

A Large-Scale Simulation of Ising Financial Market

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Keyword: Ising Model, Cumulative Risk Fraction, Inverse Participation Ratio

1 Introduction

Bornholdt proposed an Ising-based model that simulates financial markets. While the model has only two parameters, it successfully exhibits the major stylized facts seen in the real financial markets. The original model is designed to simulate one asset time series. The real financial market is a complex system that consists of many financial assets. Thus for realistic simulations it is desirable to simulate a system that contains many correlated assets. In Refs.[2, 3], an extended model, called the multiple time series Ising model is proposed and simulations with a few stocks were done. Here we make a large-scale simulation that includes 100 stocks. We study dynamical properties of the model, especially cross-correlation and risk measure such as cumulative risk fraction (CRF)[4]. We also calculate the inverse participation ratio and compare it with the results from the random matrix theory.

2 Simulation Results

We perform a simulation that trades 100 stocks and each stock is traded on a 120×120 lattice including 14400 Ising agents. Fig.1(Left) shows the volatility index defined by an average of absolute returns from 100 stocks for a particular parameter set. It is found that there exist several high-volatility periods. Fig.1(Right) shows the CRF constructed from eigenvalues of the return cross-correlation matrices calculated with a rolling window of 200. We find that the CRF increases at high volatility periods. Thus the CRF can serve as an indicator that measures the risk in the system. We also find that the inverse participation ratio shows the similar property with the CRF.

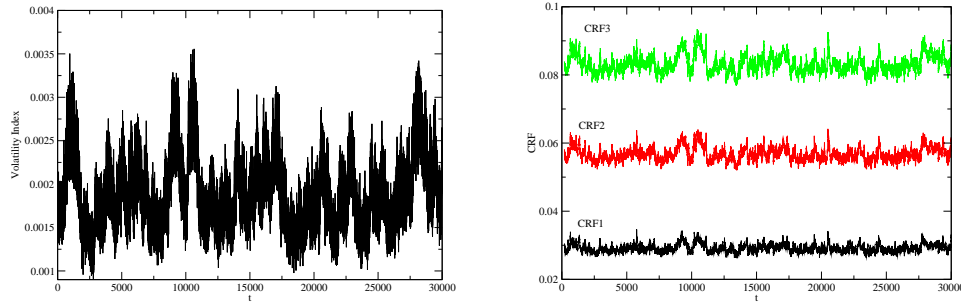


Figure1: (Left): Volatility Index. (Right): CRF1-3 from cross-correlation matrices.

References

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