Comovements and Causality of Sector Price Indices: Evidence from the Egyptian Stock Exchange

Ahmed, Walid M.A.

College of Business Administration, P.O. Box: 110200, Jeddah 21361, Saudi Arabia.

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Walid M. A. Ahmed

Assistant Professor

Finance Department, College of Business Administration,

P.O. Box: 110200, Jeddah 21361, Saudi Arabia.

Email: w.ahmed@cba.edu.sa

Tel: +966568864904

Abstract

Contributing to the meagre published literature on interrelationships amongst stock market sectors of an economy, the present study sets out to examine both the long-run and short-run aspects of the inter-sectoral linkages in the Egyptian stock market. The data correspond to daily closing prices for twelve sectoral indices of the Egyptian stock market, covering the period between January 3, 2007 and January 18, 2010. The multivariate cointegration analysis reports evidence in support of existence of only a single cointegrating vector within the sectoral indices. Moreover, the results of Granger's causality analysis show that the short-run causal relationships between the sectoral indices are considerably limited and, where they exist, virtually unidirectional. In general, these results lead to the conclusion that there is still room to derive benefits from portfolio diversification in the short run. However, investors with long-term horizon may not benefit from diversifying investments into the different sectors of the Egyptian stock market.

Key words: Stock Market sectors; Egypt; Domestic portfolio diversification; Johansen's cointegration analysis; Granger's causality analysis.

JEL Classification: G11, N25, N27, C12.

1. Introduction

In a global economic environment where international considerations are of overriding importance, knowledge of the degree and progress of capital market integration remains an intriguing area of research for academics and practitioners alike. One of the principal motives for investigating the integration of capital markets is to recognize the magnitude of potential gains derived from, and limitations of, cross-border portfolio diversification.

In essence, adding foreign securities to a purely domestic portfolio allows an investor to accomplish beneficial risk reduction inasmuch as both the domestic and foreign markets tend to drift arbitrarily away from each other. This is well established in the earliest market integration literature (e.g., Grubel, 968; Levy and Sarnat, 1970: Solnik, 1974; Lessard, 1976) that show that, due to the low correlations of foreign stock market indices with their domestic counterpart, an investor could cut down portfolio's total risk without impairing the portfolio's expected return via expanding his/her domestic portfolio to encompass foreign stocks.

Nonetheless, a salient characteristic of the global financial environment over the past three decades is the increased interlinkages of national economies due to a variety of factors. In particular, the dismantling of many legal restrictions on financial flows across national borders, the liberalization of economies, the innovations in financial products and services, the upsurge in activities of multinational corporations, and the impressive advances in communication technology have immensely intensified the interdependence level of world capital markets, thus restricting the scope for cross-border portfolio diversification.

Empirical evidence supporting this phenomenon indicates that the benefits of cross-border portfolio diversification diminish or may even completely disappear at the time of bearish markets, due to the noticeable increase of comovements across national capital markets (e.g., Odier and Solnik, 1993; Longin, and Solnik, 1995; Olienyk et al., 2002; Glezakos et al., 2007).

Moreover, the past two decades and half were fraught with a series of severe financial crisis episodes, such as the 1987 Wall Street crash, the 1997 Asian Financial crisis, the 2001 terrorist attack in the US, and more recently the disastrous subprime mortgage crisis that erupted in the US in 2007. Wreaking havoc with other markets of different sizes and structures all around the world, these capital market turbulences and their spillover effects have deeply cast a shadow over the viability of cross-border portfolio diversification.

In this context, an important strand of studies, looking at the dynamic linkages and the transmission of volatility amongst national capital markets, makes the point that the recent episodes of financial crises illustrate how closely the world's capital markets are connected and their roles in propagating a shock. The empirical results of these studies reveal substantial evidence for additional cross-border financial contagion provoked by these crises, implying that the efficacy of cross-border portfolio diversification typically tapers off at the time it is needed most (e.g., Arshanapalli and Doukas, 1993; Sheng and Tu, 2000; Izquierdo and Lafuente, 2004; Bekeart et al., 2005). In line with this strand of literature, Mun (2005) argues that cross-market contagion could provide an adverse investment environment for risk managers and internationally diversified investors since the changing correlation pattern and financial disturbances make it more difficult for them to select an *ex ante* optimal investment strategy.

On the other hand, there is growing evidence that the benefits of cross-border portfolio diversification strategy over those of diversification with domestic assets are statistically and economically insignificant. For example, Chang et al. (1995) and Errunza et al. (1999) demonstrate that the home-biased US investors may exhaust the benefits of cross-border diversification with portfolios constructed from equity assets traded on US stock exchanges. Cavaglia et al. (2000) show that since early 1997, opportunities for returns from industry tilts have dominated those emanating from countries' tilts and that this dominance has increased since 1997. Antoniou et al. (2010) find that it is possible for a British investor to exhaust the diversification gains of all foreign markets with UK-traded assets, a result challenging the view that cross-border equity acquisitions provide diversification benefits beyond those attainable by investing in assets within a country.

As pointed out by Ewing et al. (2003), financial market participants are interested not only in how individual stocks perform, but also in how different market indices perform. Indeed, many individual and institutional investors use sectoral indices as benchmarks to track the performance of publicly traded stocks and actively managed portfolios.

Taken together, the empirical evidence appears to support the argument that during times of global market volatility, diversification across industries vis-à-vis across countries becomes paramount in order to accomplish the desired levels of investment risk and return.

With such backdrop, this study seeks to test for possible interdependences between the different sectoral indices in the Egyptian stock market. More specifically, I try to provide answers to the following set of queries:

- Does any long-run equilibrium relationship exist between the different sectoral indices of the Egyptian stock market?
- Does the decision of diversifying domestically make sense for the local investors?
- Does any short-run dynamic causal linkage exist between the different sectoral indices of the Egyptian stock market? And which is the direction of causality, if any?

My choice for the investigation of this emerging market in particular is prompted by a couple of considerations. First, as the Egyptian capital market currently functions in regulatory, institutional, cultural, and even psychological circumstances pretty dissimilar to those of its mature counterparts, a substantial amount of research is still needed to contribute to a better understanding of many issues relevant to the inter-sectoral linkages in this emerging economy. Second, unlike many mature and emerging stock markets, the Egyptian market is characterized by its noticeable cross-sector and market capitalization differences that may eventually be more observable in empirical work.

The contribution of this study to the existing literature is three-fold: First, although a number of articles addressing the issue of market sector interrelationships and its practical implications for domestic diversification are available, articles focussing on the equity sectors of the Egyptian market are virtually nonexistent, to my best knowledge. As such, this study makes the first attempt to provide empirical analyses about the long-run equilibrium relationships as well as the short-run dynamic linkages amongst the various sectors of the Egyptian stock market. In this respect, some pertinent studies (e.g., Erb et al., 1997; Garten, 1997) point out that the evolution of an emerging market may be determined by characteristics that are unique to that particular country and the stage of economic development of the country. Therefore, it is important to analyze the behavior of an emerging market, such as the Egyptian stock market, in isolation from its peers with a view to garnering information on the main characteristics of that market.

