Risk-Based Portfolios under Parameter Uncertainty

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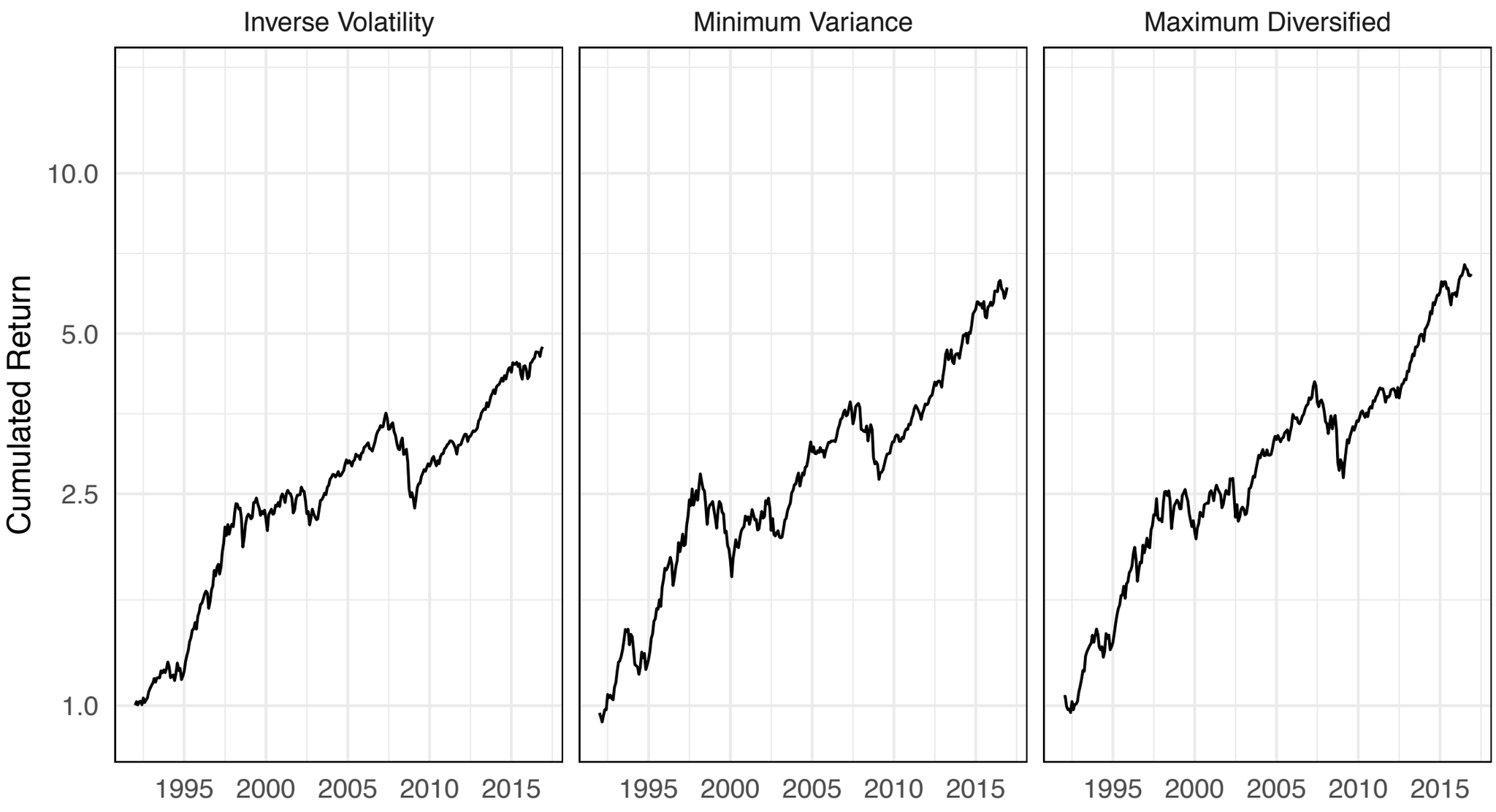
