Financial Integration of North Africa Stock Markets

Onour, Ibrahim

Arab Planning Institute

10 April 2009

Financial Integration of North Africa Stock Markets

Ibrahim A. Onour
Associate Professor of International Finance
Arab Planning Institute
P.O.Box 5834
SAFAT 13059, Kuwait
Emails:
onour@api.org.kw
ibonour@hotmail.com

Financial Integration of North Africa Stock Markets

Abstracts

This paper investigate long-term relationship linking between stock prices of three major North African stock markets: Egypt, Morocco, and Tunisia[1]. The paper shows, there is a strong evidence of multivariate and bivariate nonlinear long-term relationship between stock prices of these markets. Nonlinear cointegration between stock prices imply portfolios in these markets are inefficient (systematic risk cannot be diversified away), as movement in the prices of these markets are linked in a predictable direction but nonlinearly.

Keywords: Nonlinear cointegration, Portfolio diversification, Risk

[1] Egypt stock market is known as Cairo and Alexanderia stock exchange, and the Moroccan market is Casablanca stock market.

1- Introduction:

Full integration of capital markets require removal of barriers on capital account transactions, harmonization of laws, and currency unification, which in turn help standardize pricing of financial assets, and reduce investors' transaction and information costs, when forming regional portfolio allocation. Common currency helps eliminate currency risk premium, so that investors do not have to hold different portfolios across countries in order to hedge against unanticipated changes in exchange rates. On the other hand, partial integration of stock markets is a lower degree of integration that requires removal of barriers on foreign participation in equity markets, and removal of foreign exchange restrictions. Thus, partial integration can be attained even when full integration of capital markets failed to be accomplished.

Often raised question is: why do we need to investigate stock markets cointegration? Integration in stock markets provide some advantage in terms of gains in market efficiency, but also entails potential risks. Greater integration among stock markets imply stronger co-movements between markets, therefore reducing the opportunities for regional diversification. Furthermore, market co-movements can also lead to market contagion as investors incorporate into their trading decisions information about price changes in other markets. Earlier studies (Goldstein, 1998) have shown that information linkage among capital markets is a factor responsible for financial crisis transmission.

In pursuit of determining whether or not there is a cointegration between the major North African markets: Egypt, Morocco, and Tunisia, in this paper

beside Johansen's linear cointegration technique, a nonlinear cointegration approach suggested recently by Breitung (2001) is employed. It is well documented in the literature (Barnett and Serletis, 2000, Granger and Hallman (1991) that the performance of linear cointegration tests depend on a number of restrictive assumptions that are often questionable in empirical applications, as the assumption that the data generating process is linear seems too restrictive in many circumstances. In fact, the time series to be tested are often transformed to logarithms before cointegration analysis performed. As a result, a test which is unaffected by the choice of the initial transformation is highly desirable**.** This paper is motivated by growing evidences of nonlinearity of long term dependence of stock returns in developed markets (Hiemstra and Jones, 1994; Abhyanker et al, 1997; Chang et al, 2005), and its implications on international investors decisions. When nonlinear cointegration relationship fail to be detected by linear cointegration analysis, results would suggest misleadingly, diversification strategy is superior to non-diversification decision. In fact, under high transaction costs, as the case in many emerging markets, diversification strategy can be inferior to non-diversification policy if stock markets cointegrated, since risk adjusted gains from diversification may not outweigh the additional transaction cost arising from diversification.

The remaining parts of the paper organized as follows: Section two discuses some development indicators of the three markets. Section three includes basic statistical analysis. Section four outlines aspects of the methodology of rank test developed in Breitung (2001). Section five discuses the empirical results.The final section concludes the study.

2. Development Indicators:

When comparing the size and liquidity indicators of the three North African Markets with other emerging markets, it becomes clear that these markets, despite their fast growth in the past five years, are still considered small in terms of the number of listed companies, and market capitalization ratio, which measures the size of the stock market relative to the size of the economy in which operates. For comparison purpose, included in table (1) Malaysia and Israel stock markets' indicators. Tunisia stock market is the smallest among the group, with fewer listed companies, low market capitalization, and smaller liquidity ratio. Smaller liquidity ratio, measured by low turnover ratio imply fewer shares traded compared to the total shares listed in the market. Thus, smaller turnover ratio indicate concentration of trading activities in fewer stocks.

