Independent Study Project

A Market-Neutral Strategy

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Agenda

• Annual Returns
• Fund Strategy
• Data Collection
• Factor Analysis
• Risk Optimization
• Analysis of Results
• Further Study
Annual Returns, 1979-2001

- In-sample annual return (1979-1995): 28.6% vs. 11.5% for S&P 500
- Out-of-sample annual return (1996-2001): 27.2% vs. 10.1% for S&P 500
Fund Strategy

• Develop a quantitative, market-neutral strategy

• Limit analysis to fundamental factors

• Demonstrate strategy robustness in different market environments

• Focus on the S&P 500 due to liquidity, low transaction costs

• Develop risk-optimization techniques to enhance returns

• Explore other potential enhancements to the base strategy
Data Collection

• Select appropriate data set
  – Identify sample period transcending different market environments (1979-1995)
  – Leave large out-of-sample period (1996-2001) to test if strategy is robust
  – Focus on quarterly rather than monthly intervals to minimize transaction costs
  – Obtain fundamental data for each stock in the S&P 500

• Limitation: access to data
  – No access to expectational data (i.e. no First Call EPS estimates)
  – All fundamental factors are on a trailing basis
  – EPS, NOPAT annualized each quarter
  – Companies with negative book value or net income excluded
Factor Analysis

• Identify key factors at the outset
  – Important not to mine hundreds of factors for best result; use intuition
  – Pre-specified factors: EPS, P/B, P/S, ROE, ROIC, D/V, Market Cap

• Create three fractile portfolios for each factor
  – Perform sort each quarter based on each factor
  – Group stocks into top, middle, bottom portfolios
  – Track performance of each fractile for coming quarter
  – Rebalance each quarter

• Evaluate each pre-specified factor both in, out-of-sample
  – For each portfolio, perform diagnostics for all three fractiles
  – Select top three factors based on returns, risk
Risk Optimization

- Risk optimization performed under supervision of Professor Campbell R. Harvey
- Scoring system established for individual security selection
- Additional information available upon request
Analysis of Results: In-Sample

• In-sample results: 1979-1995
  – 28.6% compounded annual return, 11.5% for S&P 500
  – Returns exceeded 20% in 11 of 17 years
  – 6.0% quarterly standard deviation of returns, 7.0% for S&P 500
  – 0.04 quarterly beta, implying negligible systematic risk
  – Outperformed S&P 500 16 of 17 years, 45 of 68 quarters
  – Outperformed 53% of time during up quarters for S&P 500
  – Outperformed 100% of time during down quarters for S&P 500
  – Largest margin over S&P 500: 61.3% (1981)

• In-sample analysis: Overwhelming results
  – Positive absolute returns every year
  – Excellent performance in bull, bear markets
  – Margin, consistency, duration of outperformance all encouraging
Analysis of Results: Out-of-Sample

• Out-of-sample results: 1996-2001
  – 27.2% compounded annual return, 10.1% for S&P 500
  – Returns exceeded 20% in 4 of 6 years
  – 10.3% quarterly standard deviation of returns, 7.6% for S&P 500
  – -0.41 quarterly beta, implying negative correlation with market
  – Outperformed S&P 500 4 of 6 years, 12 of 24 quarters
  – Outperformed 21% of time during up quarters for S&P 500
  – Outperformed 90% of time during down quarters for S&P 500
  – Largest margin over S&P 500: 96.1% (2001)

• Out-of-sample analysis: Robust results despite challenging environment
  – Positive absolute returns in all but one year (1999)
  – Significant outperformance despite changing market environment
  – Higher standard deviation due to magnitude of returns in 2000, 2001
  – 1999: bubble period, fundamentals irrelevant, explains negative return
  – 2000, 2001: return to fundamentals, strategy significantly outperformed
## Analysis of Results: Diagnostics

<table>
<thead>
<tr>
<th>Market:</th>
<th>United States, S&amp;P 500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen name:</td>
<td>Score</td>
</tr>
<tr>
<td>In-sample period:</td>
<td>1979-1995</td>
</tr>
<tr>
<td>Number of observations:</td>
<td>24,587 In-sample/11,241 Out-of-sample</td>
</tr>
</tbody>
</table>