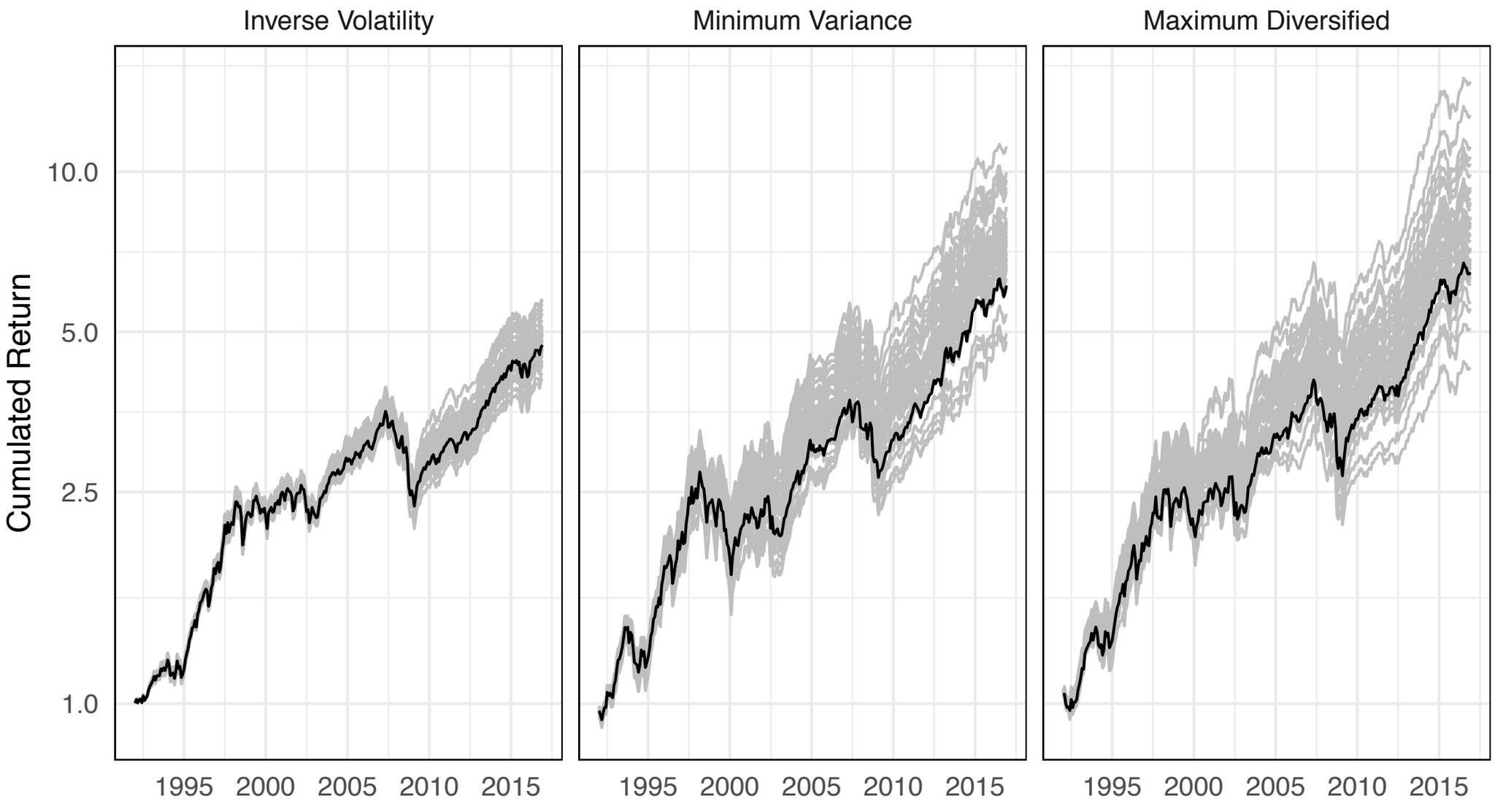
Which risk based portfolio strategy offers best out of sample performance …



