Consistent Return and Risk Forecasting for Portfolio Optimization using Kernel Regressions

Thorsten Poddig
Lehrstuhl für Finanzmathematik
Universität Bremen

Any portfolio optimization and asset allocation is based on expected asset returns and their associated risk. While portfolio optimization is rather a “technical” task using elaborated optimization algorithms and powerful computers, forming expectations about future asset returns and risks is rather difficult and many researchers provide convincing theoretical arguments and empirical results that this is impossible at all. There is no doubt that financial forecasting – if possible at all – requires advanced techniques. An additional drawback in financial forecasting is the lack of consistency between return and risk forecasts, which are both required for portfolio optimization. This problem is mainly due to different methods applied to derive return and risk forecasts. Aggregation of forecasts coming from different methods cannot assure consistency and leads to degenerated portfolio performance in the future as previous studies show. This well-known phenomenon is known as the problem of information aggregation in asset management. Unfortunately, there are only few techniques available which might provide both, return and risk forecasts, in a consistent manner, like ARCH/GARCH models, kernel regression or some type of neural networks, for instance.

This paper discusses how kernel regression could be used in order to provide consistent return and risk forecasts for portfolio optimization. As a first step, the paper shows how kernel regression can be extended to risk forecasting, namely forecasting the future variance and covariance of asset returns. This can be achieved in two different ways, the explicit and implicit modeling and forecasting of variances and covariances, which are both consistent to the underlying return forecasts. In a second step, artificial data is generated in order to investigate the power of variance and covariance forecasting. It is shown that kernel regressions are suitable for variance and covariance forecasting (beside return forecasting as well) in principle, but that the accuracy of these forecasts decreases considerably in the light of noisy data. Assuming a reasonable level of noise in financial data, implicit and explicit modeling of variances and covariances show the same accuracy, while the later technique is much more difficult. In a third step, results from a long-run simulation covering more than 30 years of financial data from stock, foreign exchange and commodity markets are presented. While kernel regression provides good forecasting results for return and risk on noisy artificial data, the results from empirical data are rather difficult to interpret. Kernel regression does not always provide better results for any asset market and any time windows with respect to much simpler benchmark methods. However, the performance for some asset markets and time windows is impressive and can hardly be explained by chance. Further research is necessary in order to judge about the potential of consistent return and risk forecasting using kernel regressions for portfolio optimization.