Financial Integration of GCC Capital Markets:Evidence of Nonlinear Cointegration

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Abstracts

This paper employs a nonparametric test to investigate nonlinearity in the long-run equilibrium relationship between GCC stock markets returns. The results in the paper show strong evidence of bivariate and multivariate cointegration between five of GCC stock markets. However, Bahrain stock market is evidenced segmented from the group of GCC markets. It is indicated that there is bivariate nonlinear cointegrating relationship linking Kuwait stock market with each of Saudi, and Dubai markets. Nonlinearity also realized between Saudi market and each of Dubai and Abu-Dhabi markets, as well as between Muscat and Kuwait stock markets.

Keywords and Phrases: Cointegration, Non-linear, Unit root, Rank test.
JEL Classification:C10, C50, G10

[*] GCC countries include Saudi Arabia, Kuwait, United Arab Emirates, Oman, Bahrain, and Qatar.
[1] Forthcoming in Afro-Asian Journal of Finance and Accounting

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1- Introduction:

The Gulf cooperation council (GCC) for the Arab States established in 1981 with the objective of realizing coordination, integration, and cooperation among member states in various aspects of economic affairs. With very limited progress achieved in the first twenty years of its existence, GCC economic agenda gained unprecedented momentum since Muscat summit of leaders in 2001. In Muscat summit of GCC leaders an economic agreement accorded with the objective of speeding up the cointegration process between GCC countries[2]. Among other things, the new agreement obligate member GCC states equal treatment of all GCC nationals in all investment activities , including stock ownership and establishment of new business, and allow free mobility of capital and labor of GCC nationals in member countries. The new agreement also calls for integration of financial markets, and for harmonization of all investment related laws and regulations (details included in appendix B of this paper). GCC leaders also agreed to a joint custom tariff of five percent by the year 2003, and to form a single currency by the year 2010.

While these policies have clear implications of deepening GCC capital markets, and enhancing the linkage between them, also the judicious

[2] In Muscat summit held by the Heads of States in December 2001, Saudi Arabia's Crown prince Abdullah, set the tone in the opening session by lamenting the limited progress made by GCC to date.

emergence of Dubai, and Abu-Dhabi stock markets as formal regional markets by the end of 2001, boosted the linkage between GCC markets.

While integration in banking and financial markets provides some advantage in terms of gains in market efficiency, it also offers potential pitfalls. Greater integration among GCC stock markets implies 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 indicated that information linkage among capital markets is a factor responsible for financial crisis. On the other hand, market cointegration is important for decisions on investment as financial integration of capital markets reduce cost of capital differentials among cointegrated markets.

To capture the underlying long-term equilibrium relationship between GCC capital markets, in this paper beside Johansen's linear cointegration technique, nonlinear cointegration tests developed in Breitung and Gourieroux (1997), and Breitung (2001) employed.

The remaining parts of the paper structured as follows. Section two includes summary statistics for stock markets returns. Sections three and four includes unit root analysis. Sections five and six respectively, illustrates the rank cointegration test, and neglected non-linearity test developed in Breitung (2001). In section seven the empirical results included, and the final section concludes the study.

2-Data Analysis:

Data employed in this study are daily closing stock price indices for GCC stock markets[3]. The sample period covers from May 2004 to Sept, 2006 (852 observations). Summary statistics for stock returns are presented in table (1).

Insert Table (1) about here

Table (1) indicates while other GCC markets exhibit positive returns, Bahrain stock market average return is negative. Dubai and Muscat markets are relatively most stable in the group as they show smaller variability, whereas Saudi and Kuwait markets are the most volatile. The skewness and kurtosis coefficients indicate the distributions of returns for all six markets characterized by peakness and fat tail relative to a normal distribution[4]. The high values of kurtosis statistics indicate the stock price returns distribution is characterized by high peakness (fat tailedness) . The negative skewness results indicate a higher probability for stock prices decrease. The Jarque-Bera (JB) test statistic provides clear evidence to reject the null-hypothesis of normality for the unconditional distribution of the daily price changes. The non-parametric runs test reject the null-hypothesis of randomness of stock returns. The sample

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[3] Qatar stock market not included in this study due to missing data gap during the sample period under investigation.

