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Multifractal analysis of SSEC in Chinese stock market: A different empirical result from Heng Seng index

Yu Wei*, Dengshi Huang

School of Economics & Management, Southwest Jiaotong University, Chengdu 610031, China

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Abstract

In this paper, high frequency (per 5 min) data of Shanghai Stock Exchange Composite index (SSEC) from January 1999 to July 2001 is analyzed by multifractal. We find that the correlation of the parameters of the multifractal spectra with the variation of daily return Z in SSEC is noticeably different from that in previous studies of Heng Seng index in Hong Kong stock market [Sun et al., Phys. A 291 (2001) 553–562; Sun et al., Phys. A 301 (2001) 473–482]. So, we suppose that there may not be a universal rule for the dependence of the parameters of the multifractal spectra with daily return of a stock index. Then, we construct a new measurement of market risk based on multifractal spectra, and test its ability of predicting index fluctuations with a more thorough method than that in Sun et al. [Phys. A 301 (2001) 473–482].

PACS: G0; G1; C1

Keywords: Econophysics; Multifractal; Market risk measurement; Predictability

*Corresponding author. Fax: +86 28 87601992.
E-mail addresses: weiyusy@126.com (Y. Wei), dhuang@mail.sc.cninfo.net (D. Huang).

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1. Introduction

In Refs. [1,2], Hang Seng index in Hong Kong stock market is analyzed by multifractal, and two main parameters of multifractal spectrum of daily high frequency indices, $\Delta\alpha$ and Δf, are calculated. Some interesting empirical results are discovered. For example, it is found that the amount of the variation of daily return is correlated with the amount of $\Delta\alpha$ of that day, and the average of Δf increases with increasing daily return. Therefore, the predictability of today's gain probability ($G\%$) and the day's index increase probability ($N\%$) with Δf of the previous 3 days are studied.

However, in our multifractal analysis of Shanghai Stock Exchange Composite index (SSEC), the most important index in China stock market, we find that the average of Δf does not increase, but decreases with increasing daily return, Z. So, we suppose that there may not be a universal rule for the dependence of Δf with daily return of a stock index. Moreover, the statistical significance of the dependence of the average of Δf with Z of SSEC is noticeably poorer than that of a new market risk measurement R_f, which is constructed by the two main parameters of multifractal spectra in Section 3, with daily return Z. We also find that today's market risk measurement R_f can be used to predict the next day's gain probability ($G\%$) and index increase probability ($N\%$), but a more thorough method than that in Ref. [2] is used.

This paper is organized as follows. In Section 2, the basic multifractal analysis is carried out, using high-frequency data (a quotation per 5 min) of SSEC, from 19 January 1999 to 6 July 2001 (586 trading days), totally 28,128 quotes. In Section 3, a new market risk measurement R_f, based on multifractal spectra, is introduced, and the dependence of R_f with daily return of SSEC is also investigated. In Section 4, predictability of the next day's gain probability ($G\%$) and index increase probability ($N\%$) based on today's R_f is tested, and some conclusions are made in Section 5.

2. Multifractal analysis of SSEC

According to Refs. [1,2], we also use box-counting method to calculate the multifractal spectra of SSEC, and denote the price of SSEC at time t (t running from 1 to $N = 28,128$) as $I(t)$. Shanghai Stock Exchange opens from 9:30 a.m. to 11:30 a.m. and then from 1:00 p.m. to 3:00 p.m., so there are totally 4 trading hours, i.e., 48 quotes (per 5 min) of SSEC may be recorded in a trading day.

The index variation with time can be divided into many normalized boxes (time intervals) of size δ ($\delta < 1$), for example, in the case the box size can be 1/48, 1/24, 1/16, 1/12, 1/8, 1/6, 1/4, 1/3, 1/2 and 1.

Suppose we need m boxes to cover the 48 indices of a trading day, $I(t)$, $t = 1, 2, \ldots, 48$, and there are n indices in each boxes. P_i is the average probability in the box i, then

$$P_i(\delta) = \frac{\sum_{j=1}^{n} I(i_j)}{\sum_{t=1}^{48} I(t)}, \quad i = 1, 2, \ldots, m, \tag{1}$$

where I_{i_j} is the jth index in the ith box of the trading day.