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Financial integration between BRICS and developed stock markets

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ABSTRACT : *This study examines the integration among the stock markets of BRICS (Brazil, Russia, India, China and South Africa) and the stock markets of U.S. and U.K. Using daily closing price of major stock indices of these countries from 1st January 2004 to 31st December 2013, the integration is modeled using the correlation test and the Johansen's co-integration test. The study found evidence for both the short-term static and long-term dynamic integration between the stock markets. This suggests that there are limited benefits of any diversification or speculative activities between these markets. Results of this study have implications for policy makers in responding to increasing financial interactions across borders.*

KEYWORDS : *Cointegration, Correlation, Stock Markets, Market Linkages, Unit root test.*

I. INTRODUCTION

The investors' interest in international diversification has increased with relaxation of capital control among the economies. International diversification of portfolio assets improves the risk-reward ratio. However, when equity markets are "cointegrated", the benefit of international diversification is limited. The presence of common factors limits the amount of independent variation of the equity markets. Cointegration among equity markets implies that there are fewer assets available to investors for portfolio diversification. Moreover, cointegration is also suggestive of inefficiency in the markets.

With globalisation, the investors have become increasingly more active in foreign capital markets. The investment in international financial market has seen a spectacular increase. As a consequence of market liberalisation, financial markets tend to become more integrated. This integration process implies increased co-movements between financial markets which can have negative effects on benefits from international diversification. However, the financial crises in America led investors to search for other emerging markets (Flight to quality phenomenon) like the BRICS emerging markets. Those markets can provide more opportunities to increase benefits from international diversification. The endeavour to bring these economies into line with the western developed economies gives them an important priority and led investors to study these investment opportunities. The higher integration between international markets calls for studying the integration between developed and emerging markets to study the important potential of emerging markets for international portfolio diversification.

In the aftermath of these events, it is interesting to investigate how the long term relationship between international financial markets has emerged. The aim of this paper to investigate whether there is long-run relationship, called co-integration, between the stock markets of emerging economies of BRICS (Brazil, Russia, India, China, South Korea and South Africa) and developed markets of US and UK. This paper hopes to extend the previous research on these topics by investigating the impact of the global financial crisis of 2008 on the integration between the afore-mentioned markets. This paper hopes to provide new insights in the area of stock market linkages.

II. REVIEW OF LITERATURE

The earlier literature pertaining to stock market integration provides strong evidence of linkages among the stock markets around the globe, as a result of global economic integration.Forbes and Rigobon (1998) tested for Southeast Asian stock market co-movement during the 1997 Asian financial crisis, the 1994 Mexican peso crisis, and the 1987 U.S. stock market crisis. They suggested that the high market co-movement during these periods was a continuation of strong cross-market linkages. 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 that the potential for diversifying risk, by investing in different Latin American markets, was limited.

Nieh (2002) investigated the effect of the Asian financial crisis on the inter-relationships between exchange rate volatility, exports, imports, and productivity for several East Asian economies. Co-integration tests showed no change in the long-run relationships among these variables during the crisis. Click and Plummer (2004) considered whether the ASEAN markets are integrated or segmented using the time series technique of co integration to extract long-run relationships. The empirical results suggested that the stock markets were co integrated. Hsiao, Wang, Yang and Li (2006) studied the long-run price relationships and the dynamic price transmission among the USA, Germany, and four major Eastern European emerging stock markets with particular attention to the impact of the 1998 Russian financial crisis. The results show that both the long-run price relationship and the dynamic price transmission were strengthened among these markets after the crisis.

Awokuse, Chopra and Bessler (2008) investigated the evolving pattern of the interdependence among selected Asian emerging markets and three major stock markets (Japan, UK and US). The results indicate that the Japan and the US have the greatest influence on the emerging markets while the influence of Singapore and Thailand has increased since the Asian financial crisis.

III. RESEARCH METHODOLOGY

Data: The data set used in this study comprises daily close quotes of major stock market indices of the stock markets of BRICS, US and UK. The indices chosen for the purpose of this study are shown in Table 1.