Despite their relative smaller sizes, the three North African markets characterized with strong regulatory and institutional set up, represented by existence of market regulators, foreign participation access, and electronic trading systems (table, 2). In terms of regualatory and insititutional development enhancing transparancy requirments, Egypt and Morocco markets are maturing to international levels, as both markets safe guarded by international custodian, and international reporting systems.

Table (1): Markets Development Indicators

	Listed Domestic Companies 2006	Market Capitalization (% of GDP) 2006	Liquidity Indicator 2007
Egypt	**435**	**87**	**48.3**
Morocco	**74**	**75.5**	**39.6**
Tunisia	**50**	**14.7**	**13.0**
Malaysia	**1036**	**156.2**	**51.6**
Israel	**654**	**123.4**	**54.8**

Note: Liquidity indicator measured by the turnover ratio, which is value of shares traded as % of market capitalization.
Source: The World Bank, World Development Indicators, 2008.

Table(2): Regulatory and Institutional Development Indicators

	Market regulator	Clearing & settlement	International Custodian	Foreign participation	Exchange control	Trading System & days	Central Depository & reporting system
Tunisia	**yes**	**electronic**	**no**	**yes**	**Yes***	**Electronic 5 days**	**Yes local**
Egypt	**yes**	**electronic**	**yes**	**yes**	**no**	**Electronic 5 days**	**Yes intern**
Morocco	**yes**	**Manual****	**yes**	**yes**	**no**	**Electronic 5 days**	**Yes intern**

Source: UNDP African Stock Markets Handbook, 2003

*For foreigners, sale of shares is restricted by elapse of six month period from the date of ownership.

**Efforts are underway to install electronic system for clearing and settlements.

3-Data Analysis:

Data employed in this study are daily closing price indices for Tunisia, Egypt, and Morocco stock markets. The sample period covers from May-28- 2002 to Sept-2-2006, including 1125 observations. All price data

collected from Arab Monetary Fund's data base. Summary statistics for stock returns are presented in table (3).

Table (3): Summary Statistics

	Tunisia	**Egypt**	**Morocco**
Mean (%)	0.04	0.11	0.08
St.deviation (%)	0.39	0.97	0.80
Skewness:	0.20	-0.84	-1.66
Ex. Kurtosis:	1.67	11.4	21.7
JB test	137	621	224
p-value	(0.000)	(0.000)	(0.000)
Q(10)	25.3	25.5	17.8
(p-value)	(0.005)	(0.005)	(0.006)
Q^2(10)	241	127	101
(p-value)	(0.000)	(0.000)	(0.000)
LM ARCH(1)	45.1	28.3	47.0
(P-value)	(0.003)	(0.005)	(0.003)
LM ARCH(5)	119.4	76.2	71.9
(P-value)	(0.000)	(0.001)	(0.001)
ADF unit root test:			
- level	4.5	3.5	3.3
- 1st differnce	16.0*	14.5*	16.2*

*significant at 1% level. In ADF lag parameters determined based on AIC criteria.

Table (3) shows, while the three markets exhibit positive mean returns, they show varying unconditional volatility. The high values of excess kurtosis

coefficients for Egypt and Morocco markets imply the distributions of returns characterized by peakness relative to a normal distribution. The negative skewness results imply a higher probability for stock prices decrease. The Jarque-Bera (JB) test statistic provides evidence of rejecting the null-hypothesis of normality for the unconditional distribution of the daily price changes. The sample autocorrelation statistic indicated by Ljung-Box, Q statistic reject the null hypothesis of uncorrelated price changes up to ten lags for the three markets. Investigation of ARCH behavior of stock returns, indicated by $Q^2(10)$ and LM test statistics show evidence of stock returns volatility persistence (ARCH effect) for all markets. Unit root test results reveal stock returns of the three markets are I(0).

5- Rank test for cointegration:

Since Johansen and Juseilus (1990) linear cointegration technique is well documented in the literature, in the following, a brief review of the nonlinear cointegration test of Breitung (2001) is illustrated. In the bivariate case, Breitung nonlinear cointegration can be tested by the following k-type or, ς-type statistics. Given the two variables $z_{1t} = f_1(x_{1,t}), \quad and \quad z_{2t} = f_2(x_{2,t})$ are both I(1) series, where $x_{1,t}\ and\ x_{2,t}$ are observed, whereas $f_1(.)\ and\ f_2(.)$ are monotonically increasing function but are unknown. Nonlinear cointegration between $x_{1,t}\ and\ x_{2,t}$ is computed when the difference between $z_{1t}\ and\ z_{2t}$ is integrated of order zero, or $\mu_t = z_{1t} - z_{2t}$ is I(0).