Second, knowledge of the extent to which sector-specific stock market indices move together in a particular country is crucial to portfolio managers who try periodically to allocate efficiently the resources of investors. Specifically, investment portfolios based on economic sectors that are relatively independent are more likely to add value and increase the opportunity to eliminate a fundamental part of investment risk. Moreover, gaining a better grasp of the nature of the market sector interrelationships is of practical interest to a considerable number of international investors who wish to diversify across industries and sectors. Third and last, the findings of this study could be of use to other emerging markets that have characteristics and circumstances similar to those of the Egyptian market.

Following this introduction, the study is structured in the following sequence. Section two presents a succinct review of the relevant literature. Section three casts light on the different econometric methodologies applied in this study. Data description and preliminary analyses are presented in section four. Thereafter, an interpretation of the empirical findings and an analysis of their implications are presented in section five. Finally, section six concludes.

2. Literature Review

There are voluminous studies that investigate the level of integration of the world's capital markets over time and across markets. These studies also explore a diversity of issues germane to global market linkages, such as short-run and long-run interdependences of these markets (e.g., Chung and Liu, 1994; Shamsuddin and Kim, 2003; Phaylaktis and Ravazzolo, 2005), leaders and followers amongst a set of financial markets (e.g., Arshanapalli and Doukas, 1993; Ghosh et al., 1999; Masih and Masih, 2002), and transmission mechanism of market volatility between countries (e.g., Soydemir, 2000; AuYong et al., 2004; Chung, 2005). A key contribution of this stream of research is the information it uncovers about the diversification potential amongst international capital markets.

However, a handful of studies have been undertaken to address the issue of sectoral index interrelationships concerning a particular economy. This is a persistent question for investors with preference for domestic equity and reluctance to diversifying internationally because the construction of a well-diversified asset portfolio relies on a sound understanding of how closely different market sectoral indices are interrelated and how these dynamic interrelationships vary over time.

A well-cited study in this line of research is that of Arbeláez et al. (2001) in which they investigate the short-run and long-run relationships amongst the several stock price indices of the Colombian capital markets. The data include daily price for the six indices of the Medellín Stock Exchange: General, Industrial, Financial, Commerce, Various, and Select, spanning the period between January 2, 1988 and August 9, 1994. In addition to providing substantial evidence of long-run cointegration relationships, the empirical results reveal short-run dynamic linkages amongst the Colombian market sectoral indices in about 50% of the cases. Besides, these short- and long-run linkages have strengthened over time.

Ewing (2002) examines five major Standard & Poor's stock indices (i.e., utilities, transportation, industrials, financials, and capital goods) in order to determine their interrelationships and how shocks to one index are transmitted to the others. By and large, the results of generalized variance decomposition analysis document strong interrelationships amongst the five Standard & Poor's stock indices.

Wang et al. (2005) explore the dynamic relationships amongst major sectoral indices of the Chinese stock exchanges in Shanghai and Shenzhen, using daily and monthly returns during the period between 1993 and 2001. Their empirical results reveal a high degree of interdependence, implying that potential diversification benefits from sector-level investment may be relatively limited. They also find that Industry is the most influential sector in both exchanges, while Finance in Shenzhen offers the best diversification tool within the Chinese stock market since this sector is the least integrated with other sectors.

Under a similar spirit, Mohamad et al. (2006) analyze the opportunity for diversification across different economic sectors for long-term investment using sectoral indices of the Malaysian Stock Exchange. The empirical results indicate high but unstable correlation relationships between different industry sectors in the Bursa Malaysia. This implies that investment managers should account for potential movements in sector-specific and sub-sector-specific risks. The results also imply that investment in one or two sectors of the stock market face higher total risk than in the past due to the increasing sector effects on portfolio investment.

Undertaking the perspective of a Cypriot investor who is interested in domestic portfolio diversification, Constantinou et al. (2008) provide an investigation on the potential gains that may exist in the Cyprus Stock Exchange (CSE). Analyzing daily price indices for twelve sectors of the Cyprus economy, the authors provide evidence of no cointegration in most bivariate cases, concluding that the SCE offers opportunities for making long-run profits from portfolio diversification. Additionally, the results of no short-run dynamic relationships amongst the sectoral indices lead the authors to the conclusion that traders and investors in the SCE can set up short-run investment strategies.

More recently, Al-Fayoumi et al. (2009) investigate the long-run equilibrium relationships and dynamic interactions amongst the daily returns of the Amman Stock Exchange (ASE) indices (i.e., General, Financial, Industrial, and Services) over a sample period extending from September 3, 2000 to August 30, 2007. The multivariate cointegration analysis suggests that the four stock price indices share one long-run equilibrium relationship in the long run. In addition, the results of Granger's causality analysis provide evidence of bidirectional relationships amongst all sectors, with the Services sector being the exception. Thus, the Services sector may offer appealing diversification opportunities within ASE since this sector turns out to be much less linked to other sectors.

The current study builds upon and extends the literature through the use of Johansen's multivariate cointegration analysis (1988, 1991, and 1995) and Granger's causality analysis (1969, 1988) with an eye to capturing the short-run and long-run relationships that may exist amongst equity sectoral indices of the Egyptian market.

3. Econometric Methodology

In order to accomplish the objectives of this study, I employ the econometric techniques of unit root tests, Johansen's multivariate cointegration analysis, and Granger's causality analysis. This battery of techniques gives the opportunity to explore the nature of both the long-run and short-run inter-sectoral relationships in the Egyptian stock market. Setting the stage for the empirical analyses, this section aims to provide a succinct description for these econometric methodologies.

3.1 Tests of Nonstationarity

A prerequisite for cointegration methodology is to check up whether the time series considered are individually stationary or not, and if they are nonstationary then to determine the order in which they are integrated (Granger, 1986). Thus, to test for the presence of stochastic nonstationarity in the data, I explore the integration order of the individual sectoral time series, utilizing well-known unit root tests including the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979, 1981), the Phillips-Perron (PP) non-parametric test (Phillips, 1987; Perron, 1988; Phillips and Perron, 1988), along with the KPSS test (Kwaitkowski, Phillips, Schmidt, & Shin, 1992).

In the ADF and PP tests, the null hypothesis is that a series is nonstationary (i.e., existence of a unit root); hence, rejection of the unit root hypothesis is necessary to support stationarity. The asymptotic distribution of the PP t-statistic is the same as the ADF t-statistic. The main distinction between the ADF and PP tests lies in their treatment of any "nuisance" serial correlation. The PP test tends to be more robust to a wide range of serial correlations and time-dependent heteroskedasticity (Syriopoulos, 2004).