Table 1: Stock Indices used

Country	Stock Exchange (Abbreviation)	Index Used (Abbreviation)
Brazil	Bolsa de Valores, Mercadorias & Futuros de São Paulo (BM&F BOVESPA)	Índice BOVESPA (IBOVESPA)
Russia	Moscow Exchange	Russia Trading System Index (RTSI)
India	National Stock Exchange of India (NSE)	S&P CNX Nifty (NIFTY)
China	Shanghai Stock Exchange(SSE)	Shanghai Stock Exchange Composite Index (SHCOMP)
South African	Johannesburg Stock Exchange (JSE)	FTSE/JSE Top 40 Stock Index (FTSE/JSE 40)
United States	New York Stock Exchange (NYSE)	Dow Jones Industrial Average (DJIA)
United Kingdom	London Stock Exchange (LSE)	FTSE-100 (FTSE-100)

Data consists of the daily closing prices for each index from 1st January 2004 to 31st December 2013 which gives a total of 2201 observations. The data is omitted for days when any of the stock markets were closed. Thus data is collected on the same dates across the stock exchanges. The closing prices of market indices are obtained from the respective websites of the stock exchanges. The closing prices series are converted to US dollars return series. US dollar return series is chosen for three reasons. First, a common currency across countries allows for comparisons of the results. Second, several emerging markets have relatively high inflation rates, which would lead to inflated returns if returns are denominated in the local currency. Finally, these indices reflect changes in the exchange rates as well since they have been calculated in dollars.

The data is analysed using E-Views 7 statistical software package.

Methodology: The analysis is done on the daily log return series of the indices; computed as follows:

$$R_t = \text{Log } P_t - \text{Log } P_{t-1}$$

where Rt is the daily return at time t. Pt -1 and Pt are daily closing prices of the indices at two successive days, t-1 and t respectively. In order to analyse the integration between stock markets of BRICS with developed stock markets of US and UK, the study adopts three two methods: Correlation and Johensen's Cointegration method.

Correlation Test: Correlation is used to measure the strength and direction of the association between different stock indices. The correlation coefficient indicates the extent to which a stock market is linearly associated with another stock market. If a stock market is linearly associated with or influenced by another market, the correlation coefficient between the two markets is higher (close to 1).However, if the return series are heteroskedastic, correlation coefficients may be biased upward and do not provide a sound basis for exploring interdependence. Moreover, correlation only measures the degree of linear association between two variables. It does not provide insight on the long run dynamic linkages between stock markets. Therefore, stock market integration is analysed employing Johansen's Cointegration method.

Unit Root Test: For presence of cointegration, all the return series are required to be integrated of the same order. Therefore, it is necessary to ascertain that the order in which the return series are stationary. In the economic practice, the Augmented Dickey Fuller Test developed by Dickey and Fuller (1979) is widely used to determine the order of integration. The Augmented Dickey Fuller (ADF) determines the unit root property of the higher order auto regressive processes i.e. return series X_t, by regressing it as follows:

$$\Delta X_t = \alpha_0 + \delta X_{t-1} + \sum_{i=1}^{\rho} \beta_i \Delta X_{t-i} + \varepsilon_t \tag{1}$$

where Δ is the first difference operator, ε_t is the white noise error term and ρ is the lag order of the autoregressive process and $\delta = \rho - 1$. The idea behind the ADF test is to include enough lagged terms so that the error term is serially uncorrelated. The null hypothesis is that $\delta = 0$ i.e. the series has a unit root and is thus non-stationary.

Johansen's Cointegration: Two or more time series with stochastic trends can move together so closely over the long run that they appear to have a common trend (Stock and Watson, 2003). This relationship is known as cointegration. If A_t and B_t are integrated of order one, and for some cointegration coefficient θ, $A_t - \theta B_t$ is integrated of order zero, then A_t and B_t are said to be cointegrated. The difference, $A_t - \theta B_t$, eliminates the common stochastic trend. The Johansen's Cointegration method was chosen to test cointegration between indices for the two time periods (pre and post crisis). The Johansen (1988) method relies on the relationship between the rank of a matrix and its characteristic roots (or eigenvalues). The basis of Johansen's approach is to estimate by maximum likelihood methods, a VAR equation of the form:

$$\Delta X_t = \pi X_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \varepsilon_t$$

$$\pi = \sum_{i=1}^{\rho} A_i - I \text{ and } \Gamma_i = -\sum_{i=1+1}^{\rho} A_j \tag{2}$$

where *i* determines the number of lags specified in the dynamic VAR relationship, Δ is the first-difference lag operator, X_t is a (p x 1) random vector of time series with I(1), Γ are (p x p) matrices of parameters and *r* is the number of cointegrating relations or vectors (i.e. the cointegrating rank). To test for cointegration between the two variables, Johansen's method estimates the Π matrix and also tests whether we can reject the restrictions implied by the reduced rank of Π. According to Johansen (1988), *'the matrix Π contains information about the long-run relationships between the variables in the data vector'*.

