

# Benchmark Discrepancies and Mutual Fund Performance Evaluation

## Internet Appendix

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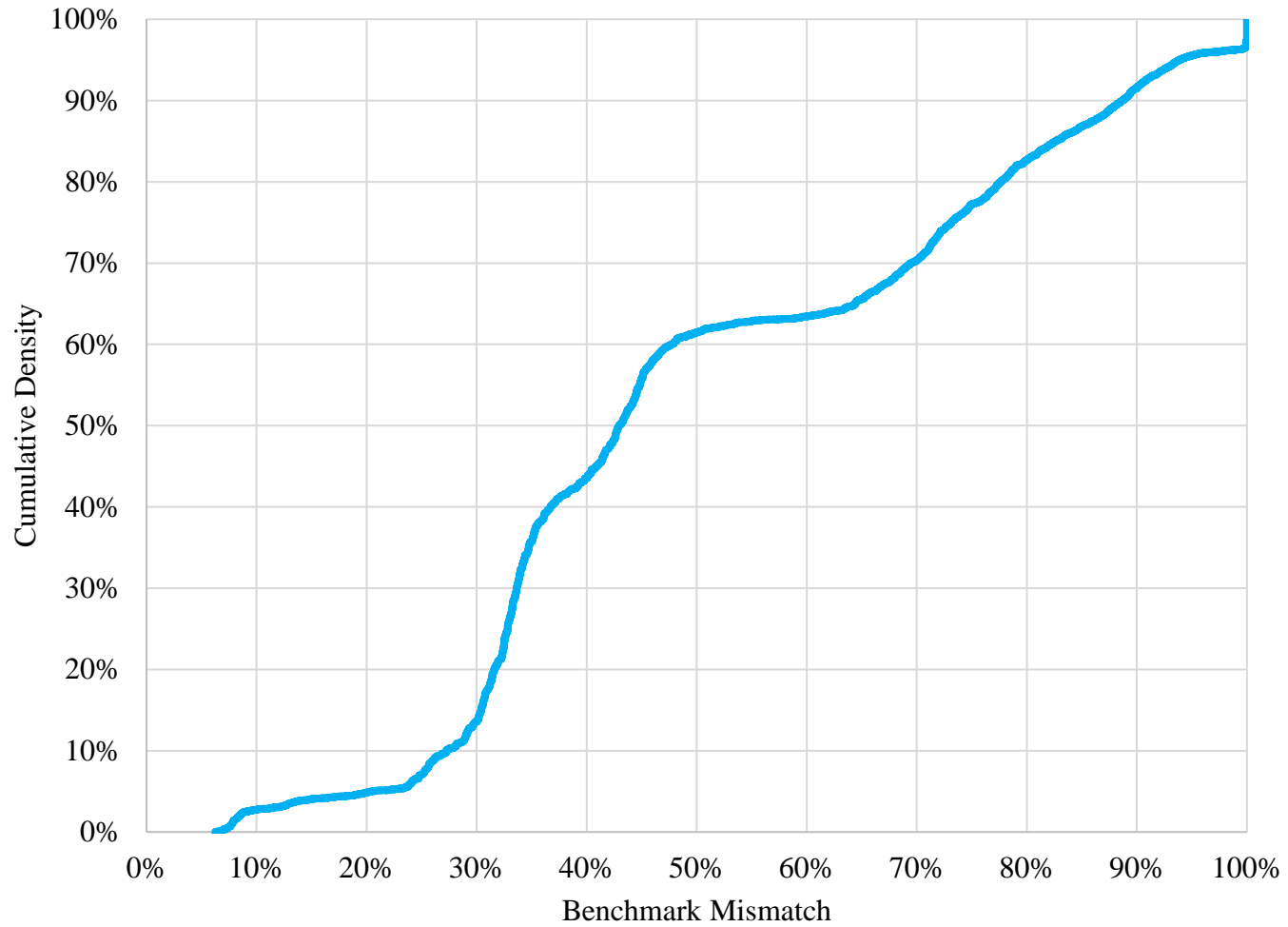