[4] The skewness (sk) and excess kurtosis (k) statistics calculated using the formulas

$sk = \frac{m_3}{(m_2)^{3/2}}$ **, and** $k = \frac{m_4}{(m_4)^2} - 3$ **, where** m_j **stand for the jth moment around the mean.**

Under the null-hypothesis of normality, the two statistics are normally distributed with standard

autocorrelation statistic indicated by Ljung-Box, Q statistic, show the Q(5) test statistic reject the null hypothesis of uncorrelated price changes for five lags for Abu-Dhabi and Dubai markets. The high values for $Q^2(5)$ test statistic for Abu-Dhabi and Kuwait markets suggest conditional homoskedasticity can be rejected for these two markets. To test the presence of hetroskidasticity more formally the LM test is employed. Results of LM statistics for ARCH(1) and ARCH(5) error terms confirm the significance of ARCH effects in the data with exception of Muscat and Bahrain markets.

3- Unit root analysis:

To motivate the use of rank test for cointegration let us first employ the conventional ADF and PP unit root tests on the original data of the six stock prices without any transformations. The ADF and PP test results in table (2) indicate except for Muscat market the null hypothesis of unit root cannot be rejected at 1% significance level for price levels, but it can be rejected for price returns. For Muscat market, since the two models give different results for price levels, we applied also KPSS test, which test the null of stationary series. The KPSS test result (not reported, but available from the author) support the finding of model (2) in ADF and PP tests[5].

Insert Table (2) about here

errors, $\sigma_{sk} = \frac{\sqrt{6}}{N}$, and $\sigma_k = \frac{\sqrt{24}}{N}$, where N is the sample size. In the table we ignored the significance test of these two statistics because JB test combines both statistics.

[5] Since KPSS test results support model 2, in Johansen's cointegration results (tables 4, and 5) we chose the specification of model 2, by including drift and trend.

More robust test of unit root which accommodates the non-normality of residuals and structural breaks is a non-parametric unit root test to which we turn now.

4- Rank test for unit root:

A rank unit root test suggested by Breitung and Gourieroux (1997) extend Schmid and Phillips (1992) ranked score statistic to test the null-hypothesis of unit root in:

(1) $y_t = b + \alpha y_{t-1} + e_t \qquad for \quad \alpha = 1$

against the trend stationary model:

(2) $y_t = c + bt + \alpha y_{t-1} + e_t \qquad for \quad |\alpha| < 1$

In what follows, it is assumed the errors are independent and identically distributed with E(e)=0. As indicated below , Breitung and Gourieroux (1997) introduce possible treatment of relaxing this assumption by allowing heteroskedastic or serially correlated errors. Schmidt and Phillips (1992) score principal give rise to the following statistic:

(3) $$\hat{\phi}_t = \frac{\sum_{t=2}^{T} x_t s_{t-1}}{\sum_{t=2}^{T} s_{t-1}{}^2}$$

where , $x_t = \Delta y_t - \hat{b}$ and

$$\hat{b} = T^{-1}\sum_{t=1}^{T}\Delta y_t = (y_T - y_0)/T$$

$$s_t = \sum_{i=1}^{t} x_i$$

Under the null hypothesis of a random walk with drift, $-(2T\hat{\phi}_T)^{-1}$ is asymptotically distributed as $\int_0^1 \overline{w}(a)^2\,da, \quad where \quad \overline{w}(a) = w(a) - aw(1)$ represent the standard Brownian bridge.

