Time Reversal Invariance in Stock Indices

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In the field of econophysics, there has been a growing interest in the investigation of various stylized facts of the financial asset prices, such as the fat-tailed probability distribution function, the volatility clustering[1], the leverage effects[2] etc. The goal of econophysists' study is to find some universal principles for the financial markets, since they consider the financial market as a typical complex adaptive system[3]. On the other hand, researchers in econometrics have a relatively long history in analyzing the time series of price returns in order to find characteristic statistics of price fluctuations. The statistical properties are used to construct reasonable stochastic models, or to evaluate the existing models, such like GARCH and so on. Time reversal invariance (TRI) is one of such statistics estimators, which has close ties to the symmetry of time series and can be used as a detector for the non-Gaussianity[4].

Is TRI a universal phenomenon in financial markets? To answer this question, we carried out an analysis of the high-frequency data of Chinese stock indices(SSE composite index and SSE component index) and a Japanese stock index(TOPIX) by calculating three TRI estimators suggested by Zumbach[5]. The break of TRI has been found in the foreign exchange markets in Zumbach's study. Nevertheless a study of TRI on the high frequency data of stock indices has not been done yet. Through a preliminary investigation, we have found the evidence for the break of TRI in the time series of the stock indices(See Fig.1).

At the same time, we expect to get a clue for a possible cause of time asymmetry in price returns. For the future work, we will develop a multi-agent model which reproduces the empirical characteristics of TRI in order to reveal the mechanism behind TRI.

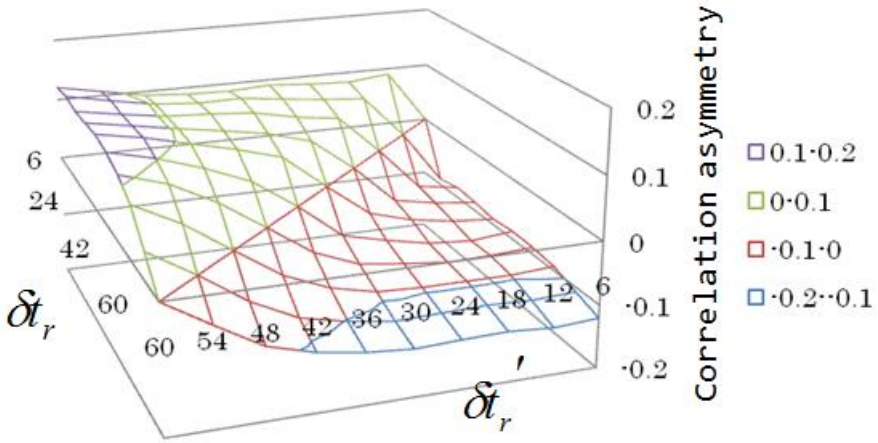

Figure1: Distribution of correlation asymmetry demonstrates the break of TRI in SSE component index. δt_r and $\delta t'_r$ is the time horizon of calculation for realized and historical volatility.

Keywords
Time reversal invariance, statistics analysis, volatility, stochastic process, price fluctuation

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