Statistical properties of the moving average price in dollar-yen exchange rates

Takaaki Ohnishi[a], Kazuyuki Aihara[b], Misako Takayasu[c], and Hideki Takayasu[d]

[a,b]Department of Complexity Science and Engineering, Graduate School of Frontier Sciences, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan
[c]Department of Complex Systems, Future University-Hakodate, 116-2 Kameda-Nakano-cho, Hakodate, Hokkaido 041-8655, Japan
[d]Sony Computer Science Laboratories Inc., 3-14-13 Higashigotanda, Shinagawa-ku, Tokyo 141-0022, Japan

E-mail : [a]ohnishi@sat.t.u-tokyo.ac.jp

Abstract. We analyze tick data of yen-dollar exchange rates for the 13-year period Jun. 1989 to Mar. 2002. We study the statistical properties of the differentiation coefficient of a moving average price. The moving average price is measured by averaging over a time window T, where T varies approximately over a factor of 10^4, from several seconds up to more than one week.

First, we compute the autocorrelation function of differentiation coefficients. The autocorrelation of differentiation coefficients cannot be distinguished from zero generally except for small values of T. The autocorrelation of absolute values of differentiation coefficients show long range power law correlations. These results are in good agreement with the stylized facts known for market's price changes.

We investigate the cumulative distribution of the normalized differentiation coefficient. The distribution is consistent with a power law behavior, characterized by an exponent $\mu \approx 2.5$ with an upper cut off. We find that the cut off value follows a scaling relation $T^{-\alpha}$, $\alpha \approx 0.5$ which is consistent with the random walk theory. By evaluating an average and standard deviation from the distribution of the differentiation coefficient, we show that for T smaller than several dozens of ticks, the moving average's fluctuation deviates from a random walk.

We also study the statistical properties of short time fluctuations around the moving average for various values of T.