Multi-Factor Design
Part 2: Keep a Handle on Trading Costs
Webinar Series Outline

1. What Matters in Multi-Factor Investing?
   - Business case for multi-factor investing – academic framework
   - Critical review of evidence for popular factors

2. Ignored Risks of Factor Investing


4. Multifactor Design, Part 2 – Keep a Handle on Trading Costs

5. Issues in ESG Integration
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Multi-Factor Design
Part 2: Keep a Handle on Trading Costs
Traditional Passive Index Funds Have Many Compelling Features

» In the beginning, index funds were derided as “un-American,” but in time investors came to appreciate these features

» Funds that track cap-weighted indices benefit from:
  – High liquidity and capacity *
  – Broad market participation *
  – Low turnover and trading costs *
  – Transparent portfolios
  – Low fees
  – A track record of beating active managers most of the time

* Not so fast... as we will see!
We Can Quantify the Cost of Buy High, Sell Low

- Additions outperform the market and discretionary deletions lag the market between announcement date and effective date.
- This performance starts reversing about a week after the effective date.

Deletions beat additions by over 20% in the year after an index change.

Hidden costs of buy high, sell low are about $19B per year as of 2016.

Source: Research Affiliates, LLC, using Siblis Research and CRSP.
What Are Trading Costs?

» Explicit trading costs – how much strategy lags the index
  – Easy to observe
  – Usually insignificant for skilled implementers

» Implicit trading costs – trading costs imbedded in the index performance due to impact on stock price from index-related trades
  – Not directly observable
  – Usually quite significant while hidden in the index performance
  – Grows with the amount of assets tracking the index
Poor Index Design Can Lead to High Costs

Trading Costs – Developed Markets

Estimated Cost of Trading

RAFI  Equal Weight  RAFI Low Vol Factor  Min Vol  Low Vol  High Dividend  Dividend Growth  Quality  Growth/ Stability  Momentum  Sharpe Momentum  RAFI Dynamic Multi

1 bps  26 bps  8 bps  41 bps  167 bps  66 bps  274 bps  16 bps  37 bps  143 bps  116 bps  14 bps


Source: Research Affiliates, LLC, using data from CRSP/Compustat and Datascope/Worldstream as of 9/30/2018. Annualized trading costs are estimated as the market impact of transactions, assuming $10B in AUM. For descriptions of the strategies shown, please see https://interactive.researchaffiliates.com/smart-beta.html. Strategy returns and characteristics are simulated. Please see important information at the end of this presentation regarding simulated data.
What Should Investors Pay Attention To?

» Assumptions

» Trading costs arise from temporary price impact created from buying/selling securities

» Price impact is proportional to percentage of ADV bought/sold

» Volume on rebalance days are assumed to be equal to ADV

» Maximum impact per trade is capped at 2%

Source: Research Affiliates, LLC. Measured for 25,000 trades for all geographies from the period 2010–2013 using the FTSE RAFTM Index Series. Average Impact Reversal vs. Trade Size is measured for the three trading days following index reconstitution.
Alternative Sanity Check

Characteristics That Affect Trading Costs – Developed Markets

**Average Annual Turnover (1969 - 2017)**
- RAFI: 70.2%
- Low Volatility: 24.1%
- High Dividend: 12.8%
- Quality: 21.1%
- Standard Momentum: 50.5%
- RAFI Dyn. Multi-Factor: 146.2%

**Weighted Avg. Market Cap (9/30/2018)**
- RAFI: $125B
- Low Volatility: $36B
- High Dividend: $37B
- Quality: $239B
- Standard Momentum: $245B
- RAFI Dyn. Multi-Factor: $91B

**Number of Holdings (9/30/2018)**
- RAFI: 1,697
- Low Volatility: 199
- High Dividend: 100
- Quality: 450
- Standard Momentum: 676
- RAFI Dyn. Multi-Factor: 2,656

Source: Research Affiliates, LLC, based on data from CRSP/Compustat. For descriptions of the strategies shown, please see [https://interactive.researchaffiliates.com/smart-beta.html](https://interactive.researchaffiliates.com/smart-beta.html). Strategy returns and characteristics are simulated. Please see important information at the end of this presentation regarding simulated data.
Thoughtful Implementation
## Differences of Weighting Schemes

