

FIN 5011 Quantitative Investment Analysis

Final Project

Yu Miaojian, Zhu Jiyuan, Du Meng and Shi Yang

1. Following the nine steps as suggested, we have constructed two portfolios, the minimum variance portfolio and the constrained optimal long-short portfolio. All coding files and prediction results are in the attachment.
2. The performance evaluation results for minimal variance portfolio and enhanced index strategy are as followed:

Measure	Minimal variance portfolio	Enhanced index strategy
Annualized average excess return	0.1470	0.8913
Annualized standard deviations	0.1126	0.3712
Sharpe ratio	1.3053	2.4011
CAPM alpha	0.1098	0.7952
CAPM alpha (t-stat)	8.2855	16.1293
Beta	0.4593	1.1864
Annualized systematic volatility	0.0725	0.1874
Annualized idiosyncratic volatility	0.0860	0.3201
R-squared	0.4151	0.2549
Annualized information ratio	1.2761	2.4841
Max drawdown	0.3447	0.5192
Maximal recovery period	30	16

3. Summary

For minimal variance portfolio, we construct it minimizing the portfolio variance and get the optimal weights. It is a long-only strategy. For enhanced index strategy, it includes two portfolios, the market portfolio and the constrained optimal portfolio. Note that the constrained optimal portfolio is a beta-neutral, size-neutral and long-short portfolio.

The annualized average excess return, annualized standard deviation of excess return and annualized Sharpe ratio of the market is 0.0679, 0.1601 and 0.4244 respectively.

Therefore, we conclude that:

- i. Annualized average excess return: $R_{3,t}^e > R_{1,t}^e > R_{m,t}^e$,
- ii. Annualized standard deviation of excess return: $SD_{3,t} > SD_{m,t} > SD_{1,t}$,
- iii. Sharpe ratio: $SR_3 > SR_1 > SR_m$.

And for the rest of performance measures, the comparisons are as followed:

- i. CAPM alpha: $\alpha_1 < \alpha_3$ and both p values are fairly significant
- ii. Beta: $\beta_1 < \beta_3$
- iii. Annualized systematic volatility: $\sigma_1 < \sigma_3$
- iv. Annualized idiosyncratic volatility: $\sigma'_1 < \sigma'_3$
- v. R-squared: $R_1^2 > R_3^2$
- vi. Annualized information ratio: $IR_1 < IR_3$
- vii. Max drawdown: $Md_1 < Md_3$
- viii. Maximal recovery period: $MRP_1 > MRP_3$

In terms of returns, the enhanced index strategy performs better. However, it bares more risks as its systematic volatility, market beta and maximal drawdown are higher than the minimum variance strategy. It is worth mentioning that the enhanced index strategy has a better risk-return tradeoff because it earns higher return per unit risk concerning Sharpe ratio and Information ratio.

The plots of cumulative wealth series of the two strategies are as followed. More information about the strategies is discussed in the file mv_w.csv and R_3_W.csv. In short, we will invest all the wealth in the enhanced index strategy because of its higher Sharpe ratio and higher return per unit risk. For further improvement, we suggest that:

- a. Stop trading when it is losing money over two months and reevaluate the strategy.
- b. Combine the information of historical weights into the prediction of the next period concerning the reduction of transaction cost.

