Physica A 477 (2017) 114–127

Contents lists available at ScienceDirect

Physica A

journal homepage: www.elsevier.com/locate/physa

Anchoring effect on first passage process in Taiwan financial market

Hsing Liu, Chi-Yo Liao, Jing-Yuan Ko, Jiann-Shing Lih *

Department of Physics, National Kaohsiung Normal University, 82446, Kaohsiung, Taiwan

HIGHLIGHTS

- Using diffusion model, we analyze anchoring effect on first passage of price change.
- Power-law scaling is observed in price change of local trend in financial markets.
- Anomalous diffusion for price fluctuation is related to the anchoring effect.
- Micro-trend of first passage is in agreement with the integrated price change.
- Analytic result of micro-trend is useful to understand the macro-trend in markets.

ARTICLE INFO

Article history:
Received 27 June 2016
Received in revised form 19 December 2016
Available online 28 February 2017

Keywords:
First passage process
First return time
Switching point
Anchoring effect
Anomalous diffusion

ABSTRACT

Empirical analysis of the price fluctuations of financial markets has received extensive attention because a substantial amount of financial market data has been collected and because of advances in data-mining techniques. Price fluctuation trends can help investors to make informed trading decisions, but such decisions may also be affected by a psychological factors—the anchoring effect. This study explores the intraday price time series of Taiwan futures, and applies diffusion model and quantitative methods to analyze the relationship between the anchoring effect and price fluctuations during first passage process. Our results indicate that power-law scaling and anomalous diffusion for stock price fluctuations are related to the anchoring effect. Moreover, microscopic price fluctuations before switching point in first passage process correspond with long-term price fluctuations of Taiwan's stock market. We find that microscopic trends could provide useful information for understanding macroscopic trends in stock markets.

1. Introduction

Understanding the price fluctuations of financial markets is critical for forecasting financial collapse [1,2], analyzing market data [3–9], modeling financial markets [10,11], and investors' strategic decision making [12]. Stock price fluctuations can originate from political, economic, financial and market policies and events as well as the operational abilities of companies. Traders receive an initial piece of information from these sources and decide on trading prices. Traders' cognition of the first transaction price influences the switching processes of local trends such as the support level, resistance level, and breakout point. This is known as the anchoring effect [13]. However most studies concerning the anchoring effect investigate it from a psychological viewpoint [12–18]. This motivates us to investigate how local trends in stock price variance relate to the anchoring effect from a physical perspective.

* Corresponding author.
E-mail address: jslih@nknu.edu.tw (J.-S. Lih).

http://dx.doi.org/10.1016/j.physa.2017.02.043
0378-4371/

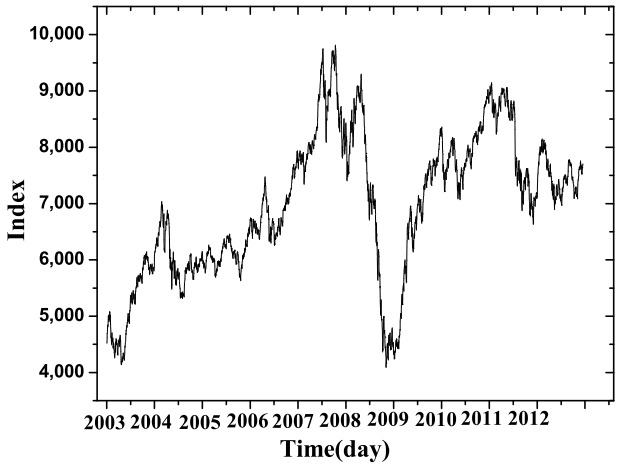

Fig. 1. The daily weighted index for Taiwan stock exchange (TWSE), the period is from January 2, 2003 to December 28, 2012.

This study explores the intraday price time series of the Taiwan futures from 2003 to 2012. During that period, the fluctuations of the Taiwan stock exchange weighted index (TAIEX) were typical bull and bear market cycles and were influenced by the subprime mortgage crisis (Fig. 1), and the special process of economic activity is worth investigation. We seek to understand the aforementioned macroscopic changes by analyzing the microscopic fluctuations in stock prices. According to the variance of local trends, the switching processes can be divided into local maximum and local minimum. We utilize diffusion models and quantitative techniques to analyze the relationship between the anchoring effect and price fluctuations during first passage process [19]. Our analytic results show that the power-law scaling and anomalous diffusion for stock price fluctuations are related to the anchoring effect, and this behavior depends on the selected temporal scale of local maximum and minimum. This indicates that the anchoring effect is similar to an action force that drags the displacement of a particle (trading price) resulting in the phenomena of superdiffusion, subdiffusion, and normal diffusion. Furthermore, the microscopic trend before the switching point in first passage process corresponds with the long-term price trends of the Taiwan stock market. Our finding from microscopic analysis could provide useful information for understanding the macroscopic trends in stock markets.

2. Data description and definition

In this study, we analyze intraday price time series of TAIEX futures (Taiwan Futures Exchange) from January 2, 2003 to December 28, 2012. We use this database because (i) the fluctuations of stock price in this 10 year period possess a complete structure that fully exhibits the character of the stock market cycle, this information is helpful for understanding overall economic development in Taiwan. (ii) The Taiwan market is an emerging market exhibiting large price fluctuations, and the underlying mechanism is worth investigating. (iii) The rules of trade changed infrequently during this period, and we can perform analysis without concerns regarding rule changes. The database contains volumes, trade prices, and time stamps to the second. Multiple trading events occur every second, which allows us to observe detailed variations in trends.

For the intraday price time series, we define a local maximum of order S to be a transaction price $P(t)$ without a higher price in the interval $t - S \leq t \leq t + S$, and define a local minimum of order S to be a transaction price $P(t)$ without a lower price in the interval [1]. To study the anchoring effect of the local maximum (or minimum), we set the local maximum (or minimum) as the initial point (anchor) of first passage process (Fig. 2). The first return time L_{max} and L_{min} are defined as the amount of time required for the price diffusion process to return to the local maximum (Fig. 2(a)) and local minimum (Fig. 2(b)) for the first time. We divide the process of first passage into Trend 1 and 2 on the basis of the switching point, which is the price extremum in this process. Let $T_{1,max}$, $T_{2,max}$, and H_{max} be the time of Trend 1 before the switching point, the time of Trend 2 after the switching point, and the switching point amplitude, respectively. The switching point amplitude is the price difference between the anchor and switching points for the case of local maximum. The definitions of $T_{1,min}$, $T_{2,min}$, and H_{min} are identical in the case of local minimum. Furthermore, for the case of local maximum, Trend 1 is a negative trend that starts at the anchor and ends at the switching point, and Trend 2 is a positive trend that starts at the switching point and ends at the returning point of first passage process (Fig. 2(a)). The case of local minimum as an anchor is the inverse (Fig. 2(b)).

3. Method of analysis

The anchoring effect may affect the "displacement" of the price in first passage process, which could be observed by studying the relationship between the anchor and fluctuation of the switching processes including the period of Trend 1