

Economic interpretation of GARCH models: an agent-based simulation study

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Abstract

GARCH models, developed by R. Engle and T. Bollerslev, are widely used technical models for volatility reproducing a number of features of real stock price processes, among others volatility clustering. However, GARCH parameters do not have any direct economic interpretation. One of the objectives of this talk is to present newly discovered possible qualitative relationships between fundamental economic factors and the parameter values of the GARCH model that best fits the data. This is done by developing a detailed, agent-based fundamental model for the market, and considering the associated price process as real data.

In our novel market microstructure model chartists and fundamentalists trade in a stock market. Chartists predict future stock prices by extrapolating current trend. On the other hand, the belief of the fundamentalists about future stock prices is effected by the information they receive. The information arrival process is modelled by a discrete time Hawkes's process, which captures the feedback effects of market news.

Assuming a fixed behavior pattern for individual agents of a given type, modulo random choices, the market structure is defined and parameterized by the distribution of wealth among the two groups of agents as described above. Extensive numerical experiments have shown that market structure is a fundamental factor for the coefficients of the best-fitting GARCH(1,1) model. In particular, we established monotonic dependence between the relative weights defining a market structure and the GARCH(1,1) coefficients. However, the exact relationship will depend on the unknown individual behaviors.

On the other hand, the established ability of the technical model to reproduce data generated by the fundamental model motivates the use of GARCH models to detect changes in the market structure. For this purpose we use the MDL (Minimum Description Length) approach to real-time change detection as developed in the works of L. Gerencsér and J. Baikovicus.

A stand-alone component of this algorithm is a novel recursive method for estimating GARCH coefficients, developed and analysed by the authors in cooperation with Zs. Orlovits. We have tested our change-point detection algorithm extensively on simulated data, and experienced excellent detection capability. We have also tried our algorithm on real data, and found that alarms on possible abrupt changes in the market structure occur only before the price trends become consistent, up or down, indicating that a real change in the market dynamics has indeed occurred.