Inflation and deflation in financial markets

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In this paper we investigate the statistical properties of the returns for the Nikkei 225 index in the 54-year period from January 1975 to April 2003, and for the Dow-Jones industrial average in the period for January 1935 to January 2003. We divide the time series of returns into two parts, the period of inflation and the period of deflation. We find that the return distributions can be approximated by the power-law distribution in the period of the inflation, while the return distributions is well described by the exponential distribution in the period of the deflation. Figure 1 shows the time series of the Nikkei 225 index in the period from 1975 to 2003. The figure indicates that the period of inflation is from January 1975 to December 1989, and the period of deflation, form January 1990 to April 2003. Figure 2(a) and Figure 2(b) show the semi-log plots of the cumulative probability distributions of returns for the Nikkei 225 index in the period of the inflation and in the period of the deflation. We find that the return distributions can be approximated by the power-law distribution in the period of the inflation, while the return distributions is well described by the exponential distribution in the period of the deflation. Figure 3 shows the time series of the Dow-Jones industrial average in the period from 1935 to 2003. The figure indicates that the period of inflation is from January 1935 to December 1999, and the period of deflation, form January 2000 to April 2003. Figure 4(a) and Figure 4(b) show the semi-log plots of the cumulative probability distributions of returns for the period of the inflation and for the period of the deflation. We also find the similar empirical results for DJAI in the period from January 1930 to April 2003, that is, the return distributions can be approximated by the power-law

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distribution in the period of the inflation, while the return distributions is well described by the exponential distribution in the period of the deflation.

We then propose a stochastic model of stock markets [1] inspired from physics to explore the empirical findings. In particular we show that the model can naturally illustrate how power-laws and exponential laws can arise. In our model the fluctuations of stock prices are caused by interaction among traders. We show that as the interaction among traders is strong, the shape of the return distribution changes from exponential to power-law.

References

[1] T. Kaizoji and M. Kaizoji, Modeling share returns, submitted into *International Journal of Modern Physics* **C** (2003).

Figure 1: The time series of the Nikkei 225 index in the period of January 1975 to April 2003. The period of inflation is from January 1975 to December 1989 and the periods of deflation is from January 1990-April 2003.

Figure 2

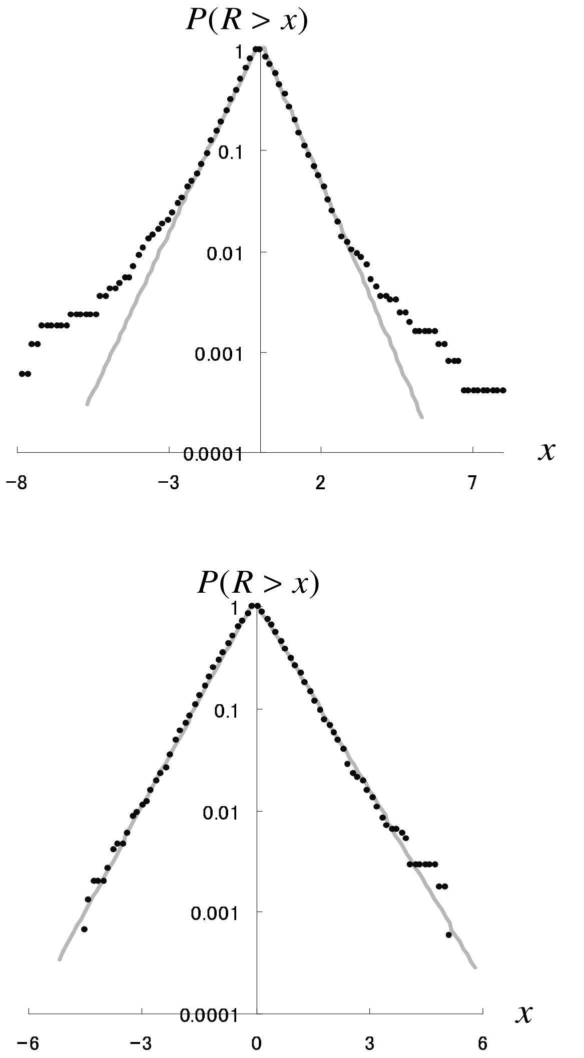

Figure 2: (a) The semi-log plot of the cumulative probability distribution of returns for the Nikkei 225 index in the period of inflation (January 1975-December 1989) and (b) the semi-log plot of the cumulative probability distribution of returns for the NIKKEI 225 index in the period of deflation (January 1990-April 2003). The straight lines indicate exponential functions.

