Inference in high-dimensional matrix-valued time series with common stochastic trends and multifactor error structure

Abstract

We develop a factor model for high-dimensional matrix-valued time series, where both common stochastic trends and common stationary factors are present. We study the estimation of (row and column) loading spaces, of the common stochastic trends and factors. In a set of (negative) preliminary results, we show that for such a model, the standard projection-based technique fails to improve the rates of convergence compared to a ``flattened'' estimation technique which does not take into account the matrix nature of the data. Hence, we develop a four-step procedure where: (i) we ``anti-project'' the data onto the orthogonal complement to the (row and column) loadings of the common stochastic trends, using the trend free data to estimate the common stationary component; (ii) we remove the estimated common stationary component from the data, and re-estimate, using a projection-based estimator, the common stochastic trends and their loadings; (iii) we refine the estimator of the stationary component by using a projection-based approach; and (iv) we iterate the second step, obtaining refined estimates of the common stochastic trends. We show that this estimator succeeds in refining the rates of convergence of the initial, ``flattened'' estimator. Monte Carlo evidence shows that our estimators offer a marked improvement compared to the ``flattened'' techniques.
We validate our theory through an application to a set of multinational macroeconomic indices.

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