Tax Aware Backtest Framework

Michael Kapler, MMF, CFA

Systematic Investor Blog
thesystematicinvestor@gmail.com
Idea

- Backtest Framework that properly accounts for US tax laws:
  - Long/Short Term Capital Gain Taxes
  - Wash-Sale Rule
  - Qualified and Non-Qualified Dividend Taxes
- Realistic performance metrics for Taxable Account
Challenges

- Work with UNadjusted prices to compute taxes on dividends and taxes on capital gains
- Handle reinvestment of dividends
- Model regular withdrawals to pay taxes
Example: Specify Tax Rules

Capital Gains

  short.term.tax = 35/100
  long.term.tax = 15/100
  long.term.min.holding.period = 365
  wash.sale.min.holding.period = 30

Dividends

  qualified.tax = 15/100,
  qualified.min.holding.period = 60
  nonqualified.tax = 35/100
Example: Specify Tax Cash Flows

Tax Cash Flows

\[
\text{at} = \text{custom.date.bus('1st day in April', prices)}
\]

\[
\text{cashflow.fn} = \text{tax.cashflows}
\]

\[
\text{invest} = 'update'
\]

\[
\text{type} = 'fee.rebate'
\]
Example of Impact of Taxes

Annually rebalanced strategy: Long-term versus Short-term capital gains
# Example of Impact of Taxes

<table>
<thead>
<tr>
<th></th>
<th>BeforeTax</th>
<th>OneYearTax (Short-term)</th>
<th>OneYearOneDay Tax (Long-term)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAGR</strong></td>
<td>8.4%</td>
<td>5.9%</td>
<td>7.3%</td>
</tr>
<tr>
<td><strong>Implied Tax Rate</strong></td>
<td>29.8%</td>
<td>= 1 - 5.9/8.4</td>
<td>= 1 - 7.3/8.4</td>
</tr>
</tbody>
</table>

**Calculation:**

- OneYearTax (Short-term) = 1 - 5.9/8.4
- OneYearOneDay Tax (Long-term) = 1 - 7.3/8.4
The Real Impact is Not that extreme

Monthly allocation across 9 Sector ETFs: equal weight and minimum variance

<table>
<thead>
<tr>
<th></th>
<th>EqWt</th>
<th>EqWt.Tax</th>
<th>MinVar</th>
<th>MinVar.Tax</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAGR</td>
<td>5.8%</td>
<td>5.3%</td>
<td>6.2%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Implied Tax Rate</td>
<td>8.3%</td>
<td></td>
<td>14.5%</td>
<td></td>
</tr>
<tr>
<td>Turnover</td>
<td>28.9%</td>
<td></td>
<td>143.2%</td>
<td></td>
</tr>
</tbody>
</table>
Summary

- First example was artificial; in reality, the difference between before-tax and after-tax performance will not be that huge.
- The Tax Aware Backtest Framework is a tool to evaluate strategy performance in taxable account. It does NOT suggest optimal tax decisions.
- You should specify the tax rates that are applicable to your own personal situation.
Future Work

- Adjust Long-term capital gain holding period for leap years.
- Rcpp Parallel version of the Tax Aware Backtest Framework to suggest optimal tax decisions.
The End

Please visit my blog at systematicinvestor.github.io for more examples and ideas.

Download R Code at systematicinvestor.github.io/rfinance2016