If r = p (i.e. Π has full rank), then all elements in X_t are stationary I(0). In this case, Π is the matrix of the form $\Pi = a\beta'$, where α and β are (p x r) matrices of full rank. Johansen (1988) provides the Trace statistic to test for the null hypothesis of no cointegration, with Trace Statistic = $-T \sum_{i=k+1}^{N} \ln(1 - \lambda_i)$ where λ is the estimated values of the characteristic roots obtained from the estimated Π matrix, T is the number of usable observations and r is the number of cointegrating vectors. The Trace test is a joint test that tests the null hypothesis of no cointegration (H_0: r = 0) against the alternative hypothesis of cointegration (H_1: r > 0).

Johansen (1988) also provided the maximum eigenvalue statistic = $T \ln(1 - \lambda_{r+1})$. The Maximum Eigenvalue test conducts tests on each eigenvalue separately. It tests the null hypothesis that the number of cointegrating vectors is equal to *r* against the alternative of *r+1* cointegrating vectors. The maximum eigenvalue test examines the number of cointegrating vectors. If the variables in X_t are not cointegrated, the rank of Π is equal to zero and all the characteristic roots are equal to zero. Given that ln(1)=0, each of the expressions $\ln(1 - \lambda_i)$ will be equal to zero in that case.

IV. RESULTS

Descriptive Statistics: The descriptive statistics for returns of all the seven stock indices are given in Table 2. A preliminary investigation of summary statistics of the stock market returns reveals that average daily returns of the markets are positive and range between 0.03% and 0.07%. The Brazilian market provides the highest return with an average of 0.079% followed by Russian market recording an average return of 0.078%. The volatility, measured by standard deviation, of Brazilian market is also the highest. The lowest mean return and volatility is observed for the United States market. The returns on price indices of all the BRICS markets are higher than developed markets (U.S. and U.K.). The returns of all the market indices are negatively skewed in the period.

Table 2: Descriptive Analysis of Stock Market Returns

	BRAZIL	RUSSIA	INDIA	CHINA	S. AFRICA	U.S.	U.K.
Mean	0.00079	0.00078	0.00065	0.00045	0.00073	0.00031	0.00040
Standard Error	0.00048	0.00045	0.00042	0.00038	0.00041	0.00024	0.00028
Standard Deviation	0.02237	0.02076	0.01933	0.01761	0.01923	0.01109	0.01323
Sample Variance	0.00050	0.00043	0.00037	0.00031	0.00037	0.00012	0.00018
Kurtosis	2.88575	4.28336	9.67960	4.11196	2.32168	6.75941	3.81825
Skewness	-0.16878	-0.52225	-0.11193	-0.34433	-0.22811	-0.21639	-0.20165
Range	0.27248	0.23658	0.35554	0.21720	0.19509	0.17104	0.16927
Minimum	-0.12285	-0.13387	-0.16395	-0.12731	-0.08693	-0.08014	-0.07016
Maximum	0.14963	0.10272	0.19159	0.08988	0.10816	0.09090	0.09910

It is observed that the market providing the highest return is also the most volatile and the market providing the least return is least volatile. This is in congruence with the high risk-high return theory. It is also seen that the developed markets have a lower standard deviation than the BRICS markets. Figure 1 presents time series plots of the returns for all seven stock markets used in the study. Of particular note is the high volatility of the market returns series associated with the 2008 global financial crisis. The stock market of U.S. appears to have the sharpest increase in volatility over this time compared with the other stock markets.