Since the sequence of ranks is invariant to monotonic transformations of the original data, the unknown $f_1(.)\ and\ f_2(.)$ can be replaced by the ranks, R(x) so that: $R(z_{1t}) = R(x_{1t}), \quad and \quad R(z_{2t}) = R(x_{2t})$.

Breitung's nonlinear cointegration test employ the following two statistics:

(7) $k_T = T^{-1} \sup|d_t|$

(8) $\zeta_T = T^{-3} \sum_{t=1}^{T} d_t^{\,2}$

where $d_t = R(x_{1t}) - R(x_{2t})$ *and* $\sup|d_t|$ is the maximum value of $|d_t|$ over t=1,2,…T. The null-hypothesis to be tested is linear cointegration, and it is rejected if the statistics are smaller than the critical values at an appropriate significance level. The statistics expressed in (7) and (8) depends on the assumption that z_{1t} *and* z_{2t} are not correlated. To correct for the possibility of correlation, Breitung (2001) propose corrections based on the size of the correlation. When the absolute value of the correlation coefficient of the two series is small but not close to zero, the test statistic should be corrected so that[2]

(9) $k_T^{\,*} = \dfrac{k_T}{\hat{\sigma}_{\Delta d}}$

(10) $\zeta_T^{\,*} = \dfrac{\zeta_T}{\hat{\sigma}^2{}_{\Delta d}}$

where $\hat{\sigma}^2{}_{\Delta d} = T^{-2} \sum_{t=2}^{T} (d_t - d_{t-1})^2$

Breitung (2001) also suggest generalization of the bivariate nonlinear cointegration test for multivariate case, $y_t, x_{1t}, ...x_{mt}$ where it is assumed that $g(y_t)$ *and* $f_i(x_{it})$ are monotonic functions.

Let $R_T(x_t) = [R_T(x_{1t}), ...R_T(x_{mt})]'$ be a mx1 vector and $\hat{\beta}_T$ be the OLS estimators for a regression of $R_T(y_t)$ *on* $R_T(x_t)$.

[2] Breitung (2001) point out that small values (in absolute terms) of correlation coefficient that warrant use of (9) and (10), range between (0.2 and 0.4).

Using the residuals $\mu_t = R_T(y_t) - \hat{\beta}_T R_T(x_t)$, a multivariate rank statistic is obtained from the normalized sum of squares:

$$(11) \quad m_T(k) = T^{-3} \sum_{t=1}^{T} (\mu_t)^2$$

To account for a possible correlation between the series, a modified statistic is given as:

$$(12) \quad m_T^*(k) = \frac{m_T(k)}{\hat{\sigma}_{\Delta\mu}^{\ 2}}$$

$$where \quad \hat{\sigma}_{\Delta\mu}^{\ 2} = T^{-2} \sum_{t=2}^{T} (\mu_t - \mu_{t-1})^2$$

critical values for the test statistic in equation (12) provided in Breitung (2001), table (1).

6-Empirical results:

Results in table (4) indicates while the linear cointegration test fail to capture pairwise cointegration, the rank test show significant evidences of multivariate and pairwise nonlinear cointegration relationship between stock market prices of the three markets. The evidence of multivariate linear cointegration indicated by Johanson's test needs to be treated with caution since results in table (3) indicates the distribution of stock price changes do not support the normality assumption, and exhibit fat tailedness and high peaks indicated by high values of excess kurtosis coefficients. Given the low values of the correlation coefficients (ρ_T), the rank cointegration results in table (6), are based on K_T *and* ζ_T statistics in equations (7) &(8). To better capture the common trend linking the three markets, and safe guard against spurious cointegration result caused by linkage of the three markets with an exogenous common factor, that influence the three markets simultaneously,

I included oil price changes as exogenous variable, beside the relevant endogenous variables, in the calculation of residuals. Cointegration results, in general, imply these markets are becoming accessable for foreign investors participation, and restrictions on capital flows across the three countries are becoming more lenient during the sample period under investigation.