On the other hand, much as both the ADF and PP tests are widely used, some studies (DeJong et al., 1992; Crowder, 1996; Schwert, 2002) indicate that the ADF test notoriously lacks power against trend stationary alternatives, and that the PP test is not adequately informative in distinguishing between a unit root and a near unit root case, so these two tests may render spurious unit root results. These studies also imply that it would be an interest in unit root tests that have the null of no unit root. A popular test with this feature is the KPSS test of Kwaitkowski et al. (1992). In contrast to both ADF and PP tests in which the null hypothesis is nonstationarity, the KPSS test uses trend stationarity as the null hypothesis against the alternative of a unit root, so any lack of power will work in the opposite direction.

The selection of optimal lag length for the ADF regression is based on the lowest value for Akaike Information Criterion (AIC). Also, the determination of the bandwidth for both the PP and KPSS tests is based on Newey-West Bandwidth procedure (1994) using Bartlett kernel spectral estimation method.

3.2 Johansen's Cointegration Analysis

The objective of cointegration analysis is to assess the existence of a long-run equilibrium relationship amongst a set of nonstationary time series. In the case of two nonstationary variables, an equilibrium relationship between $\boldsymbol{X_t}$ and $\boldsymbol{Y_t}$ implies that the two variables are cointegrated. If both $\boldsymbol{X_t}$ and $\boldsymbol{Y_t}$ are integrated of the same order $\boldsymbol{d}$ and there exists a linear combination of these series that is integrated of order $\boldsymbol{b}$ where $\boldsymbol{b<d}$, then $\boldsymbol{X_t}$ and $\boldsymbol{Y_t}$ are said to be cointegrated of order $\boldsymbol{d, b}$, denoted $\boldsymbol{CI}$ ($\boldsymbol{d, b}$). Whilst a number of methodologies for detecting the presence of cointegration have been proposed in the literature of market integration, this study carries out VAR-based cointegration analyses using the methodology developed in Johansen (1988, 1991, and 1995).

Basically, Johansen's cointegration analysis is based on maximum likelihood estimation. He starts with a VAR (k) specification for the $n \times 1$ vector of $I(1)$ variables, y_t:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \dots\dots\dots + A_k y_{t-k} + \varepsilon_t \tag{1}$$

where $\varepsilon_t \sim$ i.i.d. $(0, \sigma^2)$

Next, defining $\Delta \equiv 1\text{-}L$ where L is the lag operator, Johansen rewrites equation (1) as follows:

$$\Delta y_t = \alpha + \Gamma_1 \Delta y_{t-1} + \ldots\ldots\ldots + \Gamma_{k-1} \Delta y_{t-k+1} + \Pi y_{t-k} + v_t \qquad (2)$$

where $\Gamma_i = -(I - A_1 - \ldots\ldots - A_i), i = 1, \ldots\ldots, k-1$

$$\Pi = -(I - A_1 - \ldots\ldots - A_k), \qquad \text{I = identity vector}$$

The reason for doing this arrangement is that all the long-run information in the $\boldsymbol{Y_t}$ process is fairly summarized by the 'long-run impact matrix', Π, and it is the rank $\boldsymbol{r}$ of this matrix that identifies the number of cointegrating vectors. The above representation combines both differences and levels of variables so that the information included in levels is not lost as it is the case when utilizing differences only. If Π has rank zero (i.e., be a null matrix), equation (2) reduces to a standard VAR in first differences and the components in $\boldsymbol{Y_t}$ are not cointegrated. On the other hand, if Π is in full rank $\boldsymbol{n}$, all the components in $\boldsymbol{Y_t}$ are stationary. In a more general case when $\mathbf{0} <$ rank $\Pi < \boldsymbol{n}$, the number of cointegrating vectors is equal to $\boldsymbol{r}$, the rank of matrix Π.

Inasmuch as the rank of a matrix is equal to the number of eigenvalues λ_i (i.e., characteristic roots) that are significantly different from zero, Johansen (1991) proposes two statistics to test the rank of the long-run information matrix Π:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \qquad (3)$$

$$\lambda_{max.}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \qquad (4)$$

where λ_i are estimated eigenvalues ranked from largest to smallest. λ_{trace} is called the **Trace** statistic, which is a likelihood ratio test statistic for the hypothesis that there are *at most* r cointegrating vectors. The second statistic λ_{max}, the **Max** statistic, tests the hypothesis of r cointegrating vectors against the hypothesis of r + 1 cointegrating vectors. If the computed values of the statistics are less than the corresponding critical values, then the null hypothesis cannot be rejected.

More important still, a salient property of cointegration analysis is its linkage with the error correction representation. Engle and Granger (1987) maintain that the existence of a cointegrating relationship implies that the data are generated according to a partial adjustment or error-correction mechanism. The equilibrium error ensures that, after short-run deviations from the equilibrium, the system will return to its long-run equilibrium. Using the two-variable system as an example, the error correction model (ECM) has the following format:

$$\Delta x_t = \alpha_{10} + b_1 (y_{t-1} - \beta x_{t-1}) + \sum \alpha_{11}(i) \Delta x_{t-i} + \sum \alpha_{12}(i) \Delta x_{t-i} + \varepsilon_{1t} \quad (5)$$

$$\Delta y_t = \alpha_{20} + b_2 (y_{t-1} - \beta x_{t-1}) + \sum \alpha_{21}(i) \Delta x_{t-i} + \sum \alpha_{22}(i) \Delta x_{t-i} + \varepsilon_{2t} \quad (6)$$

where ε_{it} are white noise disturbance terms and $(y_{t-1} - \beta x_{t-1})$ is the error correction term, which measures last period's equilibrium error. The coefficients associated with the error correction terms can be interpreted as the speed of adjustment since they represent the responses of the variables to the deviations from equilibrium. If a simple but common case when x_t and y_t are *I(1),* all terms with Δx_t and Δy_t in expressions (5) and (6) are stationary. Therefore, $(y_{t-1} - \beta x_{t-1})$ must also be stationary, implying that x_t and y_t are cointegrated.

3.3 Granger's Causality Analysis

Apart from the examination of the long-run comovements between the sectoral indices of the Egyptian market, the current study looks at the short-run dynamics between the same set of variables via performing the Granger's causality tests. The objective in this exercise is to determine whether significant inter-sectoral causal relationships exist in the Egyptian market.

Granger's approach (1969, 1988) to the question of whether ***X*** causes ***Y*** is to see how much of the current ***Y*** can be explained by past values of ***Y*** and then to see whether adding lagged values of ***X*** can improve the explanation. In other words, ***Y*** is said to be Granger-caused by ***X*** if ***X*** helps in the prediction of ***Y,*** or equivalently, if the coefficients on the lagged ***X***'s are statistically significant.

