Econometrics of Many Financial Assets

NES Research Project Proposal for 2013-2014

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Outline

Although many multivariate econometric models for financial data are developed and successfully applied to small sets of objects, there are problems with their implementation to even a moderate number of assets. The problem arises from the "curse of dimensionality", the phenomenon that the number of model parameters grows rapidly with a number of objects modeled, thus essentially prohibiting accurate estimation when their number is beyond handful. At the same time, practitioners need to apply such models to numerous sets of, say, stock returns when they balance their typically big portfolios (containing hundreds of assets) or perform other asset allocation or risk management exercises.

This project is geared towards finding out a reasonable compromise between the complexity of a multivariate econometric model for many or very many asset returns and its performance. When a dynamic econometric model is overparameterized, one may look for reasonable interpretable restrictions that can be placed on model parameters so that it remains tractable. Even when these restrictions do not in fact hold, the model may exhibit better predictive ability just because it is smaller and hence its parameters can be more accurately estimated which improves forecasting.

There is some limited literature on many asset modeling. For example, there is a series of papers by Engle and coauthors (e.g., Engle et al., 2008) on multivariate volatility models. They propose certain homogeneity restrictions to ARCH equations across assets, and propose methods to reduce a number of necessary estimations. Another way of reducing the number of coefficients is via ideas borrowed from spatial econometrics (e.g., Caporin & Paruolo, 2012). Here the restrictions are associated with proximity, i.e. division of stocks into sectors and/or sorting them by size. When the object of interest is a dynamic density, some ideas may be sought in the copula literature that offers various choices for parameterization of dependence among the component assets (e.g., Patton, 2012). The literature on copula modeling for many objects is in its infancy; there are limited simulation studies in the IID context that do not correspond to plausible applications (see Embrechts & Hofert, 2013). For example, it would be interesting to look for a golden rule in how a degree of copula parameterization is reflected in forecasting performance. Or, one may wonder how big misspecification in how many marginals is needed for the resulting density to exhibit noticeable distortions. Similar studies may be undertaken for parametric multivariate densities (see, e.g., Balaev, 2011 for examples in the context of stock returns). A related interesting task may be describing jointly movement directions of a big number of assets following the dependence ratios approach as in Anatolyev (2009) or many asset values-at-risk possibly starting from the multivariate CAViaR methodology of White et al. (2008).

Besides modeling of historical densities there is a strong interest in option-implied densities (e.g., Christoffersen et al., 2012). These densities, according to derivative pricing theory, are by construction forward looking which makes them ideal candidates for market-based predictions. Some times option-implied distributions can be even more informative about the future than historical based time series models.

Students with interests in time series econometrics are invited to participate in this project. The research in spirit is empirical modeling using real (in more rare cases, simulated) financial data, but with some twists in econometric methodology or theory. The target is producing high-quality research publishable in international journals.

Research directions

Below are some potential research directions, but the project may not be limited to these.

1. Vast-dimensional parametric density: what to equate in marginals and conditionals?
2. Vast-dimensional copula-based density: what is a good degree of copula parsimony?
3. Vast-dimensional copula-based density: how big misspecification in how many marginals is noticeable?
4. Sensitivity of multivariate density predictions to specification of its components.
5. Proximity based vast-dimensional joint density.
6. Using pseudocopulas instead of copulas: how much is lost?
7. Multivariate ARCH structure implied by news of different specifics.
8. Modeling price movement directions of a large number of assets.
9. Modeling values-at-risk for a large number of assets.

References

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