

CROSS-CORRELATION IN STOCK MARKETS AS THE INDICES OF MARKET RISKS

J. Maskawa^a , W. Souma^b, and K. Fukuda^c

^aDepartment of Business Administration, Fukuyama Heisei University
Fukuyama, Hiroshima 720-0001, Japan
maskawa@heisei-u.ac.jp

^bNiCT/ATR CIS Applied Network Science Laboratory
2-2-2, Hikaridai, Seika-cho, Soraku-gun, Kyoto, 619-0288, Japan (ATR)
souma@atr.jp

^cNational Institute of Informatics
2-1-2 Hitotsubashi, Chiyoda-ku, Tokyo 101-8430, Japan
kensuke@nii.ac.jp

Recently, many stock markets in the world underwent heavy falls in the stock prices, due to the ripple effects of the US sub-prime crisis. In some situation, a piece of exogenous information can trigger such a financial crisis as this case. The process of the rising of market risks, in other words, the process that stock price reflects the information is crucial, and is valuable to study for financial risk control.

Risks are usually measured based on the historical probability distributions of asset returns, e. g. , historical volatility, VaR and so on. However, in the situation of global economy, unexpected large fluctuations of asset price was triggered by the affairs happened outside the relevant market. In addition, it is known that the drastic price change as in abrupt rise or crash has different statistical characteristics from that of ordinary price changes[1]. Then, what is the appropriate index for such market risks?

The cross-correlations of returns among various stocks carry the signals about market risks. If we take an example out of statistical physics, the cross-correlation coefficient indicates the sensitivity of the stock price to an external force according to the fluctuation-response theorem[2]. In this presentation, we will report the result of the empirical study of the historical stock prices listed on London Stock Exchange for the two period:

- a) The period from May-2007 to July-2008, which includes the period that we have experienced the drastic price change, due to the US sub-prime crisis.
- b) The period from July-2004 to December-2004 by way of comparison.

We will report the profile of the eigenvalue spectrum of the cross-correlation matrix of log returns, transaction volumes, number of trades and so on, and will discuss the change of the group structure of issues listed on the market throughout the period, which is indicated by the profile of a certain eigenvector, appropriately using the random matrix theory. In Fig. 1, we show the profile of the maximum eigenvalue of the cross-correlation matrix and FTSE100 index for the period a).

A few of the results of the empirical study are following:

- Maximum eigenvalue indicating market mode increases when the stock price heavily changes. There is an upward/downward asymmetry.

- Cross-correlation between daily return and maximum eigenvalue for the dataset a) is statistically significant, while it is not the case for the dataset b).
- Maximum eigenvalue for the dataset a) has long memory, while it is not the case for the dataset b) nor the daily return for the both datasets.

We will also propose a simple model of the herding behavior of market participants to link the structural change of stock market and the investment behavior of the participants.

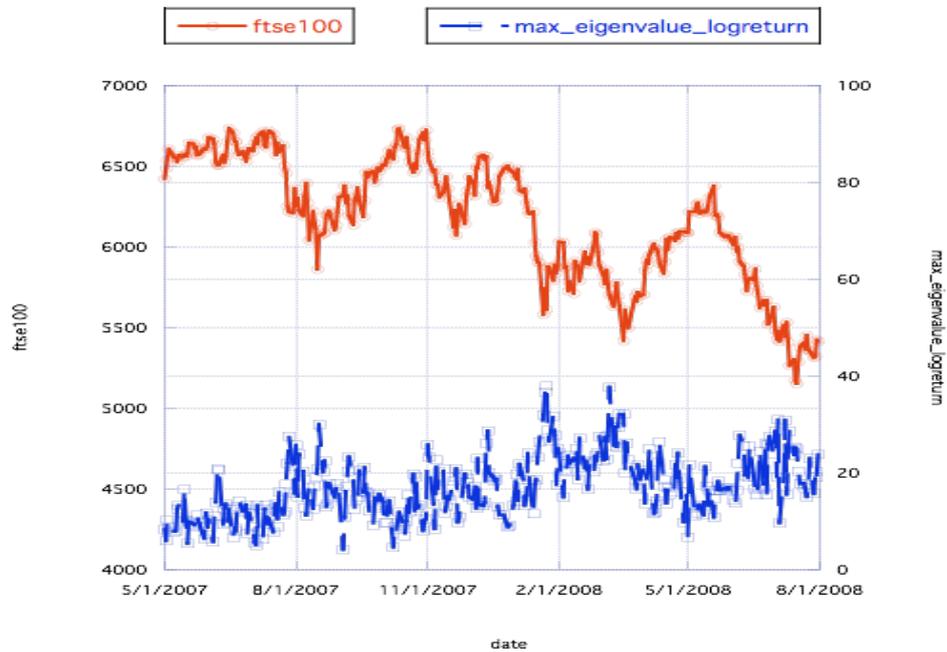


Fig. 1

Keywords

cross-correlation, stock market, market risk, US sub-prime crisis

References

[1]F. Lillo and R. N. Mantegna “Symmetry alteration of ensemble return distribution in crash and rally days of financial markets” *Eur. Phys. J. B*, 15, p. 603-606, 2000.

[2]Jun-ichi Maskawa “Ordered phase and non-equilibrium fluctuation in stock market” *Physica A* , 311, p. 563- 570, 2002.