Statistica Sinica **32** (2022), 2171-2198
doi:https://doi.org/10.5705/ss.202020.0177

AUTOMATED ESTIMATION OF HEAVY-TAILED VECTOR ERROR CORRECTION MODELS

Feifei Guo, Shiqing Ling and Zichuan Mi

Beijing Institute of Technology, Hong Kong University of Science and Technology and Shanxi University of Finance and Economics

Abstract: This paper proposes an automated approach that uses adaptive shrinkage techniques to determine the cointegrating rank and estimate the parameters simultaneously in a vector error correction model with unknown order p when its noise is represented by independent and identically distributed heavy-tailed random vectors with tail index $\alpha \in (0, 2)$. We show that the estimated cointegrating rank and order p are equal to the true rank and the true order p_0, respectively, with probability trending to one as the sample size $n \to \infty$. The other estimated parameters achieve the oracle property. That is, they have the same rate of convergence and the same limiting distribution as those of the estimated parameters when the cointegrating rank and the true order p_0 are known. This paper also proposes a data-driven procedure for selecting the tuning parameters. Simulation studies are carried out to evaluate the performance of the proposed procedure for finite samples. Lastly, we use our techniques to explore the long-run and short-run behavior of the prices of wheat, corn, and wheat flour in the United States.

Key words and phrases: Cointegration, heavy-tailed, LASSO, reduced rank LSE.

1. Introduction

The vector error correction (VEC) model was introduced by Granger (1983) and Engle and Granger (1987). Estimating and testing cointegration is the most essential target for the VEC model, and various approaches have been proposed in the literature. Early research can be found in Phillips and Durlauf (1986), Ahn and Reinsel (1990), Reinsel and Ahn (1992), Stock and Watson (1993), and Johansen (1988, 1995), among many others. Recently, Wang and Phillips (2012) proposed a test for nonlinear nonstationary models. Kristensen and Rahbek (2013) develop tests and estimators for nonlinear cointegrating VEC models. Cavaliere, Nielsen and Rahbek (2015) consider a bootstrap test on the cointegration rank relation in vector autoregressive (AR) models. To determine the cointegrating relationship of vector time series, the classical method needs to im-

Corresponding author: Shiqing Ling, Department of Mathematics, Hong Kong University of Science and Technology, Hong Kong. E-mail: maling@ust.hk.