Breitung and Gourieroux (1997), utilized the score statistic defined in equation (3) by introducing a variable denoting for ranks of change in observations in place of the variable x, or letting

$$r_{1,T} = Rank[of\ \Delta y_t\ among\ \Delta y_1,...,\Delta y_T] - \frac{T+1}{2}$$

$$s_{t,T} = \sum_{i=1}^{t} r_{i,T}$$

A rank counterpart of the score statistic is

$$(4)\quad \hat{\phi}_T = \frac{\sum_{t=2}^{T} r_{t,T}\ s_{t-1,T}}{\sum_{t=2}^{T} (s_{t-1,T})^2}$$

Since the ranks of the observations are not affected by subtraction of the mean of the series, then the mean of the differences, $\hat{b}$, is neglected in the rank test. Breitung and Gourieroux (1997) show equation (4) can be reduced to

$$(5)\quad \lambda_T(uni) = T^{-2}\sum_{t=1}^{T}\sum_{i=1}^{t}(\sqrt{12}\ Q_{i,T})^2$$

where, $Q_{i,T} = T^{-1} r_{t,T}$ is the normalized rank. This is the “uniform” version of the score statistic. Critical values for the statistic in (5) are given in appendix B, in Breitung and Gourieroux (1997). The test statistic in (5) can be improved by using nonlinear transformations of ranks such as inverse normal scores (Ins) transformation:

$$(6)\quad \lambda_{(Ins)} = \phi^{-1}(Q_{t,T} + 0.5)$$

where, $\phi(.)$ is the cumulative density function of the standard normal distribution.

5- Rank test for cointegration:

It is indicated in Breitung (2001) that in the bivariate case nonlinear cointegration can be tested by using the following k-type or, n-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: $R(z_{1t}) = R(x_{1t}), \quad and \quad R(z_{2t}) = R(x_{2t})$.

To test for ranks cointegration we need to calculate the following two statistics:

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

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

where $d_t = R(x_{1t}) - R(x_{2t}) \quad and \quad \sup|d_t|$ 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 $z_{1t} \quad and \quad z_{2t}$ 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[6]

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

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

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

When the absolute value of the correlation coefficient is close to one, the test statistics are modified to be (when 5% significance level is chosen):

(11) $\tilde{k}_T = \dfrac{k_T^{\,*}}{\lambda^{\alpha}{}_k(E\rho_T)}$

(12) $\hat{\zeta}_T = \dfrac{\zeta_T^{\,*}}{\lambda^{\alpha}{}_n(E\rho_T)}$

where $E(\rho_T)$ is the expected correlation coefficient of the rank differences, given as:

(13) $\rho_T = \dfrac{\sum_{t=2}^{T}\Delta R_T(x_{1t})\Delta R_T(x_{2t})}{\sqrt{(\sum_{t=2}^{T}\Delta R_T(x_{1t})^2)(\sum_{t=2}^{T}\Delta R_T(x_{2t})^2}}$

Based on Monte Carlo simulation results, Breitung (2001) provide approximating values for the function $\lambda^{\alpha}(E\rho_T)$:

(14) $\lambda_k^{\,0.05} \approx 1 - 0.174(\rho_T)^2$

(15) $\lambda_n^{\,0.05} \approx 1 - 0.462(\rho_T)$

[6] 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).

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

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

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:

$$(16) \quad m_T(k) = T^{-3} \sum_{t=1}^{T} (\mu_t)^2$$

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

$$(17) \quad m_T{}^*(k) = \frac{m_T(k)}{\hat{\sigma}_{\Delta\mu}{}^2}$$

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

critical values for the test statistic in equation (17) provided in Breitung (2001), table (1).

6- **Neglected nonlinearity test:**

Given the rank test for cointegration implies stable long-run relationship, it is important to know if there is hidden nonlinear relationship is holding between stock market returns.

Given the non-linear relationship:

$$(18) \quad y_t = \beta_0 + \beta_1 x_t + f(x_t) + \mu_t$$

where $\beta_0 + \beta_1 x_t$ is the linear part of the relationship. Under the null-hypothesis of linear relationship it is assumed that $f(x_t) = 0$, for all t. Since f(x) is unknown, different approaches used in the literature to approximate f(x) function. Lee et al (1993) employed neural network approach, whereas Breitung (2001) suggest rank transformation approach, as explained in the following.

