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Fractional integration in daily stock market indices at Jordan's Amman stock exchange

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ABSTRACT

Using daily data on five sectoral indices from 2006 to 2014, this paper aims to investigate the possibility of fractional integration in sectoral returns (and their volatility measures) at Jordan's Amman stock exchange (ASE). Empirical analysis, using the log-periodogram (LP) and local whittle (LW) based semi-parametric fractional differencing techniques suggest that all sectoral returns at ASE exhibit short memory. However, in the case of volatility measures, we found evidence of long memory. Following the recent literature that argues that structural breaks in a time series could also explain the presence of long memory, we tested the volatility measures for the presence of structural breaks. We found that long memory in some volatility measures could be attributed to the presence of structural breaks. Furthermore, using impulse response functions (IRF) based on ARFIMA, we found that shocks to sectoral returns at ASE exhibit short run persistence, whereas shocks to volatility measures display long run persistence.

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1. Introduction

One of the most controversial issues in behavioral finance is the modeling of long memory behavior in stock returns. efficient market hypothesis (EMH), proposed by Fama (1965), suggests that the flow of new information influences all investors simultaneously and in response to this information stock prices fluctuate randomly (i.e., stock prices follow a random walk). Accordingly, stock prices cannot be predicted based on historical information (Fama, 1970; Summers, 1986). Stock investors in efficient markets cannot earn abnormal returns as stocks are traded at their fair values.

Different from EMH, at least some stock prices may follow a specific pattern in the long run that is inconsistent with the idea of random walk. In such a case, stock prices may be predicted based on the past information and hence stock investors may generate different levels of excess returns. In other words, if stock prices were predictable in the long run, stock investors may be able to develop profitable investment strategies. One possible pattern that stock prices may exhibit in the long run is the long-range dependence (also known as long memory). The other possibility is that stock prices may exhibit a short memory behavior (see Baillie, 1996; Baillie, Bollerslev, & Mikkelsen, 1996; Clark & Coggin, 2011; Fama & French, 1988).

Long memory refers to a situation where the current values of stock returns remain significantly correlated with their values in the distant past. This implies that stock returns are not independent over time and hence the future returns can be predicted based on the past returns, which contradicts the weak form of EMH. Stock returns exhibit long memory behavior if their autocorrelation functions decay at slow hyperbolic rates. This possibility involves a fractional order of integration. In simple words, the number of differences required to render a series stationary, i.e., $I(0)$, take a value between 0 and 1. Baillie (1996) argues that a fractionally differenced process can also be viewed as a halfway house between an $I(0)$ and $I(1)$ process.[2] On the contrary, a short memory behavior describes the low-order autocorrelation structure of a series whereby the autocorrelation function decays at a faster rate (Assaf, 2006; Bollerslev & Mikkelsen, 1996).

Investigation of long memory behavior is important due to several reasons. For example, market efficiency is directly linked to the existence of long memory in the returns series, testing for the presence of long memory can help to determine whether the financial markets are efficient or not (Assaf, 2015). Testing for long memory can also help stock market participants as well as policymakers in (i) developing appropriate risk assessment strategies and (ii) comparing different types of asset return behaviors. Examination of long memory also allows investors to re-evaluate their stock trading strategies. Long memory in volatility series can also play a significant role in derivative pricing as modeling of derivative pricing is associated with the long run volatility structure (Bollerslev & Mikkelsen, 1996). Furthermore, analysis of long memory behavior can contribute to the process of stock prices prediction as well as the overall decision-making process.

The existing literature on long memory behavior can be divided in two groups: (i) studies that only test for long memory using various statistical methods and (ii) studies that argue that the presence of long memory in a time series may also be due to structural breaks in the series (Bekaert, Harvey, & Lumsdaine, 2002; Chatzikonstanti & Venetis, 2015; Yau & Davis, 2012). Most existing studies that belong to group 1 (i.e., studies that examine only the possibility of long memory) focus on stock market returns in developed countries.[3] However, only a few studies have examined the possibility of long memory in stock market returns in developing and emerging economies. For example, Limam (2003) found evidence of fractional integration in the stock markets of the Arab region (including Bahrain, Egypt, Jordan, Kuwait, Morocco, Oman, Saudi Arabia and Tunisia). Bellalah, Aloui, and Abaoub (2005) and Charfeddine and Ajmi (2013) detected long memory behavior in the Tunisian stock market. Using data from Egypt, Jordan, Morocco, and Turkey, Assaf (2006) found evidence of long memory in the returns series for Egypt and Morocco. Whereas, based on data from January 1997 to December 2007, Rejichi and Aloui (2012) reported evidence of the presence of long memory in the Middle East and

[2] The order of integration of a long memory process usually lies between 0 and 1 but it can also be greater than 1 (see Anoruo & Gil-Alana, 2011; Phillips, 1999, 2007).

[3] For example, to name a few, see Lo (1991), Ding et al. (1993), Cheung and Lai (1995), and Barros et al. (2012).