Which risk based portfolio strategy offers best out of sample performance … at smallest sensitivity to parameter estimation.



Sensitivity to Calibration

- High dispersion of out-of-sample performance of portfolios calibrated with bootstrapped sample periods indicates elevated sensitivity to parameter estimation.

- Bootstrap does not require distributional assumptions and maintains (nonlinear, higher moment) dependence information.

- Block-bootstrap with monthlong blocks maintains serial dependence.

"Financial variables are intrinsically linked in complicated ways."

Harvey and Liu (2015)

Bootstrap Procedure

Monthlong blocks of returns:

Bootstrap sample:

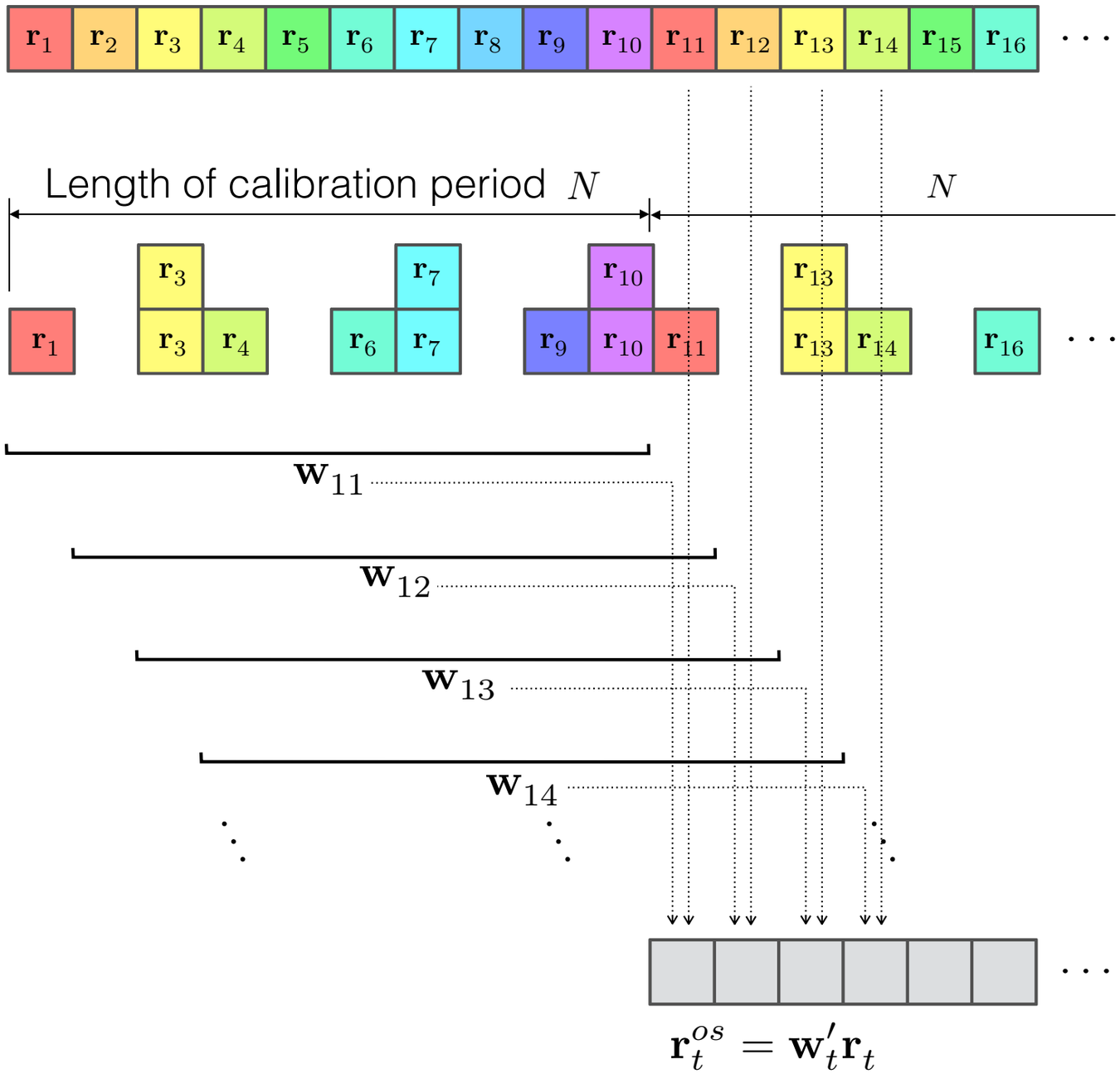
1. Randomly draw N blocks with replacement from $r_1 \dots r_N$
2. Recycle random sequence over entire data set

⇒ overlapping parts of calibration periods remain unchanged.

⇒ Each calibration period contains N observations.