Under the null hypothesis of linear relationship, the following representation accommodates serially correlated error terms, and endogeniety of regressors:

$$(19) \quad y_t = \beta_0 + \sum_{i=1}^{m} \alpha_i y_{t-i} + \beta_1 x_t + \sum_{j=q}^{n} \pi_j \Delta x_{t-j} + \varepsilon_t$$

A test for nonlinear relationship is performed by determining appropriate lag parameters in (19), and forming $T R^2$ for the regression of the residuals $\hat{\varepsilon}_t$ on the regressors of (19) and on the ranks, $R_T(x_t)$. Breitung (2001) indicate (theorem 3) the resulting score statistic is asymptotically Chi-square distributed under the null hypothesis of linear relationship.

7-Empirical results:

This section discusses the application results of the rank unit root tests discussed in section (4). Results in table (3) indicate the null hypothesis of difference stationary cannot be rejected at 1% significance level for all six markets, but the null hypothesis is rejected for price level stationarity for the six markets. This implies the transformed series for GCC stock markets are difference stationary rather than level stationary. Given that the parametric unit root tests of ADF and PP tests, as well as the rank test confirm I(1) process for the GCC stock prices, the next step is to investigate cointegrating relationship between price changes in these markets.

Insert Table (3) about here

Results in tables (4) and (5) present pairwise and multivariate linear cointegration test statistics using Johanson's test approach applied on the residuals of a linear regression. The bivariate cointegration results indicate evidence of pair wise linear cointegration between Muscat stock market and Saudi, Dubai, and Abu-Dhabi markets, as well as between Dubai and Abu-Dhabi markets. The multivariate results of Johansen cointegration indicate evidence of at least one cointegrating relationship linking the six GCC markets. Since Johansen method is based on the assumption of linear cointegration, and the rank test is invariant to monotonic transformation of the data generating process, the results of Johansen test should be verified by using the rank test so that if Johansen test fail to detect cointegration, and the rank test shows evidence of cointegration relationship, it will be concluded evidence of nonlinear cointegration. But where both test confirm evidence of significant cointegrating relationship the cointegration is concluded linear.
Given the low values of the correlation coefficient values (ρ_T), the rank cointegration results in table 6, are based on K_T *and* ζ_T statistics (equations 7 &8). Results in tables (6) and (7) indicate there is no significant evidence of cointegration of Bahrain stock market with GCC markets, while it shows evidences of linear and nonlinear cointegration between the other GCC markets. From the nonlinear rank and the linear cointegration test results it can be verified that the cointegrating relationship that hold Kuwait stock market with each of Saudi, and Dubai markets is nonlinear, and the one holding Saudi market with each of Dubai and Abu-Dhabi markets is also nonlinear, and the cointegration of Muscat market with Kuwait stock market is nonlinear too. The neglected nonlinearity test results in table (8) show evidence of significant nonlinear relationship between stock market returns of Kuwait and Saudi; and between Kuwait and Dubai markets.

Insert Table (4) about here

Insert Table (5) about here

Insert Table (6) about here

Insert Table (7) about here

Insert Table (8) about here

Insert table (9) about here

8-concluding remarks

The performance of linear cointegration tests depend on a number of restrictive assumptions that are often questionable in empirical applications. As argued by Granger and Hallman (1991), 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. Also the standard linear cointegration techniques are based on the assumption of normally distributed errors. Although the normality distribution assumption of errors is supported by asymptotic theory, the critical values for small samples are computed using normally distributed data. However, it is well known that the distributions of financial data exhibit much fatter tails than is expected by the normal distribution. To overcome these difficulties it is important to consider robust versions of nonparametric cointegration tests, which is based on the ranks of the observations. Using ranks instead of the original observations has two major advantages over the parametric approaches.

