets post-crisis, except for China-South Africa, and Russia-South Africa.

Multivariate co-integration tests

The results from the multivariate co-integration tests are displayed in Tables 5a, 5b, and 5c. Table 5a displays the results of the stock markets of the sample countries in combinations of threes. In the full sample, the null hypothesis of no co-integration is rejected in two cases, that of, Brazil-India-South Africa, and China-India-South Africa, since both the maximum eigenvalue statistics and trace statistics are greater than their respective critical values at 95 percent level for these combinations hence there exists a long run relationship between these markets. The null of no co-integration is not rejected for the remaining multivariate market combinations.

TABLE 5A: MULTIVARIATE CO-INTEGRATION TEST RESULTS

Countries	Null	Alternative	Full Sample		Pre Crisis		Post Crisis	
			Eigenvalue	Trace	Eigenvalue	Trace	Eigenvalue	Trace
Brazil	r = 0	r = 1	14.187	25.399	34.900*	49.290*	11.541	17.072
China	r ≤ 1	r = 2	8.318	11.212	13.833	14.390	4.988	5.532
India	r ≤ 2	r = 3	2.894	2.894	0.557	0.557	0.544	0.544
Brazil	r = 0	r = 1	9.760	21.338	23.939*	28.270*	13.912	26.816
China	r ≤ 1	r = 2	7.967	11.578	4.271	4.331	10.650	12.904
Russia	r ≤ 2	r = 3	3.611	3.611	0.059	0.059	2.254	2.254
Brazil	r = 0	r = 1	9.592	16.390	25.672*	38.848*	15.47979	27.364
China	r ≤ 1	r = 2	4.122	6.799	12.988	13.176	11.59091	11.884
S.Africa	r ≤ 2	r = 3	2.677	2.677	0.188	0.188	0.293218	0.293
Brazil	r = 0	r = 1	11.804	23.078	21.563*	26.563*	13.772	19.466
India	r ≤ 1	r = 2	7.077	11.275	4.551	5.000	5.116	5.694
Russia	r ≤ 2	r = 3	4.197	4.197	0.449	0.449	0.578	0.578
Brazil	r = 0	r = 1	28.862*	38.529*	21.383*	31.991*	14.743	19.054
India	r ≤ 1	r = 2	7.188	9.668	10.259	10.608	4.168	4.311
S.Africa	r ≤ 2	r = 3	2.479	2.479	0.350	0.350	0.143	0.143
Brazil	r = 0	r = 1	7.863	15.104	14.180	18.866	19.529*	32.021*
Russia	r ≤ 1	r = 2	5.288	7.241	4.306	4.686	12.106	12.492
S.Africa	r ≤ 2	r = 3	1.952	1.952	0.380	0.380	0.386	0.386
China	r = 0	r = 1	9.19	18.047	20.043	27.897	11.470	22.706
India	r ≤ 1	r = 2	5.684	8.857	7.835	7.854	6.760	11.236
Russia	r ≤ 2	r = 3	3.173	3.173	0.019	0.019	4.476	4.476
China	r = 0	r = 1	23.203*	30.766*	24.270*	39.166*	15.784	24.407
India	r ≤ 1	r = 2	4.710	7.563	14.893	14.896	4.991	8.622
S.Africa	r ≤ 2	r = 3	2.853	2.853	0.003	0.003	3.631	3.631
China	r = 0	r = 1	9.995	16.758	20.990	26.496	16.760*	29.822*
Russia	r ≤ 1	r = 2	3.960	6.763	5.475	5.506	11.001	13.062
S.Africa	r ≤ 2	r = 3	2.803	2.803	0.032	0.032	2.061	2.061
India	r = 0	r = 1	14.960	25.108	13.281	18.243	13.736	23.132
Russia	r ≤ 1	r = 2	7.518	10.148	4.532	4.962	4.878	9.396
S.Africa	r ≤ 2	r = 3	2.630	2.630	0.430	0.430	4.518	4.518

**Significant at 95% level*

Further testing for evidence of multivariate co-integration, we see evidence of co-integration between Brazil and almost all the other market combinations in the pre-crisis period, but not so in the post-crisis period. Brazil-Russia-South Africa, and China-Russia-South Africs were not co-integrated in the pre-crisis period but the results show that the null of no co-integration is rejected in the post-crisis period indicating that these markets became more integrated after the crisis. Overall, the results are mixed with no clear increase in integration among the markets.

