Bayesian unit root tests of nonlinear time series models with heteroskedasticity

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Abstract

This thesis proposes a Bayesian testing procedure to detect the presence of nonstationarity or local non-stationarity against nonlinear autoregressive processes. Three popular nonlinear time series models are considered: a double threshold autoregression, a double smooth transition autoregression, and a double Markov switching autoregression. Double models exhibit mean asymmetry and volatility asymmetry. In order to capture well-known salient features like fat-tailed distributions of risky asset returns, and volatility clustering in the financial time series. A GARCH model of standardized Student-t innovations is considered. To implement a test, a posterior odds analysis is proposed. In particular, a mixture prior for the autoregressive coefficient is used to alleviate the identifiability problem that occurs when a time series has unit roots. The proposed methods achieve a reliable inference despite the non-integrability problem posed by the likelihood functions. We implement a formal approach for Bayesian hypothesis testing with posterior odds ratios. Further, we discuss adaptive MCMC methods for estimation and inference with these models, including the development of a mixture prior distribution allowing for autoregressive coefficient parameters and solving the identifiability problem. Our simulation and empirical studies confirm that the proposed methodology successfully detects instances of local non-stationarity in these nonlinear autoregressive GARCH models.

Keywords: Bayesian hypothesis testing, heteroskedasticity, Markov switching autoregressive model, Markov Chain Monte Carlo, mixture prior, posterior odds ratio, regime-switching models, smooth transition autoregressive model, threshold autoregressive model, unit-root testing