First, ranks are invariant to monotonic transformation of the data, and thus their distribution does not change if a monotonic transformation is applied to the original data. Second, ranks are also invariant to the distribution of the data. Based on these merits of nonlinear approach to cointegration analysis in this paper rank tests developed in Breitung and Gourieroux (1997) and Breitung (2001) employed, beside the linear approach of Johansen's test for cointegration to detect nonlinearity in the long-run equilibrium relationship between six of GCC stock markets.

Both Johansen's test for linear cointegration, and Breitung's rank test for nonlinear cointegration employed on bivariate and on multivariate models. The former can only apply to the case of linear integration, whereas the later apply to both linear and nonlinear integration. Ignoring the nonlinear nature of the cointegration relationship may lead to the misleading conclusion that no long-run relationship exist between stock markets series.

The paper shows while there is strong evidence of bivariate and multivariate, linear and nonlinear cointegration relationship between five of GCC stock markets, Bahrain stock market is evidenced segmented from the group of GCC markets. Segmentation of Bahrain stock market is probably due to the distinct nature of Bahrain economy which is the smallest among GCC countries and the least oil-dependent economy in GCC region. It is also indicated in the paper, the cointegrating relationship that link Kuwait stock market with each of Saudi, and Dubai markets is nonlinear, and that of Saudi market with each of Dubai and Abu-Dhabi markets is characterized as nonlinear, and the relationship of Muscat market with Kuwait stock market also realized as nonlinear.

The evidence of nonlinear cointegration between some of GCC markets imply decisions on regional diversification of equities is more complex since the long-term relationship that link movement in price changes in these markets is nonlinear. Diversification strategies under such cases require estimation and identification of the particular functional forms of price changes. Another policy implication includes cointegration of capital markets enhance the currency unification policy planned for the year 2010. This is because since correlation of shocks is stronger among cointegrated markets, adjustment to such shocks become faster, and this in turn reduces the cost of adjustment using monetary instruments[7]. More specifically, when the effect of an adverse temporary shock on a certain GCC market is transmitted to another market in the group, its impact will be realized on varying degrees by other GCC markets. On the other hand, when a market is segmented from the group of GCC markets the impact of any shock will be limited to that specific market, and that may require use of monetary instruments to mitigate the adverse effects of the shock in the affected market.

[7] **Bayoumi and Eichengreenn (1993) show that while demand and supply shocks across U.S regions are higher than across European Union countries, the adjustment to shocks is faster in the U.S than in Europe**.

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Appendix B

Capital Markets Related Policy Reforms:

During the past five years a package of policy reforms implemented by GCC member states with the objective of harmonizing the financial and investment policies among member states[8]. These policy reforms include foreign direct investment reforms; state enterprise ownership reforms; and capital market policy reforms.

a) Foreign Direct Investment Reforms:

Policy makers in GCC countries have realized that in order to achieve a diversified economies based on non-oil resources they must liberalize the foreign investment policies. It is well conceived that the pattern of foreign business ventures in GCC countries is a mixture of local capital with foreign capital participation and technology and other expertise from abroad. As a result, to encourage inward investment flow all GCC countries restructured their foreign investment laws and adopted similar packages of incentives to attract foreign direct investments to all sectors but a few strategic sectors as oil, and aluminum. The new foreign investment incentives include , among other things, reduction of corporate taxes, and the establishment of one-stop investment shop to facilitate all procedures related to foreign business operations.

b) State Enterprise Ownership Reforms:

In line with the reforms in foreign investment laws, comprehensive privatization strategies announced in all GCC countries. The strategies identify state enterprises to be privatized, and set up regulatory bodies to manage the privatization schemes. Privatization of power plants, and telecommunication enterprises implemented in a number of GCC countries, and management contract methods applied in some sectors like airports and sea ports services.

c) Capital Markets Restructuring:

New laws that aim to deepen and strengthen local capital markets in GCC countries adopted. Likewise, laws have been enacted to improve prudential regulations of commercial banks. All GCC countries opened up their equity markets to foreigners to trade in securities, and adopted anti-money laundering policies to safeguard against unwanted inflow of foreign money to the region.