As recommended by Sims et al. (1990) and Enders (1995), the nonstationarity and cointegration tests should be first carried out prior to conducting the Granger's causality tests, in order to see to it that the Granger causality results will not generate nonsense inferences. Hence, based upon the results of both the nonstationarity and cointegration tests, the existence of three different cases is envisioned as follows:

- If the time series are found to be stationary or $I(0)$ to begin with, the Granger's causality tests will be based on the following bivariate vector autoregressive (VAR) equations:

$$X_t = \alpha_\chi + \sum_{i=1}^{k} \beta_{\chi,i} X_{t-i} + \sum_{i=1}^{k} \gamma_{\chi,i} Y_{t-i} + \varepsilon_{\chi,t} \tag{7}$$
$$Y_t = \alpha_y + \sum_{i=1}^{k} \beta_{y,i} Y_{t-i} + \sum_{i=1}^{k} \gamma_{y,i} X_{t-i} + \varepsilon_{y,t} \tag{8}$$

  where X_t represents a sectoral index at time t, Y_t is another sectoral index at time t, α_χ and α_y are the intercept terms, $\varepsilon_{\chi,t}$ and $\varepsilon_{y,t}$ are the stochastic error terms assumed to be serially uncorrelated with zero mean and finite covariance matrix. K is the lag length, $\beta_{\chi,i}$ is the parameter of the past value of X, which indicates how much past value of X explains the current value of X, and $\gamma_{\chi,i}$ is the parameter of the past value of Y, which shows how much past value of Y explains the current value of X. Similar notations apply for $\beta_{y,i}$ and $\gamma_{y,i}$ in equation (8).

- If the time series are nonstationary or $I(1)$ and not cointegrated, they will be converted to an $I(0)$ by taking the first difference, and the following Granger's causality tests can be applied:

$$\Delta X_t = \alpha_\chi + \sum_{i=1}^{k} \beta_{\chi,i} \Delta X_{t-i} + \sum_{i=1}^{k} \gamma_{\chi,i} \Delta Y_{t-i} + \varepsilon_{\chi,t} \tag{9}$$
$$\Delta Y_t = \alpha_y + \sum_{i=1}^{k} \beta_{y,i} \Delta Y_{t-i} + \sum_{i=1}^{k} \gamma_{y,i} \Delta X_{t-i} + \varepsilon_{y,t} \tag{10}$$

  There exits also the possibility that the time series of a variable is found to be $I(0)$ and the other $I(1)$. In this case, the $I(1)$ variable will be included in the equation in terms of first differences whereas the $I(0)$ variable will be included in levels. As the first differences of an $I(1)$ series will be converted to $I(0)$, this procedure ensures that all series included in the equation are $I(0)$ (Sander and Kleimeier, 2003).

- Lastly, if the time series are found to be $I(1)$ and cointegrated, a VAR estimation in first differences will be misleading. Engle and Granger (1987) and Granger (1988) suggest that, in the presence of cointegration, the causality tests in (9) and (10) be augmented with a lagged error correction term (ECT), derived from the cointegrating relationship, and estimated within a vector error correction model (VECM). This procedure helps to avoid the misspecification of the VAR model. In this case, the following causality test can be applied:

$$\Delta X_t = \alpha_\chi + \sum_{i=1}^{k} \beta_{\chi,i} \Delta X_{t-i} + \sum_{i=1}^{k} \gamma_{\chi,i} \Delta Y_{t-i} + \varphi_\chi ECT_{\chi,t-i} + \varepsilon_{\chi,t} \quad (11)$$

$$\Delta Y_t = \alpha_y + \sum_{i=1}^{k} \beta_{y,i} \Delta Y_{t-i} + \sum_{i=1}^{k} \gamma_{y,i} \Delta X_{t-i} + \varphi_y ECT_{y,t-i} + \varepsilon_{y,t} \quad (12)$$

where φ_χ and φ_y are the parameters of the ECT, gauging the error correction mechanism that drives the $\boldsymbol{X_t}$ and $\boldsymbol{Y_t}$ back to their long-run equilibrium relationship.

Siklos and Ng (2001) point out that much as cointegration analysis shows the presence or absence of Granger causality, it does not indicate the direction of causality between variables under study. This direction of Granger causality can be detected through the VECM. Also, the VECM approach permits the distinction between causality based on short-run dynamics of VAR and on the disequilibrium adjustment of the ECT.

Finally, because the outcomes of Granger's causality analysis are very sensitive to the number of lags included in the regression, both the Final Prediction Error (FPE) criterion and Akaike Information Criterion (AIC) are used in order to determine an appropriate number of lags.

4. Data And Summary Statistics

As from January 2007, the Egyptian Exchange has launched for the first time its sectoral indices, which comprise twelve indices tracking the price movements of the different sectors of the Egyptian market. These twelve sectoral indices include Banks (BA), Basic Resources (BR), Chemicals (CH), Construction and Materials (CM), Food and Beverage (FB), Financial Services excluding Banks (FS), Healthcare and Pharmaceuticals (HP), Industrial Goods and Services and Automobiles (ISA), Personal and Household Products (PHP), Real Estate (RE), Telecommunications (TE), and Travel and Leisure (TL).

The data set analyzed in this study consists of daily closing price indices for the twelve sectors, spanning the period from January 3, 2007 that represents the inception date of the sectoral indices up to January 18, 2010, thereby providing a sample size of 748 observations. All market sectoral indices are retrieved from the Egyptian Exchange website. The daily return, $R_{t,i}$, for each sectoral index is computed as the first difference of natural logarithm of stock price indices (ln p) as follows:-

$$R_{t,i} = \ln\left(P_{t,i}\right) - \ln\left(P_{t-1,i}\right) \qquad (13)$$

where $P_{t,i}$ denotes the closing sector price index i on day t.

Indeed, the use of higher frequency data (i.e., daily data) is preferable to the use of lower frequency data (i.e., weekly, monthly, or quarterly data) due to the fact that longer time horizons are less capable of capturing rapid transmission of information amongst the different market sectors in the short run and can blank out transient interactions which may last only a few days (Cotter, 2004; Narayan et al., 2004).

As a starting point, it is appropriate at this stage to provide some perspective on the properties and trends of the individual sectoral indices of the Egyptian stock market. The summary statistics of the daily stock index returns presented in table 1 spotlight a number of conspicuous findings.

PLACE TABLE 1 ABOUT HERE.

First, the Industrial Goods and Services and Automobiles sector (ISA) outperforms the other sectors in terms of average daily index returns (0.0009) over the entire sample period, but it also experiences the highest level of return volatility measured by the standard deviation (0.0272). Second, sectors of Telecommunications (TE), Personal and Household Products (PHP), Travel and Leisure (TL), Basic Resources (BR), Chemicals (CH), and Financial Services excluding banks (FS) perform the worst during the sample period with negative return averages of (0.0009) and (0.0007), (0.0005), (0.0003), (0.0002), and (0.0002), respectively, probably reflecting the downturn in the market activities of these sectors in the near past. Third, minimum levels of daily index returns bear a negative sign with no exception in the sectors analyzed. Fourth, on a risk/return basis, the sectors that offer the lowest, and hence most beneficial, Coefficient of Variation (CV) include Industrial Goods and Services and Automobiles (ISA) sector (30.2), Construction and Materials (CM) sector (41), and Banks (BA) sector (50.5). Fourth, except for the Telecommunications (TE) sector, all sectoral index returns display various degrees of negative skewness, implying that the distributions of these series around the mean have a long left tail. Lastly, the kurtosis statistic for each time series is considerably greater than three, indicating that the distributions of the underlying sectoral index returns are leptokurtic (i.e., peaked around the mean), relative to the Gaussian distribution. This finding is supported by the relevant Jarque-Bera test which presents clear evidence to reject the null hypothesis of normality for the distributions of all sectors at 1% significance level.