Calibrate portfolios based on overlapping bootstrap samples

Apply out-of-sample **to full return series:**



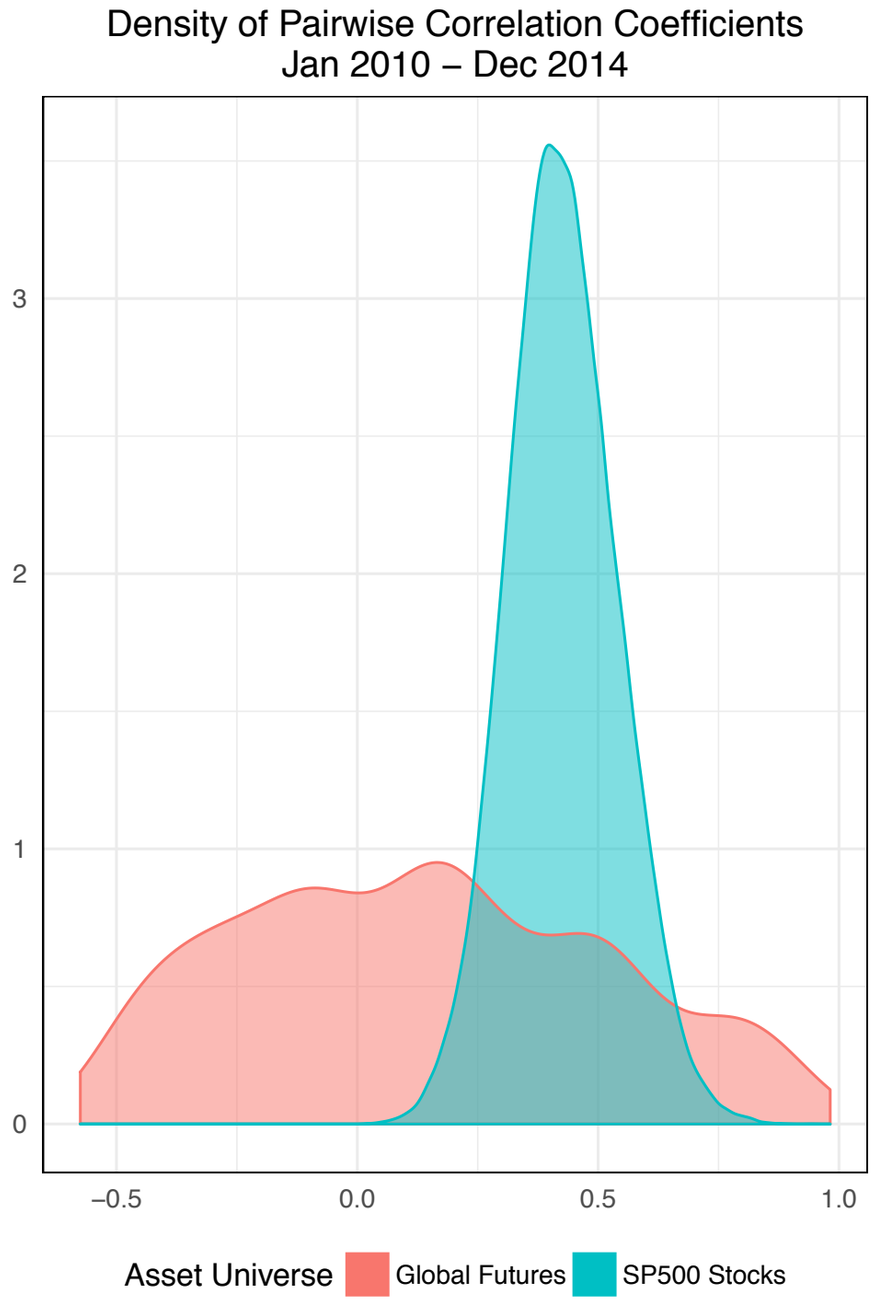
Asset Universe

S&P 500 Stocks

- Historical index members
- Homogeneous correlations
- Daily CRSP data
- 27 years of data 1990 - 2016