[8] In fact, article 5 of chapter 3, of the Economic Agreement ratified by GCC leaders in Muscat Summit in 2001, stipulates, among other things, harmonization of economic and investment policies among member states..

Table (1): Basic Statistics :log-differenced series

	Ab.Dhabi	Saudi	Dubai	Muscat	Kuwait	Bahrain
Mean(%)	0.1	0.1	0.9	0.3	0.1	-0.01
St.deviation:	0.25	0.30	0.18	0.21	0.29	0.26
Skewness:	-0.08	-0.99	-0.29	28.8	-0.10	-25.7
Kurtosis:	7.56	7.55	141.8	838	8.45	721.8
JB test	2003	2142	2495	1297	2501	3292
p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Run test:						
Z statistic	-3.5	-1.8	-1.9	-5.8	-4.4	-6.2
(p-value)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Q(5)	88.5	0.12	35.6	0.03	0.01	0.00
(p-value)	(0.00)	(0.98)	(0.00)	(0.98)	(0.97)	(0.99)
$Q^2(5)$	33.9	0.05	0.22	0.33	190	0.00
(p-value)	(0.00)	(0.99)	(0.98)	(0.98)	(0.00)	(0.99)
LM ARCH(1)	0.09	0.10	0.008	0.002	0.002	0.001
(P-value)	(0.98)	(0.98)	(0.98)	(0.98)	(0.98)	(0.98)
LM ARCH(5)	88.3	88.6	153	0.006	38.8	0.006
(P-value)	(0.00)	(0.00)	(0.00)	(0.99)	(0.00)	(0.99)

Table(2): ADF and PP tests for unit roots

Stock market	variables	ADF Model(1)	ADF Model(2)	PP Model(1)	PP Model(2)
Bahrain	P	-1.99	-2.46	-2.0	-2.48
	ΔP	**-9.59**	**-9.59**	**-52.2**	**-52.1**
Kuwait	P	-1.50	-0.46	-1.68	-0.01
	ΔP	**-7.55**	**-18.98**	**-44.0**	**-44.0**
Muscat	P	**-3.78**	-3.70	**-3.78**	-3.71
	ΔP	**-25.0**	**-25.4**	**-52.1**	**-52.1**
Saudi	P	-1.57	-0.81	-1.47	-0.59
	ΔP	**-9.33**	**-9.32**	**-43.9**	**-43.8**
Dubai	P	-1.31	-0.28	-1.34	-0.57
	ΔP	**-7.58**	**-7.58**	**-61.5**	**-61.5**
A.Dhabi	P	-1.70	-1.1	-1.61	-0.53
	ΔP	**-8.81**	**-8.81**	**-48.2**	**-48.2**

Note: Bolded numbers are significant at 1% significance level.
Model (1) has drift only, and model two has both drift and trend.
In ADF lag parameters determined based on AIC criteria, and truncation lag in PP determined according to ACF and PACF.

Table (3): Rank test for Unit Roots

Stock Markets	P	ΔP
Bahrain: λ_{UNI}	0.59	**0.0046***
Kuwait λ_{UNI}	0.54	**0.0082***
Muscat λ_{UNI}	0.50	**0.0016***
Saudi λ_{UNI}	0.46	**0.0092***
Dubai λ_{UNI}	0.43	**0.0014***
Abu-Dhabi λ_{UNI}	0.45	**0.0037***

*significant at 1% significance level.
Critical values from Breitung and Gourieroux (1997), appendix B, table (6).