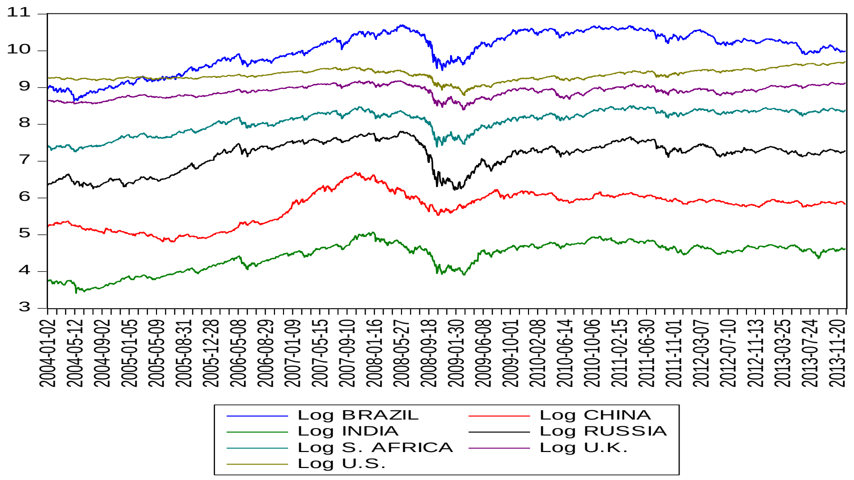

Figure 1: Movement of Log returns of the stock indices over the sample period.

Correlation: Correlation coefficients between the indices are studied to investigate the extent to which the stock markets under consideration display co-movements. The results in Table 3 indicate the correlation between the stock markets. The results indicate that the coefficients of correlation across the stock market returns are positive. Correlation coefficients range between 0.0386 and 0.6402. The stock markets of Russia and South Africa are most highly correlated. The stock markets of China and U.S. have lowest correlation coefficient. Overall, the results from the correlation coefficients suggest some insight on the short-term integration between stock markets. This measure is not adequate to investigate long-run relationships across markets.

Table 3: Correlation Matrix for Stock Index Returns

	BRAZIL	**RUSSIA**	**INDIA**	**CHINA**	**S. AFRICA**	**U.S.**	**U.K.**
BRAZIL	1						
RUSSIA	0.4846	1					
INDIA	0.3554	0.4354	1				
CHINA	0.1633	0.1733	0.2689	1			
S. AFRICA	0.5248	0.6402	0.5263	0.2226	1		
U.S.	0.6227	0.3661	0.2437	0.0386	0.3687	1	
U.K.	0.5747	0.5371	0.4103	0.1269	0.6296	0.5698	1

Unit Root Test: A perquisite for testing cointegration between stock market returns is that all variables are nonstationary. If a variable is non-stationary in time then it is said to have a unit root. Augmented Dickey-Fuller

(ADF) test is used to test whether the variables contain a unit root. Table 4 reports the results of ADF unit root test for log return series of all the stock market indices at level and first difference.

Table 4: Results of the Augmented Dickey – Fuller Unit Root Test

Series	ADF STATISTIC	
	Level	**First Difference**
BRAZIL	-1.891633	-34.69011
RUSSIA	-2.087881	-40.97576
INDIA	-1.812313	-43.96854
CHINA	-1.286150	-47.08226
S. AFRICA	-2.161686	-45.23624
U.K.	-2.184649	-45.23624
U.S.	-0.788606	-52.68429

Note: The critical values for the ADF and PP tests are -3.97, -3.41, and -3.13 at 1%, 5% and 10% level, respectively.

The results indicate the existence of unit roots at level for log return series of all the indices (i.e. the null hypothesis cannot be rejected). The ADF test finds no evidence to support the presence of a unit root in first differences of log return series of the indices. The log returns on indices are stationary at the first difference, and hence they are integrated in the order one, I(1), which is consistent with results in the literature.

Johansen's Cointegration Results: In order to gain an insight into the nature of the relationship between the stock markets, bivariate and multivariate co-integration tests were carried out between the stock markets. The results of the bivariate tests are presented in Table 5 and the results for multivariate tests are presented in Table 6.

