Dynamical Aspects of Multivariate Cross-Correlations in Financial Time Series

Y. Nakayama[a] and **H. Iyetomi**[b]

[a]Graduate School of Science & Technology, [b]Department of Physics, Niigata University
8050, Ikarashi 2-Nocho, Nishi-ku Niigata, 950-2102, Japan
hiyetomi@sc.niigata-u.ac.jp

Recently correlations between different stocks have been investigated very actively, and the results are applied to portfolio management. Noise elimination out of the empirical equal-time cross-correlations has been made successfully using the random matrix theory (RMT) [1-3]. However, it is important to pay attention to not only the equal-time (static) correlations but also the time-lagged (dynamic) correlations. There are some papers that analyzed such dynamic correlations [4], but this type of research has just started. In this paper, we propose the following new method.

We first calculate 1-day returns of 557 Japanese major companies stocks for the 11-year period from 1996 through 2006, and carry out discrete Fourier transform of the returns. Then we construct a correlation matrix $\mathbf{C}(\omega)$ for each frequency ω, and calculate the eigenvalues λ of $\mathbf{C}(\omega)$. Also we repeat the same calculation using random data instead of the real ones. Comparison of the empirical eigenvalues with the reference results enables us to extract essential correlations involved in complicated behavior of the stock returns. Furthermore, we show the eigenvectors of $\lambda^{'}s$ are significantly different from the random case. The results are demonstrated in Figs. 1 and 2.

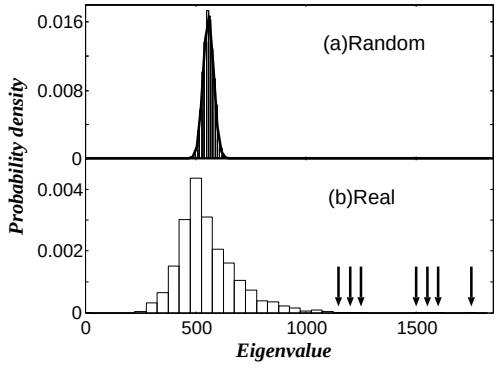

Figure 1: Probability density function of the eigenvalues; (a) and (b) for random and real data respectively.

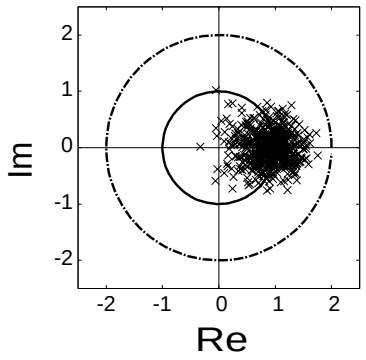

Figure 2: Eigenvector components for the largest eigenvalue with the period of 4.96 days.

Keywords
random matrix theory, time series analysis, dynamical cross correlation

References

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