



Research on the fractal structure in the Chinese stock market

Zhuang Xin-tian*, Huang Xiao-yuan, Sha Yan-li

School of Business Administration, Northeastern University, Shenyang 110004, China

Received 5 December 2002

Abstract

Applying fractal theory, this paper probes and discusses self-similarity and scale invariance of the Chinese stock market. It analyses three kinds of scale indexes, i.e., autocorrelation index, Hurst index and the scale index on the basis of detrended fluctuation analysis (DFA) algorithm and promotes DFA into a recursive algorithm. Using the three kinds of scale indexes, we conduct empirical research on the Chinese Shanghai and Shenzhen stock markets. The results indicate that the rate of returns of the two stock markets does not obey the normal distribution. A correlation exists between the stock price indexes over time scales. The stock price indexes exhibit fractal time series. It indicates that the policy guide hidden at the back influences the characteristic of the Chinese stock market.

© 2003 Published by Elsevier B.V.

Keywords: Stock market; Complexity; Fractal; Self-similarity; Scaling; Scale index; DFA

1. Introduction

Scale invariance is an important theory and method to investigate the finance complexity problem. According to scale invariance, we may investigate the complexity of the time series in prices of stock markets and probe the laws of market fluctuations, i.e., scaling in the Norwegian stock market [1], a dynamic model describing stock market price distributions [2], an empirical study on the levy distribution of the stock market risk trace. In the middle of the 1990s, Peng et al. proposed a detrended fluctuation analysis (DFA) on the basis of applying DNA to test the correlation of long nucleotide chains, that is DFA method [4–6]. The method is used to calculate the scale index in the complexity problem. It can analyse dynamic economic targets and

* Corresponding author. Tel.: +86-24-83680551; fax: +86-24-23891569.
E-mail address: zxtzxw@sina.com (X.-t. Zhuang).

stock market fluctuations. Empirical examples research on scaling in the English, Italian, Hungarian and Japanese stock markets and verify the degree of scaling in every market [7–10]. In Refs. [11–13], the scaling in the Chinese stock market is analyzed, which is the basis of probing the laws of stock market fluctuations.

First, it gives the characteristic targets describing the financial data. Second, from the angle of self-similarity and scale invariance, applying autocorrelation index, Hurst index and the scale index on the basis of DFA algorithm, we have an empirical analysis on the Chinese stock market. The results indicate that the rate of returns of the Shanghai and Shenzhen stock markets does not obey the normal distribution and exhibit a fractal time series and does not satisfy the efficient market hypothesis. Finally, it analyzes the fractal structure in the stock market, while promoting DFA into a recursive algorithm, which can improve calculation efficiency.

2. Describing the characteristic of financial data

Taking the stock price as an example, we discuss the variance character of financial data. From the angle of an investor, an investor pays more attention to the investment yield than to the stock price. The stock price at moment t is denoted as p_t . The investment yield from moment $t - 1$ to moment t is denoted as z_t .

$$z_t = (p_t - p_{t-1})/p_{t-1} .$$

Calculating the investment yield in compound interest:

$$z_t = \ln p_t - \ln p_{t-1} . \quad (1)$$

Formula (1) may be explained by the fact that during one investment period, calculating m times in compound interest, we may obtain $p_t = p_{t-1}(1 + z_t/m)^m$, when m tends to be unlimited, p_t equals $p_{t-1} \exp(z_t)$. Using the logarithmic forms on the two sides, we can obtain formula (1) of the investment yield, calculated in continuous compound interest. Because this kind of yield is convenient for us to conduct a theoretical study, the investment yield in this paper takes the same form as formula (1).

The fundamental statistics describing the investment yield characteristic variance are the sample mean, the sample standard deviation, skewness, kurtosis and autocorrelation coefficient of the daily rate of return (or monthly rate of return). Skewness describes the asymmetry degree of the rate of return. Kurtosis describes the convergence degree of the rate of return. The autocorrelation coefficient describes the correlation degree of the rate of return data in the different periods.

3. Scale theory and scale index in the stock market

3.1. Self-similarity and scale invariance

Hurst studied skew random walk in the 1940s, proposed a kind of new statistics, which is the Hurst index H , and rescaled the range analysis method. Mandelbrot studied

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ 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