Table 5: Johansen's Cointegration Result- Bivariate Analysis

BI- VARIATE FULL SAMPLE					
	Hypothesized No. of CE(s)	Trace Statistic	Prob.	Max Eigenvalue Statistic	Prob.
BRAZIL INDIA	None	**15.70799***	0.0464	12.09167	0.1072
	At most 1	3.616316	0.0572	3.616316	0.0572
Brazil UK	None	6.825806	0.5980	5.228733	0.7128
	At most 1	1.597072	0.2063	1.597072	0.2063
Brazil US	None	10.49604	0.2445	10.33999	0.1906
	At most 1	0.156053	0.6928	0.156053	0.6928
China UK	None	7.596771	0.5095	5.920675	0.6234
	At most 1	1.676096	0.1954	1.676096	0.1954
China US	None	2.174765	0.9923	1.646302	0.9966
	At most 1	0.528463	0.4673	0.528463	0.4673
India UK	None	9.015823	0.3639	5.728255	0.6483
	At most 1	3.287568	0.0698	3.287568	0.0698
S. Africa UK	None	12.55895	0.1320	7.628808	0.4177
	At most 1	**4.930138***	0.0264	**4.930138***	0.0264
S. Africa US	None	11.58181	0.1781	10.22583	0.1975
	At most 1	1.355983	0.2442	1.355983	0.2442
RUSSIA SA	None	8.922366	0.3726	4.958077	0.7471
	At most 1	**3.964288***	0.0465	**3.964288***	0.0465
Russia UK	None	12.21222	0.1470	7.948898	0.3839
	At most 1	**4.263325***	0.0389	**4.263325***	0.0389
Russia US	None	6.786854	0.6026	6.180071	0.5902
	At most 1	0.606783	0.4360	0.606783	0.4360
US UK		7.971619	0.4685	7.797761	0.3996
		0.173858	0.6767	0.173858	0.6767

Table 6: Johansen's Cointegration Result- Multivariate Analysis

	Hypothesized No. of CE(s)	Trace Statistic	Prob.	Max Eigenvalue Statistic	Prob.
Brazil China UK US	None	32.05126	0.6093	18.42289	0.4603
	At most 1	13.62837	0.8608	11.28906	0.6185
	At most 2	2.339318	0.9890	1.947192	0.9919
	At most 3	0.392126	0.5312	0.392126	0.5312
Russia India UK	None	19.40951	0.4638	10.12852	0.7325
	At most 1	9.280991	0.3400	5.563539	0.6696
	At most 2	3.717452	0.0538	3.717452	0.0538
BRAZIL CHINA INDIA RUSSIA S. AFRICA	None	53.18265	0.4972	31.51115	0.0933
	At most 1	21.67150	0.9783	8.383513	0.9976
	At most 2	13.28799	0.8780	6.879063	0.9585
	At most 3	6.408926	0.6472	3.750270	0.8847
	At most 4	2.658656	0.1030	2.658656	0.1030
Russia UK US	None	21.18860	0.3460	13.87869	0.3751
	At most 1	7.309912	0.5419	6.623709	0.5345
	At most 2	0.686203	0.4075	0.686203	0.4075
S Africa Russia UK US	None	30.59253	0.6882	14.73767	0.7686
	At most 1	15.85486	0.7225	9.644622	0.7773
	At most 2	6.210238	0.6707	5.228689	0.7128
	At most 3	0.981549	0.3218	0.981549	0.3218
RUSSIA S. AFRICA U.K.	None	18.77414	0.5092	8.709717	0.8551
	At most 1	10.06442	0.2758	5.371928	0.6943
	At most 2	**4.692493***	0.0303	**4.692493***	0.0303
RUSSIA SAFRICA UK US	None	30.59253	0.6882	14.73767	0.7686
	At most 1	15.85486	0.7225	9.644622	0.7773
	At most 2	6.210238	0.6707	5.228689	0.7128
	At most 3	0.981549	0.3218	0.981549	0.3218
RUSSIA S. AFRICA INDIA CHINA	None	38.05266	0.2997	22.03991	0.2183
	At most 1	16.01276	0.7114	7.803764	0.9153
	At most 2	8.208995	0.4433	5.909981	0.6248
	At most 3	2.299014	0.1295	2.299014	0.1295
S. AFRICA UK INDIA CHINA	None	35.24593	0.4350	19.95614	0.3442
	At most 1	15.28979	0.7610	7.805160	0.9152
	At most 2	7.484629	0.5220	5.197482	0.7168
	At most 3	2.287147	0.1304	2.287147	0.1304
AFRICA UK INDIA CHINA	None	35.24593	0.4350	19.95614	0.3442
	At most 1	15.28979	0.7610	7.805160	0.9152
	At most 2	7.484629	0.5220	5.197482	0.7168
	At most 3	2.287147	0.1304	2.287147	0.1304