Closely related to this stage of preliminary analyses is the examination of cross-sector contemporaneous correlation coefficients over the sample period. A perusal of table 2 unveils some noteworthy points.

PLACE TABLE 2 ABOUT HERE.

First, all pairwise contemporaneous correlations seem to be relatively high during the sample period, with the correlations of Basic Resources (BR)/Healthcare and Pharmaceuticals (PH) as well as Travel and Leisure (TL)/Healthcare and Pharmaceuticals (PH) being the lowest (0.38 for each) and the correlation of Financial Services excluding Banks (FS)/Industrial Goods and Services and Automobiles (ISA) being the highest (0.75). This result is however, not surprising largely because of the thinness of the Egyptian capital market. Second, all pairwise correlations are positively correlated with each other, suggesting that sectors of the Egyptian market tend to respond relatively uniformly to the market forces and the arrival of new relevant information. Third and last, the Healthcare and Pharmaceuticals (HP) sector seems to be the least correlated with the other sectors, as indicated by its pairwise correlations that range between 0.38 and 0.46.

To end off this section, figures 1 and 2 present trend plots of the individual sector price indices measured in natural logs. Based on the visual observation, it is clear in figure 1 that all capital market sectors experience a large up-and-down swing during the sample period. More interesting, the conspicuous downturn trend in all sectoral indices seems to break out in the first half of 2008, coincident with the repercussions of the subprime mortgage crisis that rapidly escalated in the US and spilled over to most of the world's financial markets. Additionally, figure 1 suggests that all of the individual time series under study seem to be nonstationary stochastic processes. However, after taking their first differences, they by and large become stationary, as depicted in figure 2.

PLACE FIGURES 1 AND 2 ABOUT HERE.

5. Empirical Findings

5.1 Results of Nonstationarity Tests

As described in section 3.1, prior to considering cointegration analysis, one should establish the nonstationarity property of the individual time series involved. To this end, I test each time series for the presence of a stochastic nonstationarity, using the ADF, the PP, and the KPSS unit root tests. It is worth noting that both the ADF and PP regression equations include an intercept and a linear trend. Furthermore, I choose to perform the KPSS test with both an intercept and a time trend since all stock market sectoral indices in figure 1 clearly display trend-like behaviour, not to mention the other option (i.e., including only a constant in the KPSS test regression) is merely a special case of this more general specification.

The results of the unit root tests are presented in table 3. Since the test statistics of the ADF and PP tests are higher than the critical values, the null hypothesis that the individual sector price indices contain a unit root in the log forms can not be rejected at 1% significance level. However, there is no evidence to support the existence of a unit root in log first differences of the individual sector price indices. Also listed in table 3 are the KPSS test results which indicate that the null hypothesis that each sector price index is a stationary process in the log forms is rejected at 1% significance level. However, the KPSS test fails to reject the null hypothesis when the individual time series are in their log first differences.

PLACE TABLE 3 ABOUT HERE.

These findings are broadly consistent with those evidenced by most market integration studies (e.g., Arshanapalli and Doucas, 1993; Kanas, 1998; Ghosh et al., 1999; Siklos et al., 2001; Glezakos et al., 2007), which demonstrate that capital market index series become stationary after differencing once. Accordingly, since unit root tests establish that all sectoral index levels are individually integrated of order one ($I(1)$), I can proceed to cointegration analysis with these indices because they are all integrated of the same order as required for cointegration.

5.2 Results of Johansen's Cointegration Analysis

To begin with, before Johansen's multivariate cointegration analysis can be carried out, the optimal number of lags in the VAR system should be determined. On the basis of the Final Prediction Error (FPE) criterion and Akaike Information Criterion (AIC), a lag length of two is identified. The chosen lag length is sufficient to remove any serial correlation in the residuals of the VAR.

As reported in table 4, when $\boldsymbol{r} = 0$ the computed values of the Trace statistic and Max eigenvalue statistic exceed the corresponding 5% critical values, indicating that at least one significant cointegrating vector exists for all the sectoral indices under scrutiny. For more than one cointegrating vector, however, both test statistics are found to be lower than the corresponding critical values, providing evidence of the existence of only a single cointegrating vector within the twelve capital market sectoral indices over the sample period. The findings of cointegration analysis are broadly consistent with the economic intuition that the capital market sectors within a certain economy share to a lesser or greater extent a long-run equilibrium relationship. That is, they have a tendency to move towards the same direction, at least in the long run.

Accordingly, two salient implications are worthy of mention. First, the different sectors of the Egyptian capital market are more or less influenced by the economy's fundamentals (i.e., inflation rates, real interest rates, monetary policy, productivity) that bring them together in the long run. Although there is still room to derive benefits from portfolio diversification in the short run, it is not possible in the long run because the presence of common factors amongst the capital market sectors circumscribes the amount of independent variation. Thus, the benefits from diversifying investments into the twelve sectors would dwindle away. Second, there must be some significant Granger's causality in the system at least in one direction. This direction can be tracked down through a VECM derived from the long-run cointegrating vector.

5.3 Results of Granger's Causality Analysis

As indicated in section 3.3, in case of the presence or absence of a long-run equilibrium relationship, the possibility of a short-run relationship between the variables under scrutiny may still exist. To test for this possibility, the Granger's causality analysis is employed.

However, since Johansen's multivariate cointegration analysis unveils a single cointegrating vector within the twelve capital market sectoral indices, a VEC Granger causality/Block Exogeneity Wald test is in place. This test assesses whether the inclusion of lagged values of a variable is important for explaining the dynamics of the other variables in the system of equations in addition to the explanatory power of the lags of those other variables. In other words, Block exogeneity Wald test indicates whether lagged values of independent variable(s) jointly affect a particular dependent variable. Hence, a necessary condition for the exogeneity of ***Y*** is that current and past values of ***X*** do not affect ***Y*** (Enders, 1995). An optimal lag length of two is chosen, based on the FPE and AIC selection criteria.

Summary results of the Granger causality/Block Exogeneity Wald test are displayed in table 5. Each entry in the table denotes the Wald χ^2 Statistics of the sectoral index on the left-hand side Granger-caused by the sectoral index at the top.