The evidence of nonlinear cointegration presented in tables (5) and (6), have important implication on portfolio allocation. Nonlinear cointegration imply decisions on regional diversification of equities is more complex as compared with the case of linear cointegration, since it requires estimation and identification of the nonlinear association between stock markets trends. Ignoring the nonlinear relation that links stock prices in these markets could lead to a misleading conclusion that no long run relationship exist between these markets, when actually does exist. Presence of nonlinear cointegration relationship, between stock markets imply diversification of portfolio investments in these markets tends to be inefficient since movement in the price of one market induce movement in another market in a predictable direction, even though disproportionately.

Table (4):Johansen's cointegration: bivariate case

Index	H_0:rank=p	Lmax	Ltrace
T,M	P = 0	9.60	9.60
	p≤ 1	3.40	13.0
T,E	P = 0	19.68	19.68
	p≤ 1	2.43	22.1
E,M	P = 0	18.54	18.54
	p≤ 1	3.76	22.3

* significant at 5% significance level.
Critical values from Mackinnon J., et al (1999), cases 3 & 5.

Table (5):Rank test for bivariate cointegration:
(k_T -type and ζ_T -type test statistics)

Indexes	k_T stat	ζ_T stat	ρ_T
T,E	0.23*	0.0085*	0.013
T,M	0.24*	0.0079*	0.086
E,M	0.25*	0.01*	0.0001

Note; T=Tunisia, E=Egypt, M=Morocco
ρ_T is the correlation coefficient (equation 13).
* significant at 1% significance level.

Table (6): Rank test for multivariate cointegration
(Three variable cointegration model)

Stock index	
Tunis	E, M 0.0049*
Egypt	T,M. 0.0059*
Morocco	T, E 0.0069*

Note; T=Tunisia, E=Egypt, M=Morocco
* significant at 5% significance level.

7. Concluding remarks:

The three emerging North African stock markets: Egypt, Morocco, and Tunisia, characterize with a strong regulatory and institutional infrastructure, reflected in existence of market regulators, access of foreign participation, and electronic trading systems. In terms of regualatory and insititutional standards, Egypt and Morocco markets are maturing to international levels in terms of transparancy requirment, as financial reporting in both markets is safe gaurded by international custodians.

To investigate cointegration of stock prices, the paper employs both Johansen and Juseilus (1990) test for linear cointegration, and Breitung (2001) rank test on bivariate and multivariate models. Results in the paper

show strong evidence of multivariate and bivariate nonlinear cointegration between the three markets. The evidence of nonlinear cointegration, have important implication on equity portfolio allocation decisions. Nonlinear cointegration imply decisions on regional diversification of equities is more complex as compared with the case of linear cointegration, since it requires estimation and identification of the nonlinear association between stock markets trends. Nonlinearity of long term trends is an indicator of pervasive influence of regional portfolio investment funds and its speculative nature. Ignoring the nonlinear relation could lead to a misleading conclusion that no long run relationship exist between these markets, when actually does exist. Since evidence of nonlinear cointegration imply change in the long term trend of prices influence each other, albeit disproportionately, then portfolio diversification in these markets fail to be efficient as systematic risk cannot be diversified away. Thus, international investors in these markets need to be cautious in formulating their portfolio strategies, since presence of long term nonlinear dependence among these markets imply portfolio diversification strategies may not be superior to non-diversification policy when taking into account risk adjusted gains.

References

Abhyanker A., Copeland L., and Wong W., (1997) "Uncovering Nonlinear Structure in Real Time Stock Market Indexes:The S&P 500, The Dax, The NIKK 225, and FTSE 100" Journal of Business and Economic Statistics, Vol.15, pp.1-14.

Barnett, W., and Serletis A., (2000) "Martigales, Nonlinearity, and Chaos" Journal of Economic Dynamics and Control, Vol.24, pp.703-724.

Bekaert, G.; and Harvey, C.; (1995) "Time Varying World Market Integration" Journal of Finance, 50, 403-444.

Breitung J., and Gourieroux, C., (1997) " Rank Test for Unit Roots" Journal of Econometrics, Vol.81, pp.7-27.

Breitung J., (2001, July) "Rank Test for Nonlinear Cointegration" Journal of Business & Economic Statistics, Vol. 19, no.3, pp. 331-340.

Chang, T., Hsu-Ling C., Hsiao-Ping C, and Chi-Wei Su (2005) "Does Rational Bubbles Exist in the Taiwan Stock Market? Evidence From Nonparametric Cointegration Test" Economic Bulliten, Vol.3, No.41, pp.1-9.