*Note: * Significant at the 95 per cent level*

The order of the underlying vector autoregression (VAR) model is determined by either the Akaike (1974) information criterion (AIC) or the Schwarz (1978) Bayesian criterion (SBC). The order of the VAR is selected by choosing in each case the lowest of the AIC and SBC coefficients, as suggested by Johansen and Juselius (1990). As far as the specification of the intercepts/trends in the VAR is concerned, the underlying VARs are assumed to contain unrestricted intercepts and nondeterministic trends. Table 5 depicts the number of co-integrating vectors (r) for pairs of stock market indices. For each test, the null hypothesis of no co-integration is compared against the alternative hypothesis of presence of co-integration. The results inform whether there exists a long-run equilibrium relationship between the stock markets. In the pairwise co-integration test, there is evidence to support presence of cointegration between stock markets of Brazil and India; South Africa and U.K.; Russia and South Africa; Russia and U.K. In contrast, there is no evidence to support a long-run relationship between the stock markets of China and U.K.; Russia and U.S. since the null hypothesis of no co-integration cannot be rejected. Cointegration results for the multivariate co-integration analysis between the stock markets suggest the presence of co-integrating vectors between Russia, South Africa and U.K. Overall, the above results suggest that there exist long-run relationships between the BRICS and developed stock markets. This is consistent with the findings of the correlation results.

V. SUMMARY AND CONCLUSIONS

This study examines the stock market integration among the stock markets of BRICS and developed economies (U.S. and U.K.).

Correlation test is used to study the short-run static linkages between the markets. Johansen's Cointegration method is used to study the long-term dynamic linkage between the markets. Correlation test reveals that stock markets showed signs of co-movement. Overall, correlation test results indicate that there is integration between the stock markets. In order to get more insight into the relationships between these markets, Johansen's cointegration method is applied. There was cointegration only between the stock markets of Brazil and India; South Africa and U.K.; Russia and South Africa; Russia and U.K. Multivariate tests found integration between the stock markets of Russia, South Africa and U.K. The results of cointegration are consistent with the findings of the correlation results.Presence of cointegration between stock markets implies that these markets simultaneously adjust to new information, thereby eliminating any opportunities for abnormal profits or risk diversification associated with lagged information processing. There appears therefore, to be no gains to be derived by investors in developed stock markets from diversifying their investments across the BRICS markets or vice versa. Results of this study have implications for policy makers in responding to increasing financial interactions across borders.

REFERENCES

[1] G. Chen, M. Firth and O. Rui, Stock market linkages: evidence from Latin America, *Journal of Banking and Finance, 26,* 2002, 1113-1141.

[2] C. C. Nieh, The Effect of the Asian Financial Crisis on the Relationships among Open Macroeconomic Factors for Asian Countries, *Applied Economics, 34*, 2002, 491-502.

[3] R. W. Click, and M. G. Plummer, Stock Market Integration in ASEAN, *Journal of Asian Economics, 16 (1)*, 2005, 5-28

[4] C. Hsiao, Z. Wang, J. Yang, and Q. Li, The emerging market crisis and stock market linkages: further evidence, *Journal of Applied Econometrics, 21(6),* 2006, 727-744.

[5] T. O. Awokuse, A. Chopra and D. A. Bessler, Structural Change and International Stock Market Interdependence: Evidence from Asian Emerging Markets, *Economic Modelling, 26,* 2009, 549–559.

[6] D. A. Dickey, and W. A. Fuller, Distribution of the Estimators for Time Series Regressions with a Unit Root, *Journal of the American Business Association, 74*, 1979, 427-431.

[7] S. Johansen, Statistical Analysis of Cointegration Vectors, *Journal of Economic Dynamics and Control, 12*, 1988, 231-254.

[8] S. Johansen, and K. Juselius, Maximum Likelihood Estimation and Inference on Cointegration with Application to the Demand for Money, *Oxford Bulletin of Economics and Statistics, 52*, 1990, 169-209