Abstract: In this paper, we develop three techniques in high-dimensional time series econometrics using latent factor models. Here, high dimensional means both cross-sectional dimension (N)and time series dimension (T) are allowed to go to infinity.

The first chapter considers a robust iterative principal components (IPC) estimator of a large linear panel data model with common factor interactive effects (Bai, 2009a). It is well-known that the original IPC estimator suffers from bias due to correlated and heteroskedastic idiosyncratic errors in cross-sectional and serial dimensions. In this paper, the developed estimator corrects the bias by a residual sparse regression to correct correlations in both dimensions simultaneously, plus a conventional bias correction for heteroskedasiticties. We rigorously establish the asymptotic properties of the proposed estimator. Monte Carlo simulations show our approach works well in finite samples both in estimation and inference.

In the second chapter, we extend the Principal Orthogonal complEment Thresholding (POET) framework by Fan, J., Y. Liao, M. Mincheva (2013) to estimate large covariance matrices with a "mixed" structure of observable and unobservable strong/weak factors, and we call this method the extended POET (ePOET). Under some mild conditions, we derive the uniform consistency of the proposed estimator for the cases with or without observable factors. Especially, the weak factor structure allows the existence of much slowly divergent eigenvalues of the covariance matrix frequently observed in real data. Furthermore, several simulation studies show that the ePOET achieves good finite-sample performance regardless of data with strong, weak, or mixed factors structure. Finally, we conduct empirical studies to present the practical usefulness of the ePOET.

The third chapter extends the estimation of a static covariance matrix to a dynamic one. We proposes a parsimonious model for estimating a high-dimensional volatility matrix. Built on the Factor-GARCH model to capture the systematic part through common factors, we include the noise covariance regularized by some thresholding method POET to address the singularity problem when $N > T$. The consistency of the GARCH parameters is proved under high dimensional space. Monte Carlo studies show that our estimator performs well in finite samples. Empirical studies demonstrate that our model is superior to the classic CCC-GARCH and DCC-GARCH in the out-sample analysis.