Dicky, D.A; and Fuller W.A; (1981) "Liklihood Ratio Statistics For Autoregressive Time Series With a Unit Root", Econometrica, Vol 49, pp. 1057 1072.

Dicky, D.A; and Fuller W.A; (1979) "Distribution of the Estimators for Autoregressive Time Series With a Unit Root" Journal of American Statistical Association, 74, 427-431.

DeJong, D.; Nankervis, J.; Savin, N.; and Whiteman, C.; (1992a) "Integration Versus Trend Stationarity in Macroeconomic Time Series" Econometrica, 60, 423-434.

Eun C.; Shim S.; (1989) "International Transmission of Stock Market Movements" Journal of Financial and Quantitative Analysis, 24, 241- 256.

Johansen, S., and Juseilus, K., (1990) "Maximum Liklihood Estimation and Inference On Cointegration – With Application to The Demand For Money, Oxford Bulletin of Economics and Statistics,52,169-210.

Kwiatkowski, D.; Phillips, P.; Schmidt, P.; and Shin, Y.; (1992) " Testing the Null Hypothesis of Stationarity Against the Alternatives of a Unit Root: How Sure Are We That Economic Time Series Have a Unit Root?" Journal of Econometrics, 54, 159-178.

King M.; and Wadhwani S.; (1990) "Transmission of Volatility Between Stock Markets" Review of Financial Studies, 3, 5-33.

Longin, F.; and Solnik, B.; (1995) "Is Correlation in International Equity Returns Constant: 1960 – 1990" Journal of International Money and Finance, 14, 3 – 26.

Longin, F.; and Solnik, B.; (2001) "Extreme Correlation of International Equity Markets" Journal of Finance,56, 649-676

Lee, S.; and Kim, K.; (1993), Does the October 1987 Crash Strengthen the Co-movments among National Stock Markets ?", Review of Financial Economics, 3, 89 – 102.

Lee, T., White H., and Granger C., (1993) "Testing for Neglected Nonlinearity in Time Series Models: A Comparison of Neural Network Methods, and Alternative Tests" Journal of Econometrics, Vol.56, pp. 269-290.

Mackinnon J., Haug A. and Michelis L. (1999) "Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration" Journal of Applied Econometrics, Vol.,14, pp. 563-577.

Masih A.; Masih R.; (1997) "Dynamic Linkages and the Propagation Mechanism Driving Major International Stock Markets" Quarterly Review of Economics and Finance, 37, 859-885.

Ng, S.; Perron, P.; (1993b), Unit Root Tests in ARMA Models with Data Dependent Methods for The Selection of the Truncation Lag, (Manuscript), C.R.D.E., University of Montreal, Quebec.

Hamao, Y.; Masulis; and Ng, V.; (1989) " Correlation in Price Changes and Volatility a Cross International Stock Markets", Review of Financial Studies, 3, 281-307.

Hiemstra, C., and Jones J.(1994) "Testing for Linear and Nonlinear Granger Causality in the Stock Price Volume Relation" Journal of Finance, Vol.49

Hsieh, D. (1991) "Chaos and Nonlinear Dynamic: Application to Financial Markets" Journal of Finance, Vol.46, pp. 1839-1877.

Granger C., Hallman, J. (1991) "Nonlinear Transformations of Integrated Time Series" Journal of Time Series Analysis, Vol.,12, pp. 207-224.

Green, W.;(1993): Econometric Analysis, 2nd Edition, Macmillan.
Roll, R.; (1989) "The International Crash of October, 1987" Financial Analysis Journal, 44, 19 – 35.

Rigobon, R.; (2001) "Contagion: How to Measure It ?", Working Paper 8118, NBER.

Rigobon, R.; (2002) "On the International Propogation Of Shocks:
Is It Stable ?" Journal of International Economics, Forthcoming.

Schmidt, P., Phillips, P., (1992) “LM Test for a Unit Root in the Presence of Deterministic Trends” Oxford Bulletin of Economics and Statistics, Vol. 54, pp. 256-287.

Phillips, P.(1988) “Trends and Random Walks In MacroeconomicTime Series” Journal of Economic Dynamics and Control, Vol.12, pp. 297 332.

Tuluca S.; Zwick B.; (2001) “The Effects of the Asian Crisis on Global Equity Markets” Financial Review, 36, 125-142.

Whistler, D.; White, K.; Wong, D.; and Bates, D.,: Shazam Software, and Users Reference Manual, Version 10, Northwest Econometrics, Ltd.