Long-range power-law correlations in stock returns

Pilar Grau-Carles
Department of Economics, Universidad Rey Juan Carlos, Paseo de los Artilleros s/n, 28032 Madrid, Spain

Received 6 July 2000

Abstract

This study investigates long-range power-law correlations in US, UK, Japanese, German, French and Spanish stock markets using daily data and applying a recently developed residual analysis termed detrended fluctuation analysis (DFA). We quantify correlations for the returns, absolute value of returns and square of returns. The results show that there is little evidence of long-range correlations in returns but there is strong evidence of long-range correlation in absolute and squared returns. For the absolute returns, a cross-over of approximately 41 days is found. © 2001 Elsevier Science B.V. All rights reserved.

PACS: 02.50.Ey; 05.45.Tp

Keywords: Stock market prices; Detrended fluctuation analysis; Long-memory processes

1. Introduction

There is a growing literature in financial economics that analyzes the temporal dependence of stock returns. The random walk hypothesis states that returns are serially random; in other words, that today returns are independent of previous periods stock returns. So the research on either short or long-term dependence has become somehow relevant. For example, the existence of long memory in financial data would affect the investment horizon of portfolio decisions. Furthermore, many empirical studies that are based on short memory statistical techniques would have to be revised. On the other hand, the literature of mean reversion in financial prices assumes the existence of some mechanism which works over long time horizons, because the mean-reverting behavior of stock prices corresponds to the idea that a given change in prices will be followed,
in long time horizons, by changes with the opposite sign. Finally, the bases of the
development of ARCH type family of stochastic models are the findings of significant
autocorrelations in volatility measures, such as squared returns or absolute returns.

Previous approaches to long-memory analysis are the application of non-parametric
statistic tests sensible to the persistence over long periods. The Hurst method [1] and the
rescaled range analysis (R/S) proposed by Mandelbrot and Wallis [2], and Mandelbrot
[3] have been applied to many financial series (e.g. Refs. [4–7]). But the findings of
long memory in stock returns using R/S analysis have been disputed because this type
of analysis might be biased due to the presence of short-term dependence.

More recently, Lo [8] developed a more refined technique of R/S analysis to identify
long-term dependence. The modified R/S analysis is robust to serial correlation and
some forms of non-stationarity. Some applications of this method to financial data sets
are Refs. [9–12]; in most of the studies little evidence is found of long memory in
returns.

Another test of long-memory hypothesis is the GPH [13], which is highly related to
one of the dominant parametric discrete-time models that present hyperbolic decay of
the autocorrelation function, the ARFIMA (fractional integrated autoregressive moving
average) model introduced in Refs. [14,15]. This methodology captures the long-range
correlations with the fractional difference parameter or d-parameter, which describes
the higher order correlation structure of the series. This approach and the R/S analysis
have been used together in some empirical analyses, for example in Refs. [9,12,16].

In this paper we will use a new methodology, a non-parametric approach that can
be applied without a detailed assumption of the structure of the underlying model.

2. Methodology

The detrended fluctuation analysis (DFA) [17,18] is a technique that permits the
detection of long-range correlations. This methodology has been shown to be independent of inherent trends, local correlations and non-stationarity [19] avoiding the
spurious detection of long-range correlations that are an artifact of non-stationarities;
also, Taquu et al. [20] proved that the DFA estimate is asymptotically unbiased.

The DFA method estimates a scaling exponent from the behavior of the average
fluctuation of a random variable around its local trend. The method can be summarized
as follows. For a time series \( \{x_t\}, t = 1, \ldots, n \), first the integrate time series \( y(t') \) is obtained:

\[
y(t') = \sum_{t=1}^{t'} x(t).
\]

Next the integrate series is divided into non-overlapping intervals containing in each
interval \( m \) data. In each interval, a least squared line is fitted to the data. The \( y \)
coordinate of the straight line segments is denoted by \( y_m(t') \). Next the root of the
دریافت فوری متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات