

RSTAR: A Package for Smooth Transition Autoregressive Modeling Using R

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In the last few years, numerous improvements have been made for statistical inference in threshold autoregressive models. Particularly, new tests are developed and methods are proposed for diagnostic control, forecasting, and impulse response analysis. These developments are examined in Granger and Terasvirta (1993), Terasvirta (1998), Potter (1999), and van Dijk, Terasvirta and Franses (2002). This study develops a comprehensive R package for testing, estimating, diagnostic checking, forecasting, and further analysis of smooth transition autoregressive models (STAR). The package is designed around the empirical modeling cycle for STAR models devised by Terasvirta (1994), and van Dijk, et al. (2002). This modeling approach consists of specification, estimation and evaluation stages and, thus, is similar to the modeling cycle for linear models of Box and Jenkins (1976). In the testing stage, the package emphasis LM-type test and implements all tests proposed in the literature (see Luukkonen, Saikkonen and Terasvirta (1988), Granger and Terasvirta (1993), van Dijk, et al. (2002)). The package allows estimation of logistic and exponential STAR models using analytical gradients. Very extensive diagnostic control techniques are implemented in the package. All aspects of the diagnostic tests examined discussed in Eitrheim and Terasvirta (1996), van Dijk and Franses (1999) and Lundbergh, Terasvirta and van Dijk (2000) are fully implemented. The R-STAR package allows robust estimation methods for all tests in order to guard against influence of possible outliers. R-STAR emphasizes aspects such as model evaluation by means of out-of-sample forecasting and impulse response analysis, and the influence of possible outliers on the analysis of smooth transition type nonlinearity. Forecasts and impulse responses are calculated using Monte Carlo or bootstrap methods with code highly optimized for speed. We also incorporate recently introduced extensions of the basic smooth transition model. On the programming side, R-STAR needs no programming experience. Although all commands have control over all aspects, default values are provided and only one or two options need to be passed, if needed at all. We take advantages of object-oriented programming, S4 methods, and vectorization provided by the R environment.

References

- Box, G.E.P. and G.M. Jenkins (1976), *Time Series Analysis; Forecasting and Control* , San Francisco: Holden-Day.
- Eitrheim, O. and T. Terasvirta (1996), Testing the adequacy of smooth transition autoregressive models, *Journal of Econometrics* 74, 59-76.
- Franses, P.H. and D. van Dijk (2000), *Nonlinear Time Series Models in Empirical Finance* , Cambridge: Cambridge University Press.
- Granger, C.W.J. and T. Terasvirta (1993), *Modelling Nonlinear Economic Relationships* , Oxford: Oxford University Press.
- Lundbergh, S., T. Terasvirta and D. van Dijk (2000), Time-varying smooth transition autoregressive models, *Working Paper Series in Economics and Finance No. 376*, Stockholm School of Economics.
- Luukkonen, R., P. Saikkonen and T. Terasvirta (1988), Testing linearity against smooth transition autoregressive models, *Biometrika* 75, 491- 499.
- Potter, S.M. (1999), Nonlinear time series modelling: an introduction, *Journal of Economic Surveys* 13, 505-528.
- Terasvirta, T. (1994), Specication, estimation, and evaluation of smooth transition autoregressive models, *Journal of the American Statistical Association* 89, 208-218.
- Terasvirta, T. (1998), Modelling economic relationships with smooth transition regressions, in A. Ullah and D.E.A. Giles (eds.), *Handbook of Applied Economic Statistics* , New York: Marcel Dekker, pp. 507-552.
- van Dijk, D., T. Terasvirta and P.H. Franses (2002), Smooth transition autoregressive models - a survey of recent developments, *Econometric Reviews* 21, 1-47.