Dynamic portfolio selection with sector-specific regularization

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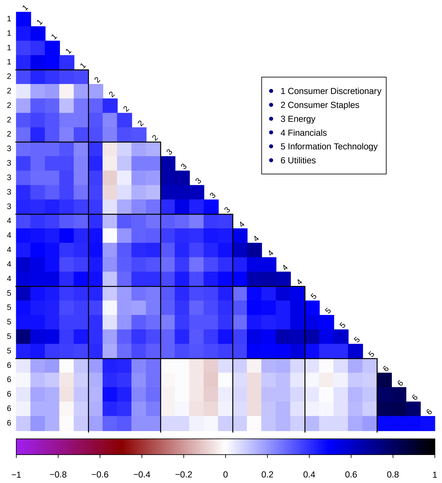
Sector-specific information

Information clustering at the industry level can be exploited in Quantitative Portfolio Management.



- Same sector is exposed to similar market conditions and regulatory environments
- Industry momentum strategies are significant and more profitable (Moskowitz and Grinblat (1999))

Our contribution

Propose a new portfolio selection procedure in a dynamic framework that takes the sector structure into account

- Estimate dynamic covariance matrix using GARCH-DCC with linear shrinkage
- Introduce an algorithm to choose the penalization parameters based on cross-validation in a dynamic context

Investigate how regularization with sector-specific structure improves portfolio out-of-sample performance through empirical study

GMV portfolio with sector-specific structure

In order to take a sector structure into account, the portfolio optimization problem is modified as

$$\min_{w \in \mathbf{R}^N} w' H_t w + P_{\lambda t}(w)$$
$$\text{s.t. } w'\mathbf{1} = 1$$

- Covariance matrix H_t is estimated by GARCH-DCC
- $P_{\lambda t}(w)$ is a penalty function:

$$P_{\lambda t}(w) = \lambda_1 \sum_{k=1}^{K} |m_{kt} - \frac{1}{N}| + \lambda_2 \sum_{k=1}^{K} \sum_{i \in G_k} |w_{it} - m_{kt}|$$

- λ_1 controls between sector penalization (B)
- λ_2 controls within sector penalization (W)

Out-of-sample portfolio volatility

We consider nine portfolios: no-penalization (NP), equal-weighted (EQ), between-sector penalty (B), within-sector penalty (W), sparsity (S), transaction cost control (C), and combinations (BW, SW, CW).

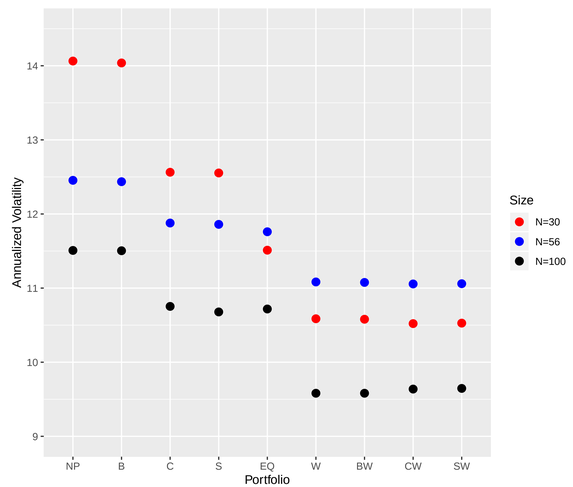


Figure: S&P 500 stock returns (daily data from 2000/01 to 2019/12). Cross-Validation period = 145 months. Out-Of-Sample period = 65 months. We consider N = 30, 56, 100 assets from respectively 6, 8, and 10 different sectors. Re-balancing frequency is monthly.

Performance comparison

	W	B	S	C	BW	SW	CW	NP	$1/N$
Annualized standard deviation									
N=30	10.586	14.038	12.554	12.563	10.580	10.528	**10.521**	14.064	11.514
N=56	11.083	12.436	11.860	11.878	11.077	11.059	**11.056**	12.454	11.760
N=100	9.581	11.504	10.678	10.753	**9.581**	9.647	9.638	11.508	10.718
Sharpe ratio									
N=30	**1.079**	0.438	0.579	0.550	1.077	1.076	1.0779	0.434	0.838
N=56	0.9226	0.3547	0.572	0.561	0.918	0.925	**0.935**	0.360	0.652
N=100	0.801	0.502	0.710	0.713	0.797	0.775	0.778	0.5050	**0.813**

Table: Out-of-sample annualized portfolio standard deviation (in percentage points) and Sharpe ratio

Stabilization of portfolio weights

Figure: Out-of-sample period weight evolution