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Generalized Hurst exponent approach to efficiency in MENA markets☆

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HIGHLIGHTS

- We study the efficiency of MENA stock markets by generalized Hurst exponents using a rolling window.
- MENA markets exhibit different degrees of long-range dependence.
- The Arab Spring has had a negative effect on efficiency.
- The least inefficient market is found to be Turkey, followed by Israel, while most inefficient markets are Iran and Tunisia.
- Turkey and Israel show characteristics of developed financial markets.

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ABSTRACT

We study the time-varying efficiency of 15 Middle East and North African (MENA) stock markets by generalized Hurst exponent analysis of daily data with a rolling window technique. The study covers a time period of six years from January 2007 to December 2012. The results reveal that all MENA stock markets exhibit different degrees of long-range dependence varying over time and that the Arab Spring has had a negative effect on market efficiency in the region. The least inefficient market is found to be Turkey, followed by Israel, while the most inefficient markets are Iran, Tunisia, and UAE. Turkey and Israel show characteristics of developed financial markets. Reasons and implications are discussed.

1. Introduction

The efficient market hypothesis (EMH) has been a highly controversial topic in theory of finance. It states that prices already reflect all known information, and in its weak form (WEMH), it suggests that all past market prices are fully reflected in asset prices, and thus one cannot beat the market by any investment strategy. According to the WEMH, the existence of serial correlations between observations is not possible. While short serial correlation is accepted by supporters of the EMH, long serial correlation is generally rejected.

The presence of long-range dependence in asset returns has been an intriguing subject for a long time. Starting with the revolutionary paper of Mandelbrot [1], the existence of long memory has been shown to exist in asset returns (see Ref. [2] and the references therein for details). Besides the violation of the EMH, the presence of long-range dependence brings out several other problems in real-life applications: the investment horizon becomes a factor in the investment risk [3], derivative pricing techniques (such as the Black–Scholes technique) may not be useful anymore, and usual tests based on the Capital Asset Pricing Model (CAPM) cannot be applied to series that have long memory [4,5].

☆ The views expressed in this work are those of the authors and do not necessarily reflect those of the Borsa Istanbul or its members.

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Despite the extensive research on long-range dependence in developed markets, less is known about it in emerging ones, especially the markets belonging to the MENA region (see Refs. [6,7] and references therein). Therefore, this study intends to examine behavior of efficiency of 15 MENA stock markets. The topic is interesting, since MENA markets are expected to display some properties that are not present in developed markets, such as investors' slow reaction to new information, the effect of highly volatile foreign capital flow, and possible severe effects of non-synchronous trading [4]. Considering the increasing dominance of MENA countries in the international arena also makes the research more important.

This study uses the generalized Hurst exponent with a rolling window approach to measure the long-range dependence.[1] Combining the generalized Hurst exponent and the rolling window technique was initially suggested by Morales et al. [11] to evaluate the level of stability/instability of financial firms in the US stock market. The authors revealed that such an approach can be used as an early warning indicator for financial crises.[2] With an extended motivation, this study applies the same approach to stock markets in the MENA region.

Another contribution to the literature is that this study contains the largest country set among other studies on the subject, and considers a time period including the recent Arab Spring, so the external effects can be observed.

The rest of the paper is organized as follows. Section 2 elucidates the methodology associated with testing for time-varying long-range dependence, and Section 3 describes the data and presents the results. Section 4 gives a robustness check of our analysis, and finally Section 5 offers a brief conclusion.

2. Methodology

Several methods have been proposed to analyze the long-range dependence phenomenon.[3] In this study, we are interested in the degree of long-range dependence of a given stochastic process $S(t)$ with $t = (1, 2, \ldots, \Delta t)$ defined over a time window Δt with unitary time steps [11], and we use the generalized Hurst exponent $H(q)$ as a measure of long-range dependence.[4] It is a generalization of the approach proposed in Ref. [9], and it may be evaluated using the qth-order moments of the distribution of increments, which is a good characterization of the statistical evolution of $S(t)$ [11,20],[5]

$$K_q(\tau) = \frac{\langle |S(t+\tau) - S(t)|^q \rangle}{\langle |S(t)|^q \rangle}, \tag{1}$$

where τ can vary between 1 and τ_{max}, and $\langle \cdots \rangle$ denotes the sample average over the time window.[6] $H(q)$ is then defined for each time scale τ and each parameter q as

$$K_q(\tau) \propto \tau^{qH(q)}. \tag{2}$$

$H(q)$ is computed from an average over a set of values corresponding to different values of τ_{max} in Eq. (1) [10,14].[7] For any value of q, $H(q) = 0.5$ means that $S(t)$ does not exhibit long-range dependence, while $H(q) > 0.5$ and $H(q) < 0.5$ imply that $S(t)$ is persistent and anti-persistent, respectively.

3. Data and results

We consider trading-day closing values $P(t)$ of 15 MENA stock markets. The list is constructed by the widest definition of the MENA region and includes Bahrain (Bahrain Bourse All Share Index), Egypt (EGX-30), Iran (TEPIX), Israel (Tel Aviv-25), Jordan (Amman SE General Index), Kuwait (Kuwait SE Weighted Index), Lebanon (BLOM), Morocco (CFG-25), Oman (MSM-30), Palestine (Al Quds), Qatar (DSM), Saudi Arabia (Tadawul All Share Index), Tunisia (TUNINDEX), Turkey (BIST-100), and United Arab Emirates (Abu Dhabi Securities Market General Index). For comparison purposes, all stock market indexes were started and ended at 02/01/2007 and 26/12/2012, respectively. We use a rolling window of $\Delta t = 252$ observations[8] that

1 The generalized Hurst exponent [8] approach combines sensitivity to any type of dependence in the data and simplicity. Moreover, in contrast to the popular R/S statistics [9] approach, it does not deal with max and min functions, and thus it is less sensitive to outliers [10].

2 With a similar approach, the authors of [12] had evidence to claim that multifractal models with a constant intermittency parameter may not always be satisfactory in reproducing financial market behavior. The same approach led Barunik et al. [13] to find that the multifractality observed in financial time series is mainly a consequence of the characteristic fat-tailed distribution of the returns, and that time correlations have the effect of decreasing the measured multifractality. For other relevant works from the same team, see Refs. [10,11,14–18].

3 See Ref. [19] for a survey of these methods.

4 $H(q)$ was introduced in Ref. [8] and recently used by Di Matteo et al. [10] to study the degree of development of several financial markets.

5 In financial applications, $S(t)$ is taken to be log-prices.

6 Note that, for $q = 1$, Eq. (1) describes the scaling behavior of the absolute increments, and it is expected to be closely related to the original Hurst exponent. For $q = 2$, $K_q(\tau)$ is proportional to the autocorrelation function $C(t, \tau) = \langle S(t+\tau)S(t) \rangle$.

7 Processes with a scaling behavior of (2) may be divided into two classes: (i) unifractal processes in which $H(q)$ is independent of q, i.e., $H(q) = H$, or (ii) multifractal processes in which $H(q)$ is not constant, and each moment scales with a different exponent. Previous research [4,5,10,15] shows that financial time series exhibit multifractal scaling behavior. If multifractality exists in stock returns, then models such as in the work of Calvet and Fisher [21] may be used for forecasting; these are competitors to ARCH and GARCH models [22].

8 The window length is chosen to be large enough that it provides satisfactory statistical significance and small enough that it retains sensitivity to changes occurring over time.