Network estimation for high-dimensional time series

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We propose FNETS, a methodology for network estimation of high-dimensional time series exhibiting strong serial- and cross-sectional correlations. We operate under a factor-adjusted vector autoregressive (VAR) model which, after accounting for pervasive co-movements of the variables by common factors, models the remaining idiosyncratic dynamic dependence between the variables as a sparse VAR process. Network estimation of FNETS consists of three steps: (i) factor-adjustment via dynamic principal component analysis, (ii) estimation of the latent VAR process via l1-regularised Yule-Walker estimator, and (iii) estimation of partial correlation and long-run partial correlation matrices. In doing so, we learn three networks under- pinning the VAR process, namely a directed network representing the Granger causal linkages between the variables, an undirected one embedding their contemporaneous relationships and finally, an undirected network that summarises both lead-lag and contemporaneous linkages. In addition, FNETS provides a suite of methods for forecasting the factor-driven and the idiosyncratic VAR processes. Under general conditions permitting tails heavier than the Gaussian one, we derive uniform consistency rates for the estimators in both network estimation and forecasting, which hold as the dimension of the panel and the sample size diverge. An application to daily volatility data confirms the good performance of FNETS.

This is joint work with Matteo Barigozzi (Bologna) and Dom Owens (Bristol)