S&P 500 – Stop-Loss Strategies

(Part 5)

By

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Rebalancing Without Stop-Loss

- The book has several adaptive strategies which annually rebalance between the S&P 500 and US Gov. Bonds.
- The stock-weight is the part of the portfolio invested in the S&P 500. It is calculated using the P/Book for the S&P 500 and the bond yield.
- Historically, the strategies had limited losses during 1978-2013.
- But future losses may be greater because the strategies are sometimes fully invested in the S&P 500 if the P/Book is low.
Rebalancing With Stop-Loss

- If losses must be strictly limited then stop-loss orders must be used.
- If S&P 500 drops e.g. (15%) below purchase price then it is sold.
- If S&P 500 increases above the stop-price then it is repurchased.
- The stop-loss strategy also uses annual rebalancing between the S&P 500 and US Government Bonds.
- Stock-weight is calculated using P/Book of S&P 500 and bond yield.
- After each year the portfolio is rebalanced regardless of share-price.
Number of Stop-Price Crossings

The stop-loss strategy sells and repurchases S&P 500 each time the stop-price is crossed, e.g. (15%) below the purchase price.

Histogram counts the number of times the stop-price is crossed within a year.

Stop-Loss Frictional Cost

We may not be able to sell and repurchase exactly at the stop-price.

The frictional cost is modelled as a penalty factor:

\[ \text{Penalty} = (1 - 0.5\%)^{\text{Number of Stop Price Crossings}} = 0.995^{\text{Number of Stop Price Crossings}} \]

Example: If a year has 15 stop-price crossings then the penalty factor is:

\[ \text{Penalty} = 0.995^{15} \approx 0.928 \]

If return was 5% then the penalized return would be a loss of (2.6%):

\[ \text{Penalized Return} = \text{Penalty} \times (1 + \text{Return}) - 1 = 0.928 \times (1 + 5\%) - 1 \approx (2.6\%) \]
Stock Weight – Medium Risk Stop-Loss Strategy

The stock-weight is the part of the portfolio invested in the S&P 500. It is calculated using the P/Book of the S&P 500 and the bond yield. The formula is:

\[
Stock Weight = \text{Limit}(1.93 - 0.44 \times P/Book - 3.14 \times Bond \ Yyield)
\]

Limited between zero and one.
Example: Calculate the Stock Weight

On January 12, 1990 the P/Book was 2.31 and the bond yield was 7.8% so the stock-weight was:

\[
Stock \ Weight = \text{Limit}(1.93 - 0.44 \times P/Book - 3.14 \times \text{Bond Yield}) \\
= \text{Limit}(1.93 - 0.44 \times 2.31 - 3.14 \times 7.8\%) = 0.67
\]

So 67% of the portfolio should be invested in the S&P 500 and the remainder in US Government Bonds with 1-year maturity.
Back-test Medium Risk Stop-Loss strategy for all possible starting dates and investment periods up to 10 years during 1978-2013.

Box-plot shows statistics for the annualized return.

This can also be shown in a table...

<table>
<thead>
<tr>
<th>Years of Investing</th>
<th>Min</th>
<th>1(^{st}) Qrt.</th>
<th>Median</th>
<th>Mean</th>
<th>3(^{rd}) Qrt.</th>
<th>Max</th>
<th>Stdev</th>
<th>Probability of Loss</th>
<th>Probability &lt; Bond-Only</th>
<th>Probability &lt; Stock-Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(15.2%)</td>
<td>4.8%</td>
<td>9.9%</td>
<td>11.8%</td>
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<td>12.6%</td>
<td>0.15</td>
<td>0.23</td>
<td>0.60</td>
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<td>2</td>
<td>(10.2%)</td>
<td>6.0%</td>
<td>10.2%</td>
<td>11.2%</td>
<td>15.6%</td>
<td>41.9%</td>
<td>7.7%</td>
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<td>0.17</td>
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</tr>
<tr>
<td>3</td>
<td>(5.1%)</td>
<td>6.9%</td>
<td>10.8%</td>
<td>11.0%</td>
<td>15.0%</td>
<td>31.8%</td>
<td>6.1%</td>
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<tr>
<td>4</td>
<td>(2.5%)</td>
<td>6.9%</td>
<td>10.5%</td>
<td>10.9%</td>
<td>14.7%</td>
<td>29.5%</td>
<td>5.5%</td>
<td>0.01</td>
<td>0.13</td>
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<td>0.2%</td>
<td>7.0%</td>
<td>10.9%</td>
<td>10.8%</td>
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<tr>
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<td>6.7%</td>
<td>11.0%</td>
<td>10.7%</td>
<td>14.3%</td>
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<td>0.04</td>
<td>0.55</td>
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<tr>
<td>7</td>
<td>1.8%</td>
<td>6.8%</td>
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<td>10.8%</td>
<td>14.1%</td>
<td>24.9%</td>
<td>4.5%</td>
<td>0</td>
<td>0.01</td>
<td>0.57</td>
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<tr>
<td>8</td>
<td>1.3%</td>
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<td>10.3%</td>
<td>10.7%</td>
<td>14.1%</td>
<td>22.1%</td>
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<td>0.01</td>
<td>0.62</td>
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<tr>
<td>9</td>
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<td>7.5%</td>
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<td>10.6%</td>
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<td>0.69</td>
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<td>7.6%</td>
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<td>10.5%</td>
<td>13.6%</td>
<td>20.1%</td>
<td>3.8%</td>
<td>0</td>
<td>0.02</td>
<td>0.72</td>
</tr>
</tbody>
</table>

**Example:** Investing for 2 years had mean annualized return 11.2\%, min (10.2\%), max 41.9\%, stdev 7.7\%. Investing for 10 years had mean 10.5\%, min 2.2\%, max 20.1\%.
In this 35 year period the Medium Risk Stop-Loss strategy performed about as well as the S&P 500 but avoided the peaks and crashes around year 2000 and 2008.

But what about shorter investment periods?
Example: Rebalancing is BETTER Than S&P 500

Example of the Medium Risk Stop-Loss strategy performing better than both the S&P 500 and US Gov. Bonds.

Investment period is 10 years. Starting date is March 3, 2000.
Example: Rebalancing is WORSE Than S&P 500


Investment period is 10 years. Starting date is August 23, 1990.
## Probability of Under-Performance

<table>
<thead>
<tr>
<th>Years of Investing</th>
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<th>Probability &lt; Bond-Only</th>
<th>Probability &lt; Stock-Only</th>
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<tr>
<td>1</td>
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</table>

- These are historical probabilities (frequencies) for 1978-2013.
- Probability of loss decreases with longer investment duration.
- Probability of under-performing S&P 500 is high at 0.55-0.72.
Conclusion

• Stop-loss can be used to increase the average return while limiting losses.
• But stop-price may be crossed many times during a year and frictional costs may be high.
• So it is very important to trade close to the stop-price if strategies are to work.

The book gives more details and also studies other strategies.