### Performance of Factor Strategies – Developed Markets

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Weighting Methodology</th>
<th>Value Added</th>
<th>Trading Cost</th>
<th>Turnover</th>
<th>Tracking Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>Fundamental</td>
<td>2.68%</td>
<td>0.29%</td>
<td>32%</td>
<td>6.83%</td>
</tr>
<tr>
<td></td>
<td>Equal Weight</td>
<td>2.35%</td>
<td>0.57%</td>
<td>37%</td>
<td>6.14%</td>
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<td>Equal Risk</td>
<td>2.40%</td>
<td>0.52%</td>
<td>35%</td>
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<td></td>
<td>Max Decorrelation</td>
<td>2.54%</td>
<td>0.71%</td>
<td>41%</td>
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<tr>
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<tr>
<td>Quality</td>
<td>Fundamental</td>
<td>2.27%</td>
<td>0.75%</td>
<td>47%</td>
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<td>Equal Weight</td>
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<td>1.19%</td>
<td>55%</td>
<td>4.31%</td>
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<tr>
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<td>Equal Risk</td>
<td>2.28%</td>
<td>1.20%</td>
<td>53%</td>
<td>4.95%</td>
</tr>
<tr>
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<td>1.41%</td>
<td>57%</td>
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<td>0.70%</td>
<td>46%</td>
<td>3.88%</td>
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<tr>
<td>Low Volatility</td>
<td>Fundamental</td>
<td>1.68%</td>
<td>0.75%</td>
<td>42%</td>
<td>7.86%</td>
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<td>1.24%</td>
<td>47%</td>
<td>7.60%</td>
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<tr>
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<td>Equal Risk</td>
<td>2.58%</td>
<td>1.11%</td>
<td>43%</td>
<td>8.27%</td>
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<td>52%</td>
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<td>42%</td>
<td>6.80%</td>
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<td>Momentum</td>
<td>Fundamental</td>
<td>1.68%</td>
<td>4.91%</td>
<td>189%</td>
<td>7.02%</td>
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<td></td>
<td>Equal Weight</td>
<td>1.93%</td>
<td>5.28%</td>
<td>173%</td>
<td>8.77%</td>
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<td>Equal Risk</td>
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<td>5.77%</td>
<td>182%</td>
<td>7.61%</td>
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<td>Max Decorrelation</td>
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<td>6.19%</td>
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<td>160%</td>
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<td>Size</td>
<td>Fundamental</td>
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<td>0.28%</td>
<td>29%</td>
<td>4.56%</td>
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<td>0.26%</td>
<td>27%</td>
<td>5.15%</td>
</tr>
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<td>0.39%</td>
<td>35%</td>
<td>4.85%</td>
</tr>
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<td>Market Cap</td>
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<td>0.19%</td>
<td>23%</td>
<td>3.75%</td>
</tr>
<tr>
<td>5-Factor</td>
<td>Fundamental</td>
<td>2.52%</td>
<td>0.18%</td>
<td>54%</td>
<td>5.01%</td>
</tr>
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<td>Equal Weight</td>
<td>1.82%</td>
<td>0.25%</td>
<td>50%</td>
<td>4.17%</td>
</tr>
<tr>
<td></td>
<td>Equal Risk</td>
<td>1.98%</td>
<td>0.24%</td>
<td>49%</td>
<td>4.93%</td>
</tr>
<tr>
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<td>Max Decorrelation</td>
<td>1.96%</td>
<td>0.31%</td>
<td>56%</td>
<td>4.44%</td>
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<tr>
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<td>Market Cap</td>
<td>1.25%</td>
<td>0.14%</td>
<td>49%</td>
<td>2.49%</td>
</tr>
</tbody>
</table>

Source: Research Affiliates, LLC, using data from CRSP/Compustat and Datascope/Worldstream from 4/1985-11/2018. Strategies shown are long-only strategies for developed market region. Strategies are created using the most common academic definition (e.g. price-to-book is used to create the value factor). Value added is shown prior to trading costs. The data published herein are simulated. Please see important information at the end of this presentation regarding simulated data.
**Thoughtful Design to Control Transaction Costs**

**Example: Value Factor Index**

**Turnover Control**

1. Rank existing portfolio by value signal (RAFI/Cap).
2. Replace bottom 10% of portfolio with new constituents.

**Momentum Filtering**

1. With new names added, rank Value Factor Index by momentum.
2. Do not sell high-momentum stocks while they’re soaring.
3. Do not buy low-momentum stocks while they’re in free fall.
4. Rebalance the middle 50% back to fundamental weights.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Without Turnover Control &amp; Momentum Trade Filtering</th>
<th>With Turnover Control</th>
<th>With Turnover Control &amp; Momentum Trade Filtering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual One-Way Turnover</td>
<td>36.9%</td>
<td>26.0%</td>
<td>20.0%</td>
</tr>
<tr>
<td>Estimated Transaction Costs</td>
<td>19bps</td>
<td>11bps</td>
<td>9bps</td>
</tr>
</tbody>
</table>

Source: Research Affiliates, LLC, using data from Worldscope, and Datastream. Turnover and transaction costs are estimated for the period 5/1987– 9/2016 for RAFI Value Factor US Index. Estimated transaction costs assume $5B in AUM. The index data published herein are simulated. Please see important information at the end of this presentation regarding simulated data.
Is Your Strategy Rebalancing Too Often?

Frequent rebalancing increases costs without improving returns or lowering volatility!