TABLE 5B: MULTIVARIATE CO-INTEGRATION TEST RESULTS

Countries	Null	Alternative	Full Sample		Pre Crisis		Post Crisis	
			Eigenvalue	Trace	Eigenvalue	Trace	Eigenvalue	Trace
Brazil	r = 0	r = 1	14.637	34.736	35.935*	55.674*	15.744	32.067
China	r ≤ 1	r = 2	9.783	20.099	15.051	19.738	10.663	16.323
India	r ≤ 2	r = 3	6.618	10.316	4.549	4.687	5.095	5.660
Russia	r ≤ 3	r = 4	3.698	3.698	0.138	0.138	0.565	0.565
Brazil	r = 0	r = 1	32.996*	49.702*	35.355*	62.884*	17.105	33.227
China	r ≤ 1	r = 2	9.542	16.706	14.372	27.529	12.223	16.122
India	r ≤ 2	r = 3	4.161	7.165	12.981	13.157	3.739	3.899
S.Africa	r ≤ 3	r = 4	3.003	3.003	0.176	0.176	0.160	0.160
Brazil	r = 0	r = 1	10.236	26.422	27.876	45.346	20.970	46.153
China	r ≤ 1	r = 2	9.180	16.186	13.920	17.469	13.710	25.183
Russia	r ≤ 2	r = 3	3.834	7.006	3.524	3.549	11.082	11.472
S.Africa	r ≤ 3	r = 4	3.172	3.172	0.026	0.026	0.390	0.390
Brazil	r = 0	r = 1	25.036	39.786	21.643	37.357	27.130	45.365
India	r ≤ 1	r = 2	7.957	14.750	11.111	15.715	13.523	18.235
Russia	r ≤ 2	r = 3	5.101	6.793	4.177	4.604	4.550	4.712
S.Africa	r ≤ 3	r = 4	1.692	1.692	0.427	0.427	0.163	0.163
China	r = 0	r = 1	23.401	38.909	24.857	45.656	17.377	39.049
India	r ≤ 1	r = 2	9.319	15.508	15.554	20.799	12.780	21.672
Russia	r ≤ 2	r = 3	4.048	6.189	5.209	5.245	4.879	8.892
S.Africa	r ≤ 3	r = 4	2.141	2.141	0.036	0.036	4.013	4.013

**Significant at 95%t level*

Lastly, testing for co-integration among all the five markets taken together, the null hypothesis of zero co-integrating vectors is rejected at 95 percent level in the pre-crisis period, thereby implying no long-run relationship among all the five markets taken together, but this long run relationship is not evident in the post-crisis period.

TABLE 5C: MULTIVARIATE CO-INTEGRATION TEST RESULTS

Countries	Null	Alternative	Full Sample		Pre Crisis		Post Crisis	
			Eigenvalue	Trace	Eigenvalue	Trace	Eigenvalue	Trace
Brazil	r = 0	r = 1	33.686	58.560	37.575*	74.033*	28.104	59.475
China	r ≤ 1	r = 2	10.096	24.874	17.523	36.458	15.561	31.371
India	r ≤ 2	r = 3	8.340	14.778	14.957	18.935	11.150	15.810
Russia	r ≤ 3	r = 4	3.750	6.438	3.925	3.978	4.485	4.660
	r ≤ 4	r = 5	2.689	2.689	0.053	0.053	0.175	0.175

**Significant at 95%t level*

To test the robustness of the results, the Johansen procedure was tested using multiple VAR lags. The results indicated that the finding of no co-integration was not altered when different lag lengths were used in the estimation procedure.

Overall, the results of bivariate and multivariate co-integration testing tell us that the results are mixed with no significant increase in integration of the BRICS markets after the global financial crisis.

SUMMARY AND CONCLUSION

In this study, the Johansen methodology is used to test for co-integrating relationships between the national stock market indices of the BRICS (Brazil, Russia, India, China, and South Africa) countries, with the global financial crisis of 2007-09 as the focal point. Both multivariate and bivariate co-integration tests are employed.

As was revealed in Figure 1, all stock market series have high volatility around the period marked by the global financial crisis (October 2008) and the summary statistics in Tables 1a and 1b show that the series are characterized by asymmetries, fat tails, and non-normality. The mean returns and volatility have increased significantly post-crisis. The correlation coefficients in Table 2 indicate an increase in relationship among the BRICS countries post-crisis as the average coefficients increased significantly from their pre-crisis values.

In order to get more insight into the relationships between these markets, co-integration techniques were applied. The results have been mixed with no significant integration among the markets after the crisis.

Overall, the stock markets of the BRICS countries seem to have no significant long-term price linkages. Hence, it can be concluded that there is long-term portfolio diversification potential among the BRICS markets.

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APPENDIX

Information about the Indices used in this study:

- The Ibovespa Index is =a gross total return index weighted by traded volume & is comprised of the most liquid stocks traded on the Sao Paulo Stock Exchange.
- MICEX Index is cap-weighted composite index calculated based on prices of the 50 most liquid Russian stocks of the largest and dynamically developing Russian issuers presented on the Moscow Exchange.
- The CNX Nifty, a free float market capitalization index, is the leading index for large companies on the National Stock Exchange of India. It consists of 50 companies representing 24 sectors of the economy.
- SSE 50 Index includes 50 of the largest, highly liquid and most representative SSE-listed stocks and reflects the performance of a number of leading and most influential enterprises in Shanghai securities market.
- The FTSE/JSE Top40 Index is a capitalization weighted index. Companies included in this index are the 40 largest companies by market capitalization included in the FTSE/JSE All Shares Index.

Source: Bloomberg

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