

This paper injects factor structure into the estimation of time-varying, large-dimensional covariance matrices of stock returns. Existing rotation-equivariant estimators of large-dimensional time-varying covariance matrices neglect directional information embedded in market-wide risk factors. We introduce a new covariance matrix estimator that combines factor structure with time-varying conditional heteroskedasticity of residuals in large dimensions up to 1000 stocks. The empirical analysis shows that this new estimator works more efficient than many other estimators currently widely used including static models, exogenous factor models, structure-free dynamic models. This new estimator can be used in efficient portfolio selection and anomalies detection in the cross-section of stock returns.