A perusal of table 5 reveals some important findings. First, in most cases (93 out of 132 or approximately 70%), the null hypothesis of no pairwise causal relationship cannot be rejected at the conventional levels of significance. Thus, with some exceptions, the test results provide significant evidence of independence relationships between each pair of the sectoral indices of Egyptian stock market. Second, only 5 significant feedback relationships (i.e., bidirectional causality) are detected between (PHP & HP), (PHP & FS), (PHP & CH), (FB & HP), and (FB & BA), implying that the information content of lagged price changes of either sectoral index in each pair can be used to predict current price changes of the other sector in the short run. Third, for the remaining cases, the test results suggest the presence of unidirectional causality relationships throughout the sample period considered. Fourth, sectors of Travel and Leisure (TL) and Basic Resources (BR) appear to exert no significant influence on stock price movements of the other sectors, reflecting their relatively small size and modest market capitalization. On the other hand, the dominant sectors are found to be Food and Beverage (FB) and Personal and Household Products (PHP), with each Granger-causing 8 and 6 other sectoral indices, respectively. Fifth and last, in terms of econometric exogeneity, sectors of Construction and Materials (CM), Real Estate (RE), and Telecommunications (TE) appear to be statistically exogenous to changes in other sectors of the market.

Taken together, the findings suggest that the short-term causal relationships between the economic sectors of the Egyptian market are considerably limited and, where they exist, virtually unidirectional. These findings may sound typical, especially given that the Egyptian capital market is in effect inefficient because trading is comparatively thin for the information to be disseminated timely and broadly. The implication of these observations is that an attempt to predict the stock price movements of a sectoral index based on the information content of the lagged values of another sectoral index in the Egyptian market is expected to be fruitless in most cases.

6. Summary and Conclusions

Knowledge of the extent to which sector-specific stock market indices move together in a particular country is crucial to portfolio managers who try to allocate efficiently the resources of investors. Specifically, investment portfolios based on economic sectors that are relatively independent are more likely to add value and increase the opportunity to eliminate a fundamental part of investment risk.

Contributing to the meagre published literature on interrelationships amongst stock market sectors within a single economy, this study makes the first attempt to provide empirical analyses about the long-run equilibrium relationships as well as the short-run causal linkages amongst the various sectors of the Egyptian stock market.

In fulfilling the empirical part, I collect daily closing price indices for twelve sectors of the Egyptian stock market. The data set is retrieved from the Egyptian Exchange website and spans the period from January 3, 2007 up to January 18, 2010, rendering a total of 748 daily observations for each sectoral market index. The daily return for each index is computed as the first difference of natural logarithm of stock price indices.

Prior to conducting cointegration analysis, I test each time series for the presence of a stochastic nonstationarity, using the ADF, the PP, and the KPSS unit root tests. The results indicate that all sectoral market index levels are individually integrated of order one but all log first-differenced stock index series are stationary processes.

Based on the results of unit root tests, I examine the presence of long-run equilibrium relationships amongst the sectoral market indices, employing Johansen's multivariate cointegration analysis. The results provide evidence of the existence of only a single cointegrating vector within the twelve sectoral market indices over the sample period. These results are broadly consistent with the economic intuition that the capital market sectors within a certain economy have a tendency to move towards the same direction, at least in the long run.

On the other hand, the results of Granger's causality analysis show that the short-run causal relationships between the economic sectors of the Egyptian market are considerably limited and, where they exist, virtually unidirectional. Furthermore, sectors of Telecommunications (TE), Construction and Materials (CM), and Real Estate (RE) appear to be statistically exogenous to changes in other sectors of the market.

These results have a bearing on the potential benefits from diversifying portfolios into the different sectors of the Egyptian capital market. Although there is still room to derive benefits from portfolio diversification in the short run, it is not possible in the long run because the presence of common factors amongst the capital market sectors circumscribes the amount of independent variation. Thus, the benefits from diversifying investments into the twelve sectors would dwindle away.

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Table 1. Descriptive statistics of daily sectoral index returns.

	BA	BR	CH	CM	FB	FS	HP	ISA	PHP	RE	TE	TL
Mean	0.0004	-0.0003	-0.0002	0.0006	0.0003	-0.0002	0.0003	0.0009	-0.0007	0.0002	-0.0009	-0.0005
Median	0.0009	0.0007	0.0009	0.0014	0.0009	0.0013	-0.0009	0.0015	0.0000	0.0012	0.0000	0.0000
Maximum	0.1249	0.1412	0.0783	0.0857	0.1267	0.0822	0.1464	0.1663	0.0667	0.0806	0.1335	0.1021
Minimum	-0.2311	-0.1725	-0.1392	-0.2207	-0.1795	-0.1281	-0.1989	-0.1935	-0.234	-0.2433	-0.1121	-0.1352
Std. Dev.	0.0206	0.0254	0.0204	0.0246	0.0256	0.0232	0.0255	0.0272	0.0195	0.027	0.0223	0.0255
C.V	51.5	-84.7	-102	41	85.3	-116	85	30.2	-27.8	135	-24.8	-51
Skewness	-1.8602	-1.084	-1.0501	-1.3928	-0.6426	-0.8562	-0.4413	-1.0585	-2.7027	-1.3825	0.1571	-0.454
Kurtosis	26.964	11.3559	9.6267	12.9717	9.1837	6.4719	11.5572	12.2705	31.3242	13.0973	6.3695	5.68
J-B Test	18305.07	2319.465	1504.087	3336.402	1241.55	466.4511	2303.393	2814.403	25879.78	3411.354	356.4552	249.209
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: The sectoral indices include Banks (BA), Basic Resources (BR), Chemicals (CH), Construction and Materials (CM), Food and Beverage (FB), Financial Services excluding Banks (FS), Healthcare and Pharmaceuticals (HP), Industrial Goods and Services and Automobiles (ISA), Personal and Household Products (PHP), Real Estate (RE), Telecommunications (TE), and Travel and Leisure (TL). Std Dev. is the standard deviation, an absolute measure for risk. C.V is the coefficient of variation, a relative measure for risk. J-B is the Jarque-Bera test for normality. Both mean and standard deviation are in percentage terms. Total observations for each index = 748.

Table 2. Correlation matrix of the stock returns.

	BA	BR	CH	CM	FB	FS	HP	ISA	PHP	RE	TE	TL
BA	1											
BR	0.57	1										
CH	0.55	0.67	1									
CM	0.64	0.66	0.64	1								
FB	0.54	0.57	0.60	0.54	1							
FS	0.63	0.73	0.72	0.74	0.62	1						
HP	0.46	0.38	0.41	0.40	0.42	0.40	1					
ISA	0.61	0.73	0.70	0.67	0.57	0.75	0.42	1				
PHP	0.60	0.60	0.65	0.62	0.65	0.69	0.40	0.63	1			
RE	0.61	0.70	0.67	0.67	0.65	0.76	0.44	0.71	0.68	1		
TE	0.55	0.58	0.59	0.69	0.49	0.69	0.39	0.61	0.54	0.60	1	
TL	0.53	0.64	0.62	0.63	0.61	0.72	0.38	0.65	0.63	0.72	0.59	1

Note: Each entry gives a sample correlation between the daily stock index returns of the corresponding sectors.