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

Index	H_0:rank=p	Lmax	Ltrace
B,K	P = 0 p≤ 1	7.05 0.01	7.15 0.10
B,M	P = 0 p≤ 1	16.21 5.54	21.75 5.54
B,S	P = 0 p≤ 1	6.88 0.17	7.05 0.17
B,D	P = 0 p≤ 1	7.69 0.06	7.75 0.06
B,Z	P = 0 p≤ 1	8.19 0.31	8.51 0.31
K,M	P = 0 p≤ 1	19.34 0.05	19.4 0.05
K,S	P = 0 p≤ 1	10.10 0.01	10.1 0.01
K,D	P = 0 p≤ 1	16.31 1.30	17.6 1.30
K,Z	P = 0 p≤ 1	15.03 1.65	16.7 1.65
M,S	P = 0 p≤ 1	**20.57*** 0.22	**20.8*** 0.22
M,D	P = 0 p≤ 1	**23.81*** 0.08	**23.9*** 0.08
M,Z	P = 0 p≤ 1	**21.24*** 0.32	**21.5*** 0.31
S,D	P = 0 p≤ 1	9.34 0.39	9.74 0.39
S,Z	P = 0 p≤ 1	14.51 0.58	15.1 0.58
D,Z	P = 0 p≤ 1	**21.96*** 0.44	**22.4*** 0.44

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

Table (5):Johansen's Cointegration (Multivariate case)

Indexes	H_0:rank=p	Lmax	Ltrace
B,K,M,S,D,Z	P = 0	**35.1***	**99.1***
	p≤ 1	**30.4***	**64.1***
	p≤ 2	15.4	33.6
	p≤ 3	11.5	18.2
	p≤ 4	6.07	6.7
	p≤ 5	0.57	6.10

Note: The truncation lag p is determined by AIC.
* significant at 5% significance level. Critical values from James M., Alfred H., and Leo M., (1998), case 3 and case 5.

Table (6):Rank test for bivariate cointegration:
(k_T -type and ζ_T -type test statistics)

Indexes	k_T stat	ζ_T stat	ρ_T
B,K	0.67	0.22	0.033
B,M	0.77	0.24	0.074
B,S	0.68	0.22	0.013
B,D	0.79	0.23	0.013
B,Z	0.74	0.23	0.062
K,M	**0.52***	**0.03***	0.05
K,S	**0.24****	**0.009****	0.09
K,D	**0.40****	**0.032***	0.01
K,Z	0.57	0.047	-0.01
M,S	**0.43***	**0.022****	0.01
M,D	**0.44***	**0.035***	0.04
M,Z	0.60	0.044	0.065
S,D	**0.35****	**0.019****	0.006
S,Z	**0.55***	**0.032***	0.008
D,Z	**0.33****	**0.011****	0.35

*significant at 5% significance level, ** significant at 1% level.
ρ_T is the correlation coefficient (equation 13).

Table (7): Rank test for multivariate cointegration (six variable cointegration model)

Stock index	
Kuwait	B,M,S,D,Z **0.008***
Bahrain	K,M,S,Z,D 0.06
Muscat	K,B,S,Z,D 0.017
Saudi	B,K,M,D,Z **0.004***
Dubai	B,K,M,S,Z **0.006***
A.Dhabi	B,K,M,S,D **0.010***

* significant at 5% significance level.

Table (8): Nonlinearity Test Statistic

Bahrain	**Test statistic**	**Kuwait**	**Test statistic**	**Muscat**	**Test statistic**	**Saudi**	**Test statistic**
Kuwait	0.00	Bahrain	0.01	Bahrain	1.4	Bahrain	0.10
Muscat	2.62	Muscat	1.21	Kuwait	0.27	Kuwait	**5.90***
Saudi	0.22	Saudi	**6.62***	Saudi	0.82	Muscat	0.27
Dubai	0.17	Dubai	**8.81***	Dubai	2.44	Dubai	0.60
A.Dhabi	0.11	A.Dhabi	3.38	A.Dhabi	4.69	A.Dhabi	0.34

*significant at 5% significance level.

Table (9): Nonlinearity Test Statistic

Dubai	**Test statistic**	**A.Dhabi**	**Test statistic**
Bahrain	2.40	Bahrain	1.59
Kuwait	2.72	Kuwait	0.59
Muscat	1.42	Muscat	2.33
Saudi	2.86	Saudi	1.16
A.Dhabi	0.005	Dubai	0.015