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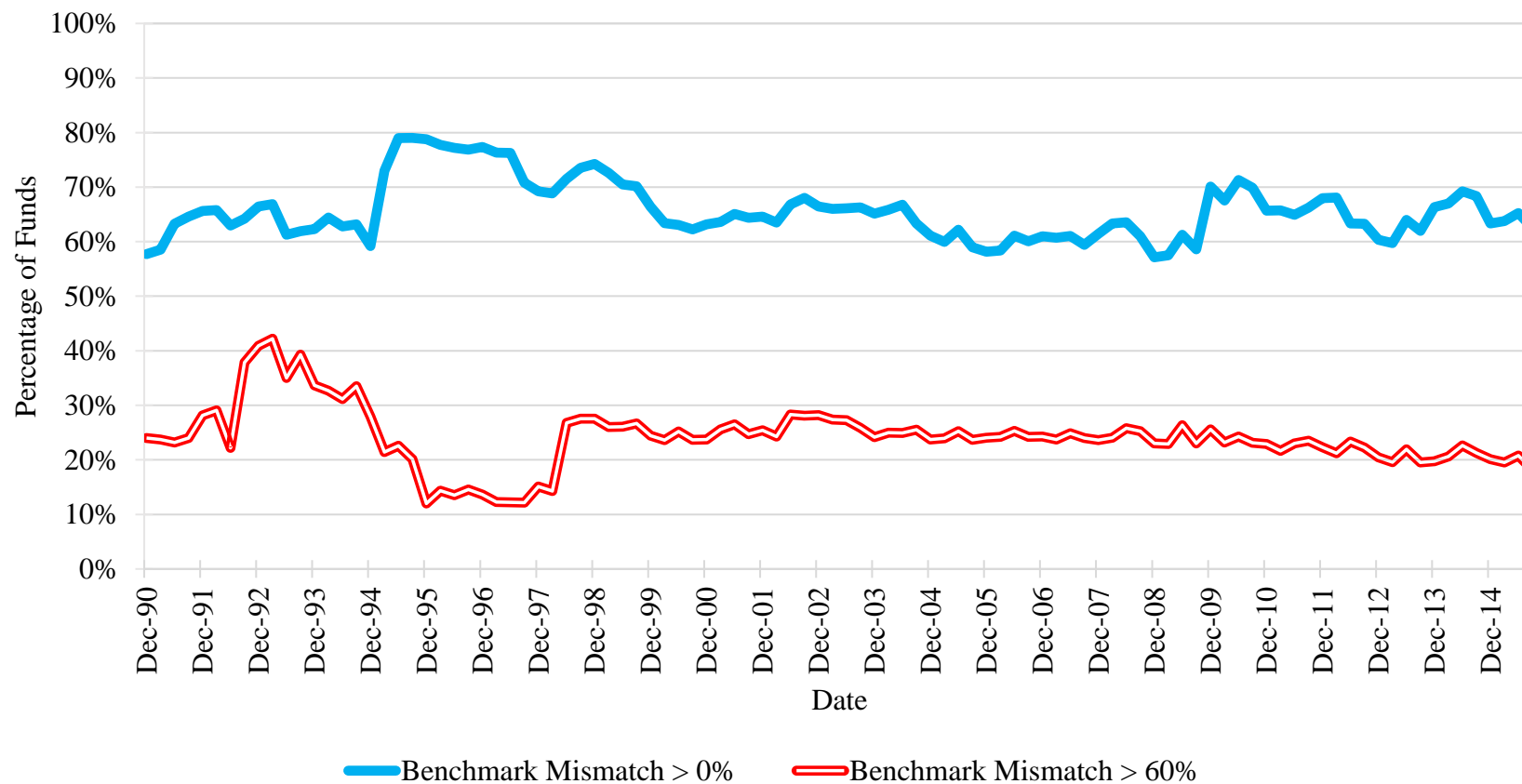
**Figure A.1: Distribution of *Benchmark Mismatch***