Table 3. Results of unit root tests

Sectoral index	Log Levels			Log First Differences		
	ADF	PP	KPSS	ADF	PP	KPSS
BA	-1.19	-1.22	0.369*	-26.67*	-26.67*	0.207
BR	-1.21	-1.19	0.355*	-23.57*	-23.60*	0.195
CH	-1.52	-1.47	0.452*	-21.04*	-21.04*	0.114
CM	-1.38	-1.35	0.395*	-21.69*	-21.73*	0.204
FB	-1.75	-1.77	0.379*	-22.66*	-22.68*	0.082
FS	-1.15	-1.19	0.371*	-22.71*	-22.88*	0.206
HP	-2.06	-1.92	0.343*	-32.28*	-34.19*	0.094
ISA	-1.67	-1.68	0.534*	-24.30*	-24.47*	0.169
PHP	-1.36	-1.38	0.311*	-22.36*	-22.56*	0.164
RE	-1.56	-1.58	0.374*	-21.69*	-21.72*	0.206
TE	-1.64	-1.50	0.328*	-22.40*	-22.42*	0.164
TL	-1.83	-1.85	0.374*	-22.11*	-22.15*	0.209

Notes: ADF, PP, and KPSS denote the Augmented Dickey-Fuller test, Phillips-Perron test, and the Kwiatkowski, Phillips, Schmidt, and Shin test for unit roots, respectively. For either ADF or PP test, the critical value, with both an intercept and a trend, is -3.97 at the 1% level of significance. For the KPSS test, the critical value is 0.216 at the 1% level of significance. The critical values are obtained from MacKinnon (1996) for the ADF and PP test statistics and from Kwiatkowski et al. (1992) for the KPSS test statistics. * denotes rejection of the corresponding null hypothesis at the 1% level of significance.

Table 4. Results of Johansen's multivariate cointegration tests.

Hypothesized No. of CE(s)	Eigenvalue	$\lambda Trace$			λMax		
		Statistic	Critical Value	Prob**	Statistic	Critical Value	Prob**
None *	0.109743	402.2481	374.9076	0.0032	86.71912	80.87025	0.0140
At most 1	0.085529	315.5290	322.0692	0.0875	66.69977	74.83748	0.2242
At most 2	0.069897	248.8292	273.1889	0.3285	54.05527	68.81206	0.5541
At most 3	0.052962	194.7739	228.2979	0.5808	40.59415	62.75215	0.9245
At most 4	0.047232	154.1798	187.4701	0.6558	36.09402	56.70519	0.9062
At most 5	0.041828	118.0857	150.5585	0.7289	31.87492	50.59985	0.8722
At most 6	0.034899	86.21083	117.7082	0.8091	26.49990	44.49720	0.8839
At most 7	0.021894	59.71093	88.80380	0.8629	16.51459	38.33101	0.9941
At most 8	0.020671	43.19634	63.87610	0.7277	15.58238	32.11832	0.9281
At most 9	0.016825	27.61396	42.91525	0.6451	12.65805	25.82321	0.8289
At most 10	0.011391	14.95590	25.87211	0.5782	8.546536	19.38704	0.7701
At most 11	0.008555	6.409367	12.51798	0.4102	6.409367	12.51798	0.4102

Notes: Both Trace test and Max-eigenvalue test indicate 1 cointegrating equation at the 5% significance level.
* denotes rejection of the null hypothesis at the 5% level of significance. ** MacKinon-Haug-Michelis (1999) p-values.
Trend assumption: Linear deterministic trend in the data.

Table 5. Results of Granger Causality/Block Exogeneity Wald test.

	Short-run lagged differences											
	ΔBA	ΔBR	ΔCH	ΔCM	ΔFB	ΔFS	ΔHP	ΔISA	ΔPHP	ΔRE	ΔTE	ΔTL
Dep Var	Wald χ^2 Statistics											
ΔBA	-	0.45	1.03	0.300	5.39*	0.788	15.88**	0.008	0.776	0.096	1.779	0.293
ΔBR	5.67*	-	3.91*	2.95	26.8**	1.79	0.113	0.43	25.1**	7.9**	4.5*	1.56
ΔCH	0.319	0.002	-	0.93	8.9**	0.325	2.702	0.618	11.1**	1.947	1.05	0.538
ΔCM	0.745	0.013	0.186	-	0.628	0.286	2.92	0.102	2.38	0.159	0.157	0.917
ΔFB	10.4**	0.052	1.867	6.7**	-	0.643	22.8**	0.000	0.297	0.173	0.501	0.158
ΔFS	0.007	1.76	0.818	0.016	4.01*	-	2.034	0.188	11.1**	0.864	1.87	0.006
ΔHP	3.66	6.09*	3.58	0.734	5.5*	5.5*	-	5.79*	10.2**	5.11*	7.7**	1.185
ΔISA	6.48*	0.005	2.93	0.638	24.5**	4.6*	0.12	-	26.9**	7.02**	4.87*	1.37
ΔPHP	0.146	2.97	7.6**	0.942	6.5*	4.3*	5.7*	1.75	-	5.3*	0.134	0.336
ΔRE	1.89	1.78	0.566	2.87	1.58	0.05	3.56	0.78	0.94	-	0.001	1.28
ΔTE	0.66	2.64	1.17	2.36	0.16	3.7	1.16	2.34	0.007	1.55	-	2.29
ΔTL	3.96*	2.92	3.36	0.03	14.7**	6.7**	0.055	7.05**	15.9**	18.1**	1.71	-

Notes: Δ is the first difference operator. Each entry in the table denotes the Wald χ^2 Statistics of the sectoral index on the left-hand side Granger-caused by the sectoral index at the top. Based on the Final Prediction Error (FPE) criterion and Akaike Information Criterion (AIC), a lag length of two is employed. *** and ** denote rejection of the null hypothesis (no Granger causality) at the 1% and 5% level of significance, respectively.

