Tax Efficient Portfolios

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R at Wealthfront

We love R! Statistical computing 4 years of use at Wealthfront Portfolio analytics, covariance estimation, optimization, ...

PerformanceAnalytics, xts, blotter, fPortfolio, quadprog, quantmod, testthat, ggplot2, lubridate, MASS, plyr, timeDate, timeSeries, ZOO,



...







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Improve After-Tax Return Using Tax-Loss Harvesting





Tax-Loss Harvesting: Example (1/4)

Begin by **buying 100** —— shares of a stock (say WAG) at **\$65** per share in a taxable investment account.



Example data from one stock during this period. Not representative of your results.



Tax-Loss Harvesting: Example (2/4)



Example data from one stock during this period. Not representative of your results.



Tax-Loss Harvesting: Example (3/4)



Example data from one stock during this period. Not representative of your results.

- Replace original stock with similar, but not identical, replacement stock
- Maintain same risk / return portfolio profile

Tax-Loss Harvesting: Example (4/4)





* The tax benefit assumes that you can take advantage of the full credit.



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Stock-level Harvesting: Math (1/2)

Maximize Tax alpha – Tracking error^2 Subject to Long-only portfolio Portfolio weights <= max weight parameter |Portfolio weights – benchmark weights| <= drift parameter Do not trade stocks in wash sale window Exclude zero or more stocks



Stock-level Harvesting: Math (2/2)

hax w
$$a^{T}(w-w0) - (w-b)^{T} 2 (w)$$

i.t. $w^{T} 1 = 1$
 $0 \le w_{i} \le 5\%$ f
 $-1\% \le w_{i} - b_{i} \le 1\%$ f
 $w_{j} - w0_{j} \le 0$ f
 $w_{i} - w0_{i} \ge 0$ f

(-b) $\lambda / 2$ = tax alpha – tracking error ^ 2 weights add up to 1 for each stock i; long only and diversification for each stock i; drift control for each stock j in Us => sell trades for each stock j in Ub => buy trades

Notations

S

- Unknown variable to be solved
 - w : target portfolio weights (Nx1)
- Known information
 - **b** : benchmark portfolio weights (Nx1)
 - w0 : current portfolio weights (Nx1)
 - α : one-sided tax alpha for each stock (Nx1)
 - **Σ** : Covariance matrix (NxN)
 - λ : focus on tracking error

Stock-level Harvesting: R

- Strategy simulation (daily)
 - Asset allocation
 - Covariance matrix estimation
 - Optimization
 - Lot-level execution simulation
 - Portfolio analytics
- Designed for extension
 - Simulate any equity index
 - Flexible stock exclusions
 - Enhance portfolio and risk analytics



Historical: After tax return



After-tax return = S&P500 after-tax return + tracking difference + tax alpha



Next Steps: Scaling R

Scale R simulations in cloud
Millions of simulations per day
Few hour turnaround
Large data sets (many GB)
On-demand capacity

Exchange data with other languages



Thank you

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The chart on page 12 showing potential after tax returns ("Historical: After tax return") from the tax-loss harvesting strategies are historical simulated returns based on backtesting and do not rely on actual trading using client assets. The results are hypothetical only. Several processes, assumptions and data sources were used to create one possible approximations of how Wealthfront's tax-loss harvesting strategy might have benefited investors in the past, and a different methodology may have resulted in different outcomes. These results were achieved by means of the retroactive application of a model designed with the benefit of hindsight. The results of the historical simulations are intended to be used to help explain possible benefits of the tax-loss harvesting strategy and should not be relied upon for predicting future performance.

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