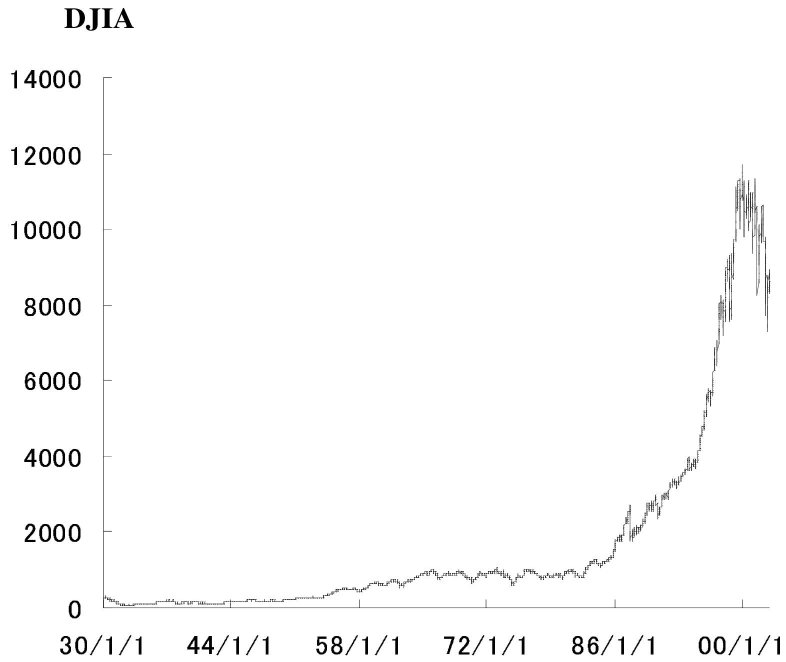

Figure 3: (a) The time series of the Dow Jones Industrial Average in the period of January 1935 to April 2003. The period of inflation is from January 1935 to December 1999, and the period of deflation is from January 2000 to April 2003. The straight lines indicate exponential functions.

Figure 4

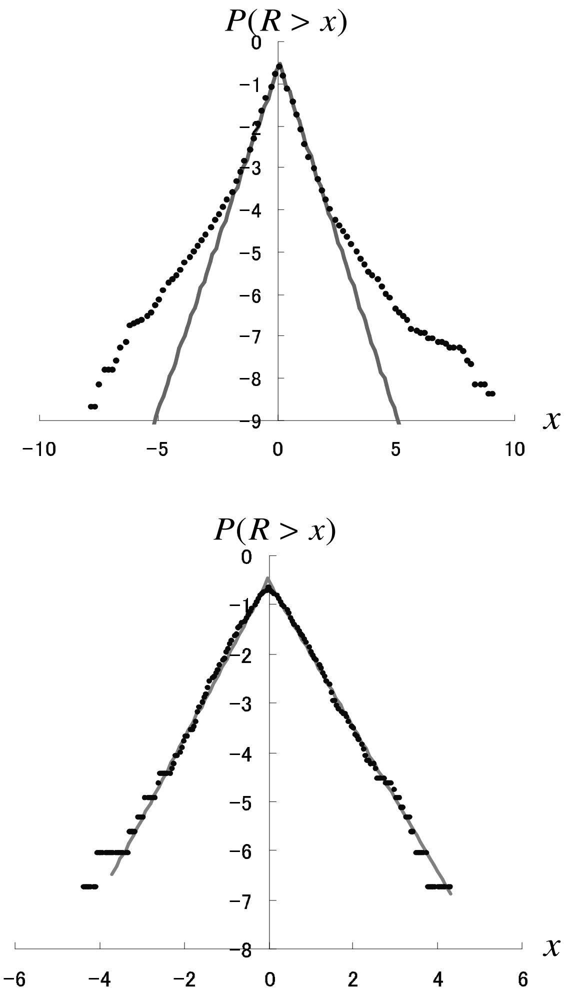

Figure 4: (a) The semi-log plot of the cumulative probability distribution of returns for the Dow Jones Industrial Average in the period of inflation (January 1935-December 1999) and (b) the semi-log plot of the cumulative probability distribution of returns for the Dow Jones Industrial Average in the period of deflation (January 2000-April 2003). The straight lines indicate exponential functions.