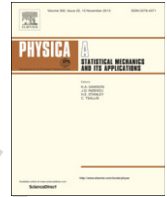




Contents lists available at ScienceDirect

Physica A

journal homepage: [www.elsevier.com/locate/physa](http://www.elsevier.com/locate/physa)

## Q1 Pattern of trends in stock markets as revealed by the renormalization method

Q2 H.S. Zhang\*, X.Y. Shen, J.P. Huang\*\*

Department of Physics, State Key Laboratory of Surface Physics, and Collaborative Innovation Center of Advanced Microstructures, Fudan University, Shanghai 200433, China

### HIGHLIGHTS

- We propose a renormalization model to analyze the pattern of stock price trends.
- The model is able to partition the time series into different scaling of trends.
- We show that the asymmetric phenomena of the trends in American stock market.
- The stronger Herd behavior is discovered in the Chinese stock market.

### ARTICLE INFO

#### Article history:

Received 19 September 2015

Received in revised form 27 January 2016

Available online xxx

#### Keywords:

Stock price dynamics

Herd behavior

Renormalization method

Econophysics

### ABSTRACT

Predicting the movement of prices is a challenging topic in financial markets. So far, many investigations have been performed to help understand the dynamics of stock prices. In this work, we utilize the renormalization method to analyze the scaling and pattern of stock price trends. According to the analysis of length and changing velocity of the price trends, we find that there exist asymmetric phenomena of the trends in American stock market. In addition, a stronger Herd behavior is also discovered in the Chinese stock market. Since the Chinese (American) stock market is a representative of emerging (mature) market, the study on comparing the markets between these two countries is of potential value, which can leave us a wiser about both the pattern of the markets and the underlying physical mechanisms.

© 2016 Elsevier B.V. All rights reserved.

## 1. Introduction

As a most challenging topic in financial market, predicting the movement of price has inspired many researches by not only market investors but also modern scientists and economists. So far, huge amount of qualitative theories about stock price dynamics [1–4] have been proposed to understand the patterns of stock markets, such as random walk model [5–7], correlation properties [8–10], scaling behavior [11–14], stock market volatility [15,16], distribution of stock price returns [17,18] and derivative pricing research [19]. Meanwhile, numerous methods in different aspects have been developed to predict the price movements. In technical analysis field, Pai et al. applied hybrid ARIMA and support vector machines model in stock price forecasting in 2005 [20]. On the other hand, in fundamental analysis field, Abarbanell and his co-workers investigated how detailed financial statement data (fundamental signals) help the market participants to make investment decisions [21]. Moreover, in marginal information field, Bollen et al. used the Twitter mood to predict the stock market and

\* Corresponding author.

\*\* Corresponding author. Tel.: +86 21 55665227; fax: +86 21 55665239.

E-mail addresses: [07300190004@fudan.edu.cn](mailto:07300190004@fudan.edu.cn) (H.S. Zhang), [jphuang@fudan.edu.cn](mailto:jphuang@fudan.edu.cn) (J.P. Huang).

<http://dx.doi.org/10.1016/j.physa.2016.03.028>

0378-4371/© 2016 Elsevier B.V. All rights reserved.

gained the excess return [22]. In addition, agent-based model and network theory which are included in complex system are also used widely to understand the mechanism of stock market [23–25].

