

A Change Detection Procedure for Nonlinear Stochastic Volatility Models

Zoé Rimay

Following in the footsteps of recent Nobel prize winners – Fama, Hansen and Schiller (2013), Engle and Granger (2003), Sharpe (1990), etc. – we were analyzing economic time series with time-varying volatility. One basic problem in real world applications is the estimation of the dynamics of the model parameters. Two estimation methods – the off-line and on-line ones – have been analyzed under various conditions in the literature and are very close to the scope of our research.

We were particularly interested in the parameter estimation of nonlinear stochastic volatility models, especially the well-known and widely used model class named Generalized Autoregressive Conditional Heteroscedastic (GARCH) model. However, while both of the off/line and online (or recursive) estimation of time invariant systems has attracted much attention in the literature, the same method on time varying systems has less attention recently. Analyzing time-varying system is an important and actual problem nowadays, since if the dynamics of the model changes slowly in time, then we should adapt to the actual system. But in order to detect the changes in the system, the estimation procedure must be modified: instead of cumulating past data we must gradually forget them. Forgetting past data is technically realized by using exponential forgetting both in the off-line and on-line case, often named as fixed gain estimation methods. Fixed gain estimation is mostly used when we anticipate that the parameters may vary over time. The analysis of this method for linear time series models such as autoregressive (AR) or autoregressive moving average (ARMA) models have widely examined in the literature.

The first objective of this thesis is to extend the results of fixed gain estimation method for linear processes to GARCH models and test the capability of the proposed algorithm by empirical applications. Using this technique a second objective of this thesis is to solve change-point detection problems in real time, with the help of the so-called Hinkley-detector. This change-point detection method is obtained for certain kinds of ARMA processes. We will apply this method with necessary transformations to GARCH models. Some results of the analysis of the change-point detection scheme are obtained and extensive simulations show that the approach exhibits surprisingly good detection capabilities.