Global Futures

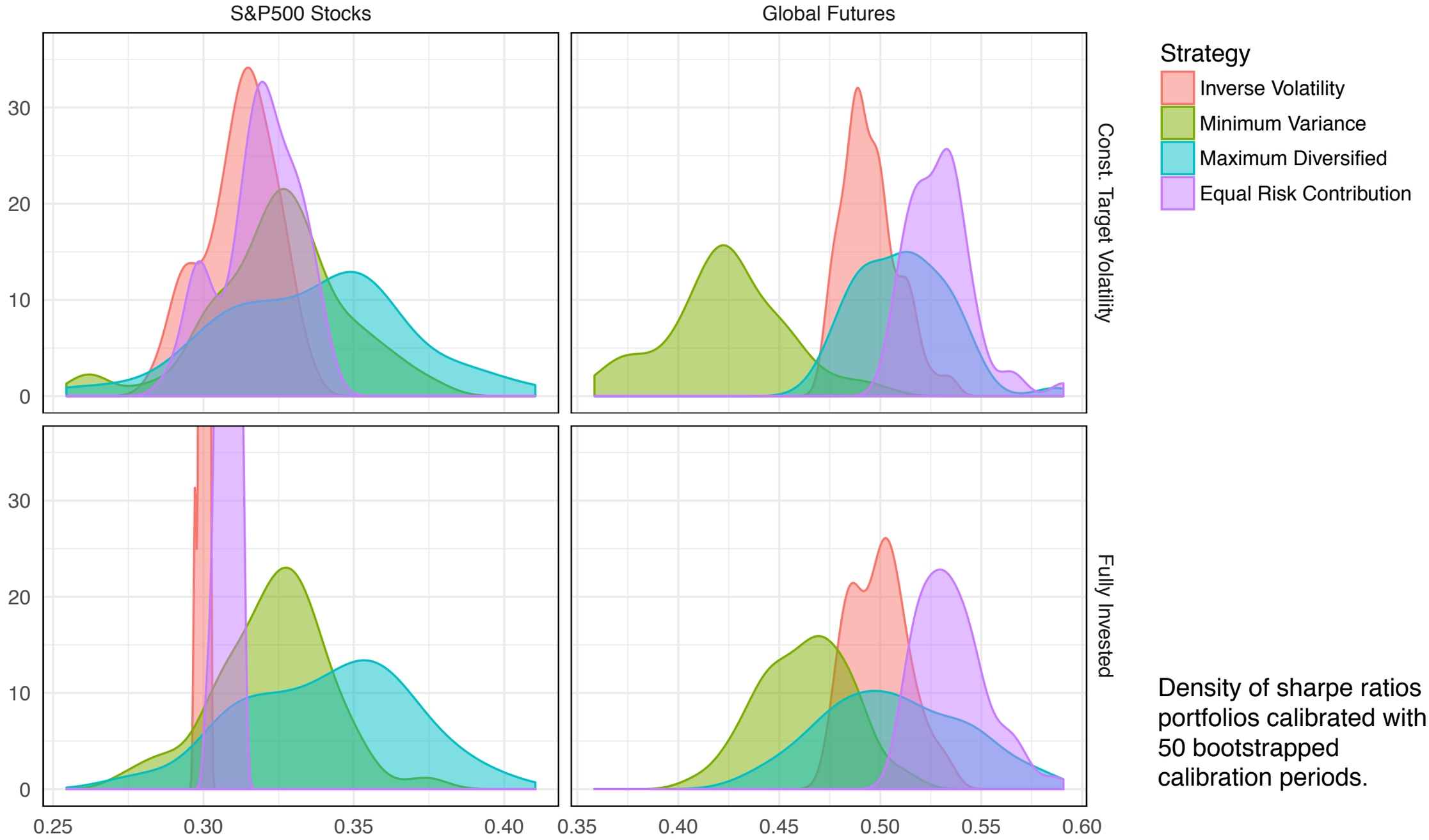
- 42 liquid rate, bond, equity, volatility, commodity futures
- Heterogeneous correlations
- 17 years of data 1999 - 2016
- Intra-day data from tickdata.com for concurrent return observations
- Define rolling dates and account for rolling costs



Cumulated Returns

Solid line represents median performance, shaded area spans from 10% to 90% quantile of performances of 50 portfolios calibrated with bootstrapped samples.

Sharpe Ratio Distribution



Density of sharpe ratios of portfolios calibrated with 50 bootstrapped calibration periods.

Take-Out

- Portfolios differ both in size and dispersion of sharpe ratios.

- Maximum Diversified portfolio reaches highest sharpe ratio in single US stocks / second highest sharpe ratio in global futures over study period.

$$\max_{\mathbf{w} \geq 0} \frac{\mathbf{w}' \sigma_r}{\sqrt{\mathbf{w}' \mathbf{\Sigma} \mathbf{w}}}$$

- It pays out to use a more complex portfolio strategy in terms of number of parameters. This also leads to higher sensitivity to parameter estimation.

- New question: How to mitigate impact of parameter estimation.

Thanks to authors of PortfolioAnalytics and FRAPO packages for great R implementations of portfolio strategies!

Annexes

Portfolio Objectives

- Inverse Volatility [1] : $w_i = \frac{1}{\sigma_r}$

- Minimum Variance [2] : $\min_{w>0} \mathbf{w}'\mathbf{\Sigma}\mathbf{w}$

- Maximum Diversified [3] : $\max_{\mathbf{w}\geq 0} \frac{\mathbf{w}'\sigma_r}{\sqrt{\mathbf{w}'\mathbf{\Sigma}\mathbf{w}}}$

- Equal Risk Contribution [4] : $\mathrm{RC}_j = \mathrm{RC}_i = \frac{1}{2} w_i (\mathbf{\Sigma}\mathbf{w})_i$

References

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