A basic theory of classical economics is that investment decisions reflect agents' rational expectations and are made by analyzing all available information in an efficient manner. However, the real market are composed of huge amount of irrational investors. Consequently, behavioral economics are created to study the effects of social, cognitive, and emotional factors on the economic or finance decisions of individuals and institutions and the consequences for market prices, returns, and the resource allocation [26,27]. In addition, the agent based model derived from Ising model is also widely used to study the macro state of the market by researching and simulating the micro mechanism (investors behavior) [28–30]. As significant behavioral phenomena impact the stock market, Herd behavior describes how individuals in a group can act collectively. For example, lots of large stock market trends often begin and end with frenzied buying (bubbles) or selling (crashes). Cont et al. gave an analysis of Herd behavior and aggregate fluctuations in financial markets [31]. Zhao et al. studied herd behavior in complex adaptive system by human dynamic experiment [32]. The price trend is defined as the instrument price in financial markets tending to a particular direction over time. Understanding the pattern and mechanism of price trends can help investors, speculators and researchers analyze the stock markets. Kasa investigated the stochastic trends in equity markets of different countries and found the presence of a single common trend which dominates these countries' stock markets [33]. Zhong et al. investigated the effects of dynamic response in the evolution of collective behavior in an evolving market [34]. Fung et al. presented a system that predicts changes of stock trends by studying the influence of non-quantifiable information [35]. Clearly, all above discoveries are valuable for us. However, the world-wide financial crisis brought a great disaster in 2008. Since then the scholars have paid more attentions to the study of large market fluctuations. In 2009, Yuan and Zhuang used multifractal detrended fluctuation analysis to measure the multifractality of stock price fluctuations and also researched the pattern of price fluctuations [36]. Later, the renormalization method adopted by Wei et al., and Liu et al., are used to analyze the scaling and volatility of breakouts and breakdowns in stock price dynamics [37,38]. In this article, we mainly focus on the statistical properties of stock price trends and attempt to give a quantification analysis. Also, we compare patterns of the price trends in American stock market and Chinese stock market, trying to discover the different regularities between developed and emerging market.

## 2. Method

The upward trends are composed by several increasing prices while the downward trends are a series of decreasing prices. The regularities of the trends are very important factors which are studied by huge amount of investors and researchers. In general, the short-term investors will pay more attention to the trends of short time scales, while the long-term investors may focus more on the trends of long time scales. In our study, the trends of the stock price are analyzed through the renormalization method [39,40].

Denote the price at time  $t$  as  $P(t)$ , where  $t = 1, 2, 3, \dots, N$ . A local maximum price,  $P_{\max(i)}$ , of  $\Delta t$  ( $\Delta t = 1, 2, 3, \dots$ ) can be defined if there is no higher price existing in the time interval  $(t - \Delta t, t + \Delta t)$ . By this way, all the local maximum  $P_{\max(i)}$ , ( $i = 1, 2, 3, \dots$ ) can be found by a given  $\Delta t$  in price series [3]. Thus, the local minimum  $P_{\min(i)}$  can be just determined through searching the minimum point between two local maximums,  $P_{\max(i)}$  and  $P_{\max(i+1)}$ . It can be easily noticed that one can connect the  $P_{\max(i)}$  and the  $P_{\min(i)}$  to determine a downward trend. Accordingly, by connecting  $P_{\min(i)}$  with  $P_{\max(i+1)}$ , one can determine an upward trend as shown in Fig. 1(a). With different  $\Delta t$ , the trends with different time scales can be found to satisfy various investors as shown in Fig. 1(b).

After finding all the trends with different  $\Delta t$ , we define the trend return,  $R_u(i)$ , to describe the return rate of the  $i$ th upward trend as

$$R_u(i) = \ln \left( \frac{P_{\max(i+1)}}{P_{\min(i)}} \right). \quad (1)$$

Similarly, we define  $R_d(i)$  to describe the rate of return of the  $i$ th downward trend and it can be expressed as

$$R_d(i) = \ln \left( \frac{P_{\max(i)}}{P_{\min(i)}} \right). \quad (2)$$

For the sake of quantifying how quickly a trend transform, we also perform a changing velocity analysis for stock trends in the two stock markets. We define the time span,  $t_u(i)$ , to describe the duration of  $i$ th upward trend, and  $t_d(i)$  to describe the duration of  $i$ th downward trend. Therefore, we can calculate the changing velocity of  $i$ th upward trend according to

$$V_u(i) = \frac{R_u(i)}{t_u(i)}, \quad (3)$$

and the changing velocity of  $i$ th downward trend can be derived according to

$$V_d(i) = \frac{R_d(i)}{t_d(i)}. \quad (4)$$

Download English Version:

<https://daneshyari.com/en/article/7377550>

Download Persian Version:

<https://daneshyari.com/article/7377550>

[Daneshyari.com](https://daneshyari.com)