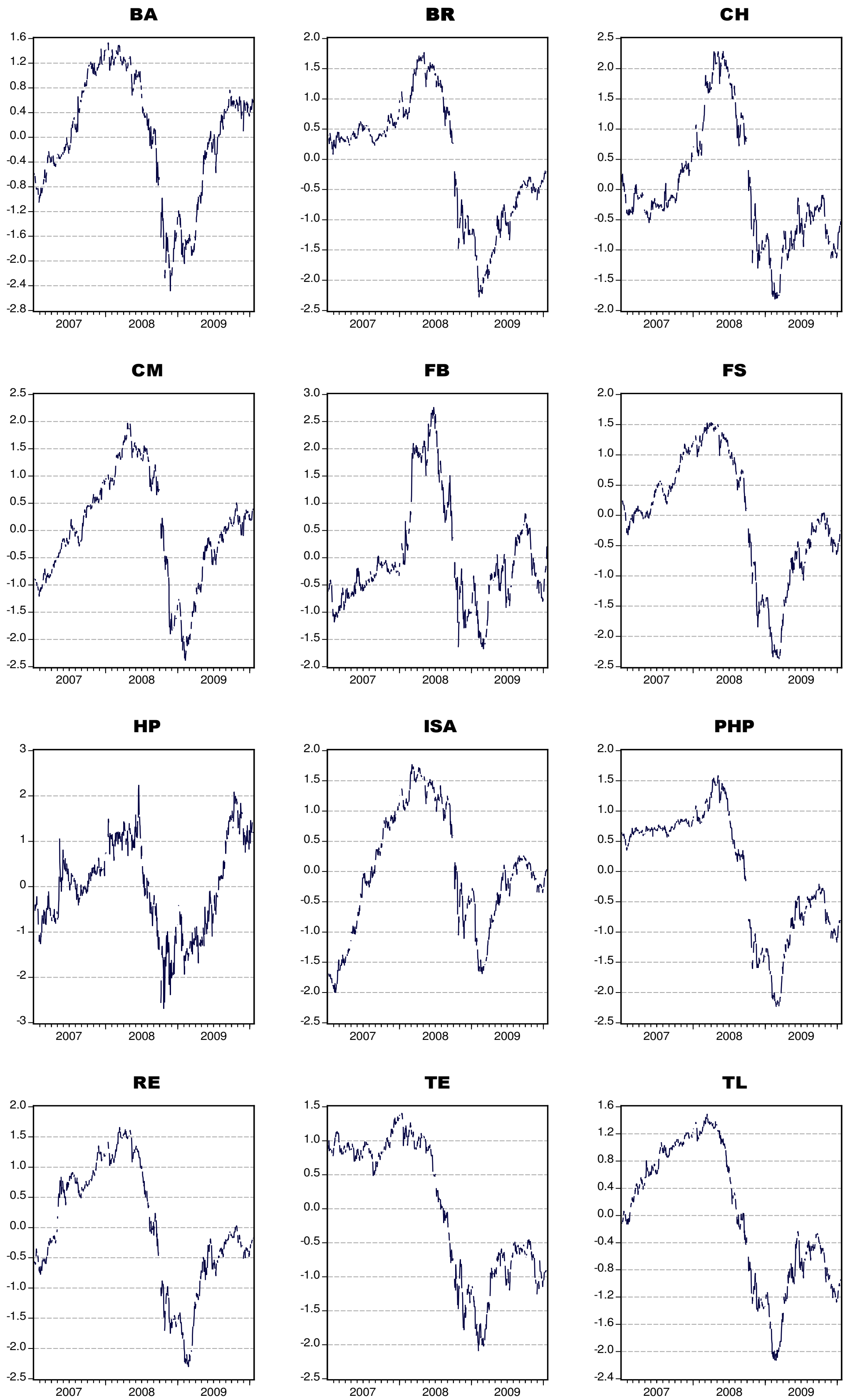

Fig.1. The logarithmic sector price indices. All logged indices are normalized to be unity on January 3, 2007.

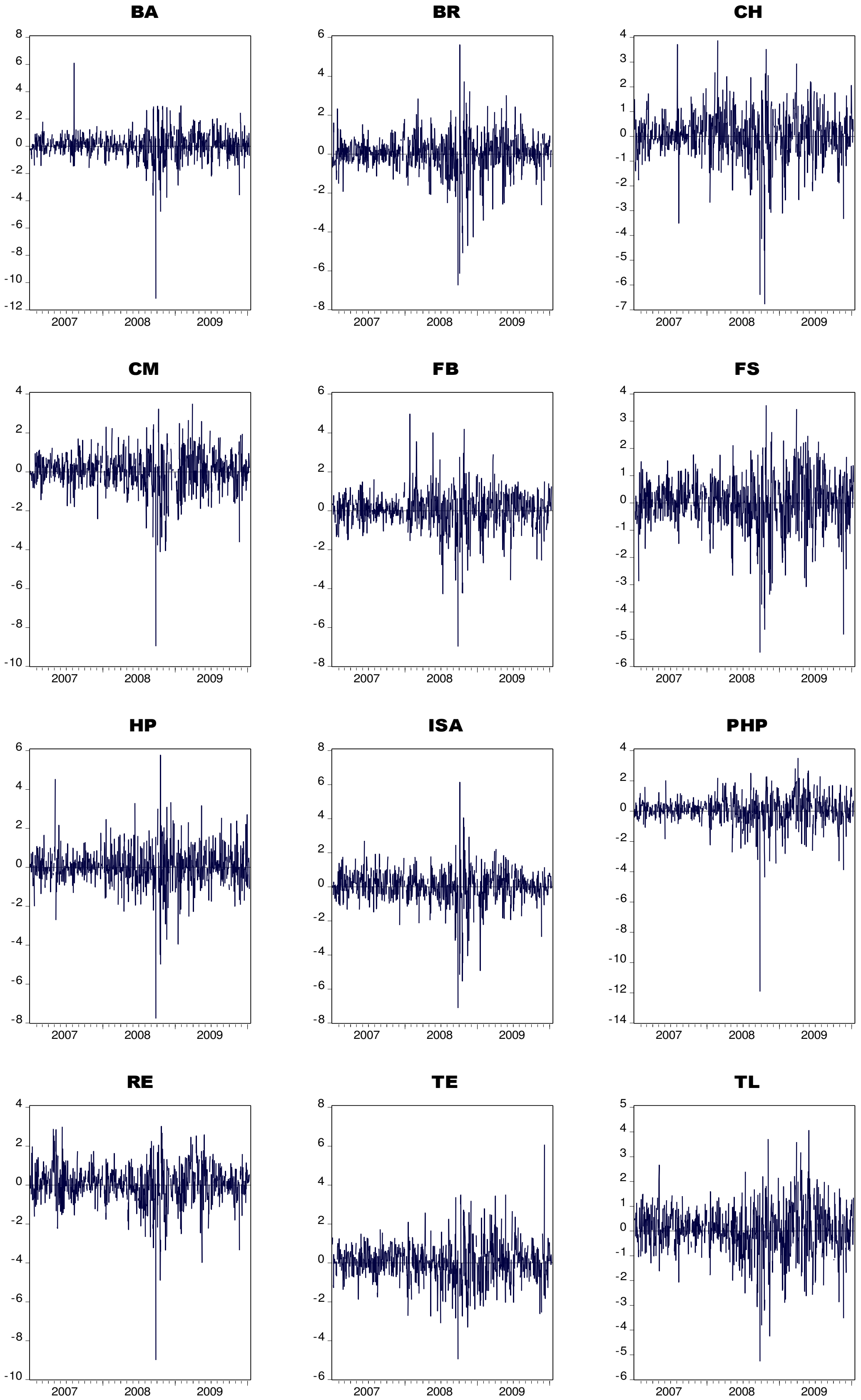

Fig. 2. Time series plots for the first differences of the logged indices.