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Peculiar statistical properties of Chinese stock indices in bull and bear market phases

W.C. Zhou, H.C. Xu, Z.Y. Cai, J.R. Wei, X.Y. Zhu, W. Wang, L. Zhao, J.P. Huang *

Department of Physics and Surface Physics Laboratory (National Key Laboratory), Fudan University, Shanghai, 200433, China

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ABSTRACT

Chinese stock markets have experienced an extraordinary bull market since Jan 2006, which attracted global eyes. We investigate the statistical properties of the indices' log-return $r(t)$ for the bull market (Jan 2006–Oct 2007) and the previous bear market (Jan 2001–Dec 2005). Here we report three peculiar features of $r(t)$: (i) the cumulative distribution function curve of $r(t)$ in the bull market is similar to that in the bear market; (ii) the autocorrelation function of $r(t)$ in the bull market has a stronger negative correlation and a shorter correlation time than that in the bear market; (iii) the bull market shows stronger long-term correlation than the bear market. This work has relevance to understanding novel statistical properties in economic systems.

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1. Introduction

The distribution function of stock price's log-return is an issue that has interested researchers for a long time. Bachelier stated that market price would follow a random walk and the probability distribution $P(r)$ of price return $r(t)$ would be Gaussian. 60 years later, Mandelbrot argued that this was wrong in his research for cotton markets. He substituted the Gaussian distribution with a Levy-stable one, in which the tail decay is weaker than $1/r^3$ [1]. And in 1995, Mantegna and Stanley refuted the Levy-stable distribution with a power-law decay, in which the tails approximately obey $1/r^4$ [2]. This result was later verified by many other researchers on different markets [3–10].

Inspired by Mantegna and Stanley's work, physicists began studying the statistical properties of financial market with methods widely used in statistical physics. Even methods in complex systems have been used, resulting in the discovery of many "universal" rules [2–6]. Among all those rules, the behavior of autocorrelation functions of $r(t)$ and $|r(t)|$ is one of the most important findings. $r(t)$ is reported to have short-term autocorrelation, while $|r(t)|$ is long-term correlated.

However, all these "universal" rules were challenged when people extended their analysis into newly-born markets. The stock price's log-return in India shows exponential distribution function instead of the power-law decay [11]. Additionally, Huang found that the HangSeng index of the Hong Kong stock market shows an exponential decay when skipping the data in the first 20 min of every trading day [12].

As another newly-born market, the Chinese stock markets have attracted researchers, who wish to testify the ubiquity of the power-law decay and other "universal" rules. Recent studies reported that the Chinese stock markets show many similar behaviors as mature markets [13–15].

The previous studies focused on difference among regions. In this work, however, we want to test the power-law decay and the correlation behaviors of $r(t)$ under different market phases, the bull market and the bear market. As is known, the

* Corresponding author. Tel.: +86 21 5566 5227.
E-mail address: jphuang@fudan.edu.cn (J.P. Huang).

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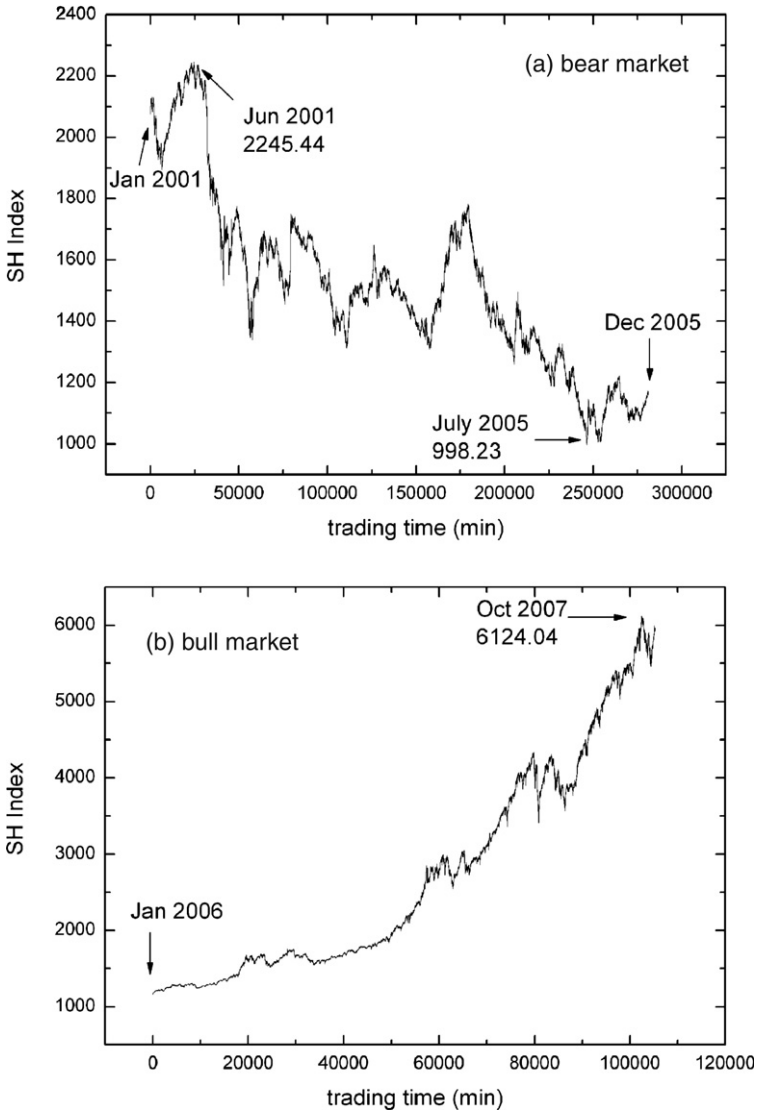

Fig. 1. The evolution of SH Index from Jan 2001 to Oct 2007, which can be divided into two different market phases, (a) the bear market and (b) the bull market. The bear market lasted from about Jan 2001 to Dec 2005, and the bull one lasts from Jan 2006 to October 2007.

Chinese stock markets experienced a nearly 5-year-long bear market and turned its direction in the end of 2005. Take the SH Index for an example, in October 2001, it reached a peak at 2245.44 and dropped to a trough at 998.23 in July 2005 (Fig. 1(a)). After that, the SH Index rose dramatically and reached a new peak at 6124.04 in 19 October 2007 (Fig. 1 (b)). During this period, the total market capitalization of Chinese stock markets has become over five times as much as that of two years ago.

Though the bear market contains rebound period and the bull market includes decline period, this division about the bear and the bull markets is appropriate due to the following reasons. First, this division is in accordance with conventions in finance industry. Most professionals viewed the history this way. Second, what determine the properties of the stock market are the participants. From 2001 to 2005, Chinese stock investors were mainly distressed by the endless decline of the stock market. Even though several rebounds occurred, the market confidence was never completely recovered. People in the bear market became conservative and the trading volume was very small. However, after the year 2006, the Chinese stock market turned into the bull market due to a series of favorable news and policies. The market players became enthusiastic, which could be reflected by the huge trading volume (Fig. 6). We believe that the different statuses of the market participants determine the features of the bull and the bear markets. So this division about the two market phases can be taken in this work.

To sum up, this article's aim is to study the stock market from a new perspective, to find out the similarity and difference between the bear and the bull markets. In Section 2, we will introduce the database we use. In Section 3, we will show the similarity between the distributions of $r(t)$ in different market phases. The differences that lie in the correlation functions in the two market phases will be discussed in Sections 4 and 5.

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