10th Financial Risks International Forum

Bollerslev T., Meddahi N. and S. Nyawa (2016)
High-Dimensional Multivariate Realized Volatility Estimation

Jiao Y., Ma C. and S Scotti (2016)
Alpha-CIR model with branching processes in sovereign interest

Christophe Hurlin

University of Orléans

March 27, 2017

Comments on

High-Dimensional Multivariate Realized Volatility Estimation

Bollerslev T., Meddahi N.and S. Nyawa (2016)

This paper introduces an original **factor-based estimator** of the **realized covolatility matrix** which is applicable with

1. A large number of assets
2. Microstructure noises
3. Non-synchronicity of the prices records (robust to the Epps-effect)
4. This method guarantees that the estimator $\widehat{\Sigma}$ is positive semi-definite.

General comments

- The idea is very convincing and the paper is very well written: the asymptotic properties, as well as the implementation strategy, are clearly documented.
- High probability to be published in top journal and to be highly cited.

High-Dimensional Multivariate Realized Volatility

Robust to	Micro. Noises	Asynchronicity	+ semi-definiteness
Hayashi and Yoshida (2005)	-	+	
Multivariate realized kernel Mker Barndorff-Nielsen et al. (2011)	+	+ (refresh-time)	+ (if p<<n)
Modulated realized covariance MRC Christensen, Kinnebrock, and Podolskij (2010)	+	+	+ (if p<<n)
Adjusted modulated realized covariance MRC, Christensen, Kinnebrock, and Podolskij (2010)	+	+ (refresh-time)	+ (if p<<n)
Composite realized kernel Lunde, Shephard, and Sheppard (2016)	+	+	+ (even if p$\approx$n)
Factor-based estimator Bollerslev, Meddahi and Nyawa (2016)	+	+	+ (even if p$\approx$n)

The **trick of the paper** consists in identifying two separate factor structures

- A latent component of order Op($\sqrt{\Delta}$) accounting for the genuine cross-sectional dependencies in the **returns**, which tends to disappear when the time-interval Δ tends to 0.
- Another component of order Op(1) for describing the **noise**, which remains invariant to the sampling frequency.

The **practical implementation** of the estimator relies on traditional factor analysis (PCA) together with already existing procedures (MRker, MRC and PRV) for consistently and robustly estimating the different components of the covolatility matrix:

1. The rotated factors $\widetilde{f}$.
2. The integrated volatilities of $\widetilde{f}$.
3. The rotated loadings $\widetilde{b}$.
4. The integrated volatility of the idiosyncratic component

Remark 1: first step

- In order to estimate the factors, you apply a PCA. The estimated factors for $\Delta \rightarrow 0$ are

$$\widehat{f}_t = \frac{1}{p} W' r_t^*$$

where W corresponds to the ordered eigenvectors of Σ.

- This estimator is not feasible because r^* and Σ are latent.

- You propose a feasible estimator defined as

$$\widehat{f}_t = \frac{1}{p} \widehat{W}' r_t$$

where $\widehat{W}$ is a matrix of ordered eigenvectors of $\widehat{\Sigma}$ a consistent estimator (Mker for instance) for Σ.

- **Question:** you show that the **speed of convergence** of your estimator exceeds that of MRker. But, you estimator of $\widehat{f}_t$ depends on the MRker?

Finite-sample simulations

1. Two types of Monte-Carlo exercises:
    1. Microstructure noises, but synchronous prices
    2. Microstructure noises and asynchronous prices
2. Comparison with:
    1. The adjusted modulated realized covariance estimator MRC^{δ} of Christensen, Kinnebrock, and Podolskij (2010)
    2. The multidimensional kernel estimator *MRker* of Barndorff-Nielsen et al. (2011)
    3. The composite realized kernel $\widehat{\Sigma}_{comp}$ comp of Lunde, Shephard, and Sheppard (2016).

Finite-sample simulations (cont'd)

Conclusion: in most of the case, the proposed estimator has a lowest (than the competing estimators) Frobenius norm of errors matrices relative to

1. the true integrated covolatility matrix,
2. the integrated correlation matrix,
3. the inverse of the integrated covariance matrix.

Remarks on finite-sample simulations

- In Appendix A.5., you consider a two factors model for the frictionless return $(K = 2)$ in the simulations.
- Maybe, it could be interesting to check the **robusteness** of the results if you **increase** K to 3 or 4 (as in the empirical application), since

$$\left\| \Sigma - \widehat{\Sigma} \right\|_F = O_p \left(pKn^{-1/4} \right)$$

Remarks on finite-sample simulations (cont'd)

1. The number of factors K' considered for the microstructure noise u_{it} is not reported. I guess (?) that $K' = 1$ since you mention that $c_i \sim N(1,1)$
2. You consider three different levels of noise: low, medium and high. But, the noise-to-signal parameter ξ^2, used to control for the level of noise, should be defined in the paper (and not only in Appendix A.5).

Empirical application

- Very convincing exercise: the author use their estimator (and the competing estimators) to built a Minimum Variance (MV) portfolio
- They **estimate** Σ_t and find the **optimal weights** $\omega_{t+1} = \arg\min \omega'_{t+1} \widehat{\Sigma}_t \omega_{t+1}$ under some constraints (short selling or not)
- They compare the portfolios according to their **ex-post variances** $\omega'_{t+1} \widehat{\Sigma}_{t+1} \omega_{t+1}$

Empirical application: suggestion

Maybe it could be interesting to build the optimal porfolios based on a **forecast** $\widehat{\Sigma}_{t+1|t}$ different from the random walk forecast $\widehat{\Sigma}_{t+1|t} = \widehat{\Sigma}_t$

Empirical application: suggestion

- Bauer and Vorkink (JoE 2011) propose a multivariate version of the heterogenous autoregressive (HAR) model (Corsi, 2009). But their model is only feasible for covariance matrices of low dimension
- More recently, Callot et al. (2017) propose a VAR type model for large realized covariance matrices, estimated with a Lasso type approach.

Callot, L., A. Kock and M. Medeiros (2017), Estimation and Forecasting of Large Realized Covariance Matrices and Portfolio Choice. forthcoming in Journal of Applied Econometrics.

Comments on

Alpha-CIR model with branching processes in sovereign interest

Jiao Y., Ma C. and S Scotti (2016)

Summary

The authors introduce a new class of interest rate model, which is a natural extension of the standard CIR model by adding a jump part driven by α-stable Levy processes

Alpha-CIR model

- Very technical paper, relatively hard to read for **non-specialists**.
- But, the authors motivate the **usefulness** of their approach.
- The main takeaway is that the α-CIR model allows to describe the persistency of **low interest rates** together with the **presence of large jumps**

Alpha-CIR model

- One of the main result of the paper is that, with the α-CIR model, the **bond prices decrease** with respect to the parameter α, with those given by the standard CIR model being the lowest prices.
- The parameter α is inversely related to the tail fatness.
- The frequency of large jumps decreases when interest rates are low thanks to the self-exciting structure.

Alpha-CIR model

Question 1: How to validate the α-CIR model in practice?

Question 2: Duffie, Filipovic and Schachermayer (2003) evok three types of application for the affine processes .

- The Term Structure of Interest Rates
- Default Risk
- Option Pricing

What could be the advantages of the α-CIR model in these three topics?