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Quasi Maximum Likelihood Analysis of High Dimensional Constrained Factor Models*

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Abstract

Factor models have been widely used in practice. However, an undesirable feature of a high dimensional factor model is that the model has too many parameters. An effective way to address this issue, proposed in a seminar work by Tsai and Tsay (2010), is to decompose the loadings matrix by a high-dimensional known matrix multiplying with a low-dimensional unknown matrix, which Tsai and Tsay (2010) name the constrained factor models. This paper investigates the estimation and inferential theory of constrained factor models under large-N and large-T setup, where N denotes the number of cross sectional units and T the time periods. We propose using the quasi maximum likelihood method to estimate the model and investigate the asymptotic properties of the quasi maximum likelihood estimators, including consistency, rates of convergence and limiting distributions. A new statistic is proposed for testing the null hypothesis of constrained factor models against the alternative of standard factor models. Partially constrained factor models are also investigated. Monte carlo simulations confirm our theoretical results and show that the quasi maximum likelihood estimators and the proposed new statistic perform well in finite samples. We also consider the extension to an approximate constrained factor model where the idiosyncratic errors are allowed to be weakly dependent processes.

Key Words: Constrained factor models, Maximum likelihood estimation, High dimensionality, Inferential theory.

JEL #: C13, C38.

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