Detecting the Number of Factors in Non-stationary Errors-in-Variables Models

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When there are non-stationary trend components and stationary noise components in multivariate non-stationary time series, it is important to determine the number of non-stationary trend factors. We use the errors-in-variables representation as

$$\mathbf{y}_i = \mathbf{x}_i + \mathbf{v}_i \ \ (i = 1, \cdots, n),$$

where $\mathbf{x}_i$ $(i = 1, \cdots, n)$ are a sequence of p-dimensional non-stationary I(1) process and $\mathbf{v}_i = 1, \cdots, n)$ are a sequence of stationary I(0) process.
We develop a new way to detect the number of non-stationary $q \times 1$ $(1 \leq q \leq p)$ trend factors from trend components $\{\mathbf{x}_i\}$ $(p \times 1)$ by using the characteristic roots and vectors of the sample variance-covariance estimates obtained by the macro-SIML (separating information maximum likelihood) method of the non-stationary errors-in-variables models. We derive the asymptotic distributions of characteristic roots and vectors from the variance-covariance estimates of the non-stationary components derived from the Macro-SIML estimation, which was developed by Kunitomo and Sato (2017). We give the analysis of some macro-economic data in Japan.

Keywords : Non-stationary multivariate economic time series, Errors-variables models, trend and seasonality, Non-stationary factors, Characteristic Roots and Vectors, Limiting Distributions, Separating Information Maximum Likelihood (SIML) estimation.

References

Engle, R. and C.W.J. Granger (1987), "Co-integration and Error Correction," *Econometrica*, Vol.55, 251-276.

Kitagawa, G. (2010), *Introduction to Time Series Analysis*, CRC Press.

Johansen, S. (1995), *Likelihood Based Inference in Cointegrated Vector Autoregressive Models*, Oxford UP.

Kunitomo, N. and S. Sato (2017), "Trend, Seasonality and Economic Time Series : the Non-stationary Errors-in-variables Models," Discussion Paper MIMS-RBP Statistics & Data Science (SDS-4), Meiji University
http://www.mims.meiji.ac.jp/publications/datascience.html

Kunitomo, N., N. Awaya and D. Kurisu (2017), "Some Properties of Estimation Methods for Structural Relationships in Non-stationary Errors-in-Variables Models," Discussion Paper MIMS-RBP Statistics & Data Science (SDS-3), Meiji University.

Kunitomo, N., S. Sato and D.Kurisu (2018), *Separating Information Maximum Likelihood Method for High-Frequency Financial Data*, Springer.