Source: Research Affiliates, LLC, based on data from CRSP/CompuStat. Return and Volatility figures are annualized. Turnover figures are one-way. Strategy shown is simulated using FTSE RAFI methodology. Please see important information at the end of this presentation regarding simulated data.
The Balancing Act of Staggered Rebalancing

» Annual rebalancing often leads to larger trade sizes vs. more frequent rebalancing — increasing costs!

» Instead, the strategy can be separated into four tranches where:
  – Fundamental weights are recalculated annually, but implemented quarterly
  – Sub-index weights are rebalanced to new weights once a year
  – Entry point risk is decreased versus single, annual rebalance
  – Costs decrease and capacity increases

Quarterly Staggered Rebalance (QSR) Portfolio

RAFI Index Strategy

Tranche 1
25% of Index
Rebalanced in March

Tranche 2
25% of Index
Rebalanced in June

Tranche 3
25% of Index
Rebalanced in September

Tranche 4
25% of Index
Rebalanced in December

For illustrative purposes only.
The Trade-Off in Multi-Factor
Theoretical Factor Returns Are Robust

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Absolute Performance</th>
<th>Relative Performance</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Return</td>
<td>Volatility</td>
</tr>
<tr>
<td>Market</td>
<td>11.01%</td>
<td>15.5%</td>
</tr>
<tr>
<td>Value</td>
<td>13.50%</td>
<td>18.5%</td>
</tr>
<tr>
<td>Low Beta</td>
<td>13.23%</td>
<td>12.3%</td>
</tr>
<tr>
<td>Profitability</td>
<td>11.29%</td>
<td>14.9%</td>
</tr>
<tr>
<td>Investment</td>
<td>13.56%</td>
<td>15.3%</td>
</tr>
<tr>
<td>Momentum</td>
<td>12.65%</td>
<td>17.2%</td>
</tr>
</tbody>
</table>

# Trading Costs Are Material

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Number of Stocks</th>
<th>WAMC ($B)</th>
<th>Turnover</th>
<th>Trading Cost (at $1B)</th>
<th>Trading Cost (at $5B)</th>
<th>Trading Cost (at $10B)</th>
<th>Capacity ($B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
<td>3,154</td>
<td>148.7</td>
<td>4.6%</td>
<td>0.00%</td>
<td>0.01%</td>
<td>0.02%</td>
<td>248.6</td>
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<tr>
<td>Value</td>
<td>154</td>
<td>136.4</td>
<td>46.0%</td>
<td>0.06%</td>
<td>0.30%</td>
<td>0.60%</td>
<td>8.0</td>
</tr>
<tr>
<td>Low Beta</td>
<td>277</td>
<td>37.9</td>
<td>57.8%</td>
<td>0.18%</td>
<td>0.89%</td>
<td>1.78%</td>
<td>3.0</td>
</tr>
<tr>
<td>Profitability</td>
<td>320</td>
<td>189.2</td>
<td>16.7%</td>
<td>0.02%</td>
<td>0.10%</td>
<td>0.20%</td>
<td>24.4</td>
</tr>
<tr>
<td>Investment</td>
<td>201</td>
<td>89.4</td>
<td>67.3%</td>
<td>0.13%</td>
<td>0.66%</td>
<td>1.32%</td>
<td>3.7</td>
</tr>
<tr>
<td>Momentum</td>
<td>258</td>
<td>112.4</td>
<td>160.4%</td>
<td><strong>0.28%</strong></td>
<td><strong>1.38%</strong></td>
<td><strong>2.77%</strong></td>
<td>1.9</td>
</tr>
</tbody>
</table>

The Consequences of Cherry-Picking Factors

The benefits of harder-to-implement factors can be captured by combining them with easier-to-implement ones.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Return</th>
<th>Vol</th>
<th>Sharpe Ratio</th>
<th>After-Cost Sharpe Ratio</th>
<th>Value-Add</th>
<th>TE</th>
<th>IR</th>
<th>After-Cost IR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>(at $1B)</td>
<td>(at $5B)</td>
<td>(at $10B)</td>
<td></td>
<td></td>
<td>(at $1B)</td>
</tr>
<tr>
<td>Market</td>
<td>11.01%</td>
<td>15.5%</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>4 Factors</td>
<td>13.10%</td>
<td>14.3%</td>
<td>0.58</td>
<td>0.58</td>
<td>0.57</td>
<td>5.6</td>
<td>0.49</td>
<td>0.48</td>
</tr>
<tr>
<td>4 Factors + Mom</td>
<td>13.09%</td>
<td>14.6%</td>
<td>0.57</td>
<td>0.57</td>
<td>0.56</td>
<td>5.6</td>
<td>0.49</td>
<td>0.48</td>
</tr>
</tbody>
</table>

Conclusion and Further Reading

» Poor index design can lead to high trading costs for investors

» Thoughtful implementation can mitigate costs
  – Using weighting schemes that promote liquidity
  – Employing turnover control mechanisms
  – Staggering rebalancing

» A well-constructed multi-factor approach can help investors capture the benefits of harder-to-implement factors without the associated costs
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