Factor-Adjusted Residual Networks for Portfolio Selection: Evidence from a Multi-Asset Universe

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Abstract

This paper examines whether factor-adjusted residual networks provide incremental information for portfolio selection in a broad multi-asset universe. We propose a centrality-penalized portfolio that constructs a residual-dependence network from the idiosyncratic covariance block of factor-based covariance inputs and incorporates residual-network centrality as a soft penalty on portfolio weights. This framework retains the covariance matrix as the primary risk input and uses residual-network topology to adjust allocations away from assets that are central in the residual-dependence network. Using daily U.S.-dollar returns for 107 assets across major asset classes, we evaluate the proposed penalty under both static and dynamic factor-based covariance inputs. The results show that dynamic covariance inputs materially reduce portfolio risk relative to static inputs. Conditional on a static covariance input, residual-network centrality provides additional risk reductions, especially for degree and eigenvector centralities. Conditional on a dynamic covariance input, however, additional risk reductions from residual-network penalties are small. Centrality-exposure diagnostics show that the penalty reduces allocations to residual-network-central assets, but this allocation tilt does not consistently translate into significant risk reductions. The evidence suggests that residual-network information can complement static covariance inputs, but adds limited value once time-varying covariance dynamics are explicitly modeled.

Keywords: Portfolio selection; Factor models; Network centrality; Dynamic covariance estimation.

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