### Performance Measures

<table>
<thead>
<tr>
<th>Summary Statistic</th>
<th>Portfolios - In-sample</th>
<th>Portfolios - Out-of-Sample</th>
<th>Market Portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quarterly arithmetic average return (USD)</td>
<td>6.9% 6.7% 0.3%</td>
<td>6.3% 6.7% -0.4%</td>
<td>3.00% 2.69%</td>
</tr>
<tr>
<td>Quarterly geometric average return (USD)</td>
<td>6.5% 6.5% -0.2%</td>
<td>5.9% 6.2% -0.9%</td>
<td>2.76% 2.42%</td>
</tr>
<tr>
<td>Annualized geometric average return (USD)</td>
<td>28.7% 28.6% -1.0%</td>
<td>25.9% 27.2% -3.7%</td>
<td>11.5% 10.1%</td>
</tr>
<tr>
<td>Cumulative return (indexed at 100 to start)</td>
<td>7155% 7070% -15%</td>
<td>298% 323% -20%</td>
<td>636% 78%</td>
</tr>
<tr>
<td>Standard deviation of quarterly returns</td>
<td>9.4% 6.0% 10.0%</td>
<td>8.9% 10.2% 10.5%</td>
<td>6.99% 7.58%</td>
</tr>
<tr>
<td>Average annual excess return Rm</td>
<td>17.2% 17.1% -12.5%</td>
<td>15.8% 17.1% -13.7%</td>
<td>- -</td>
</tr>
<tr>
<td>STD deviation of excess return Rm</td>
<td>2.4% -0.9% 3.0%</td>
<td>1.4% 2.7% 2.9%</td>
<td>- -</td>
</tr>
<tr>
<td>Systematic risk</td>
<td>1.25 0.04 1.21</td>
<td>0.72 (0.41) 1.13</td>
<td>- -</td>
</tr>
<tr>
<td>Alpha</td>
<td>0.03 0.07 (0.03)</td>
<td>0.04 0.08 (0.03)</td>
<td>- -</td>
</tr>
<tr>
<td>Coefficient of determination</td>
<td>85.3% -1.3% 70.5%</td>
<td>33.9% 5.2% 64.6%</td>
<td>- -</td>
</tr>
<tr>
<td>Average market cap</td>
<td>na na na</td>
<td>na na na</td>
<td>na na</td>
</tr>
<tr>
<td>% periods &gt; benchmark</td>
<td>88.2% 66.2% 30.9%</td>
<td>75.0% 50.0% 25.0%</td>
<td>- -</td>
</tr>
<tr>
<td>% periods &gt; benchmark, up market</td>
<td>93.9% 53.1% 38.8%</td>
<td>64.3% 21.4% 28.6%</td>
<td>- -</td>
</tr>
<tr>
<td>% periods &gt; benchmark, down market</td>
<td>73.7% 100.0% 10.5%</td>
<td>90.0% 90.0% 20.0%</td>
<td>- -</td>
</tr>
<tr>
<td>Max # of consec benchmark outperformance</td>
<td>16 8 3</td>
<td>8 7 2</td>
<td>- -</td>
</tr>
<tr>
<td>Maximum negative excess return</td>
<td>-5.3% -18.2% -15.5%</td>
<td>-9.7% -19.6% -15.6%</td>
<td>- -</td>
</tr>
<tr>
<td>Maximum positive excess return</td>
<td>12.9% 23.9% 13.7%</td>
<td>19.2% 39.6% 8.6%</td>
<td>- -</td>
</tr>
<tr>
<td>% periods positive absolute returns</td>
<td>82.4% 89.7% 52.9%</td>
<td>66.7% 70.8% 45.8%</td>
<td>- -</td>
</tr>
<tr>
<td>% periods of negative absolute returns</td>
<td>17.6% 10.3% 47.1%</td>
<td>33.3% 29.2% 54.2%</td>
<td>- -</td>
</tr>
<tr>
<td>Max # of consecutive positive periods</td>
<td>13 16 4</td>
<td>7 9 3</td>
<td>- -</td>
</tr>
<tr>
<td>Max # of consecutive negative periods</td>
<td>2 1 5</td>
<td>3 5 7</td>
<td>- -</td>
</tr>
</tbody>
</table>

Note: Diagnostics for Short portfolio assume you are long the securities in the Short portfolio.
Further Study

• Incorporate expectational data
  – Inherent limitations to relying on past accounting data

• Use other indicators to enhance strategy
  – Incorporate macro factors to determine when to employ leverage
  – Use technical factors in conjunction with fundamental factors

• Apply strategy to different markets, market segments
  – Test strategy in less liquid (and presumably less efficient) markets
  – Examine results within different market sectors

• Develop security weighting system
  – Examine value-weighted returns
  – Explore additional risk optimization techniques