This figure shows a cumulative density function (CDF) of *Benchmark Mismatch* for all fund-month observations where the prospectus benchmark does not match the AS benchmark.



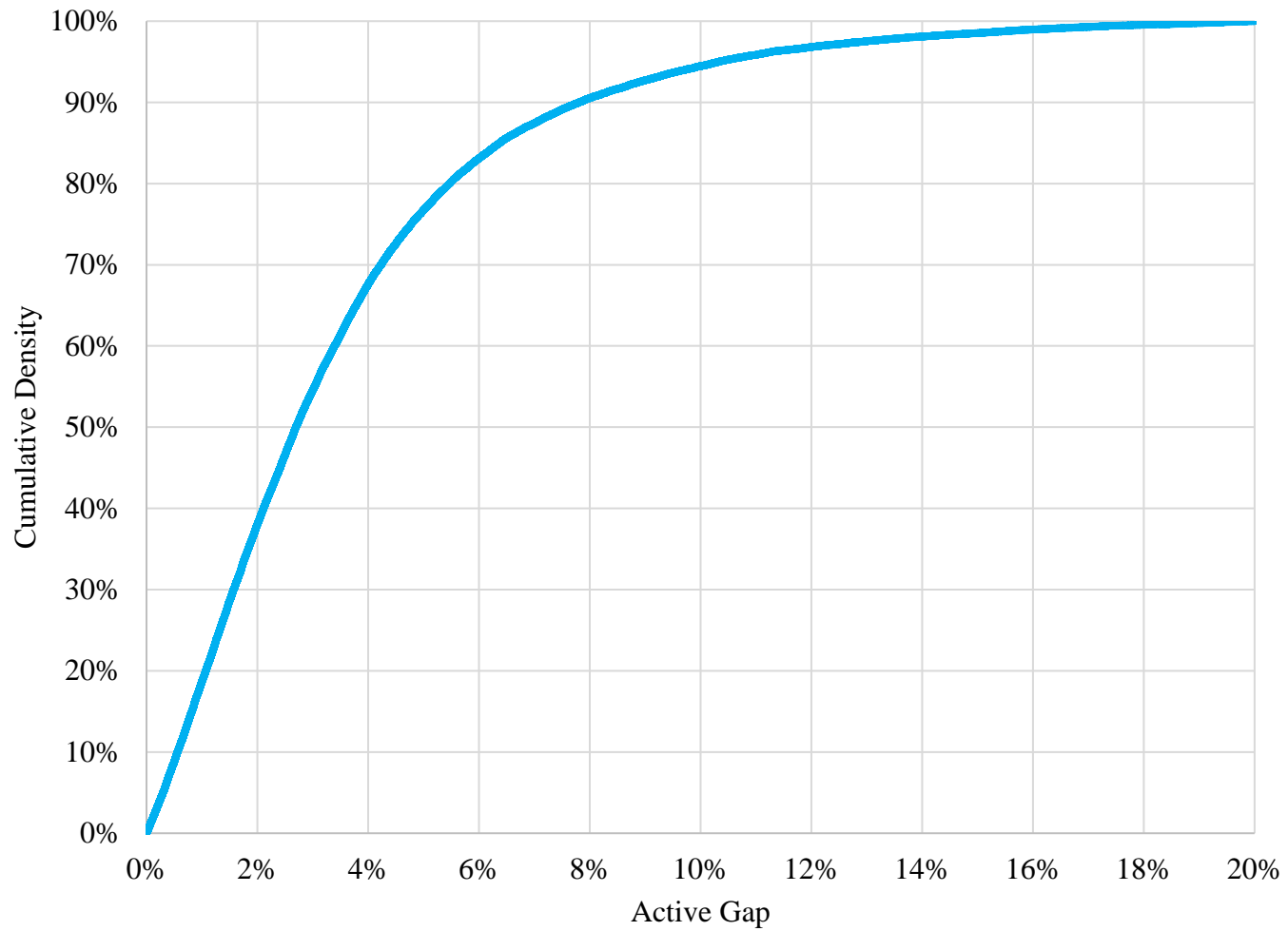
**Figure A.2: Percentage of funds with different prospectus and AS benchmarks by quarter**

This figure shows (i) the percentage of funds in each quarter with different prospectus and AS benchmarks and (ii) the percentage of funds in each quarter with different prospectus and AS benchmarks and *Benchmark Mismatch* greater than 60%.



**Figure A.3: Distribution of Active Gap**

This figure shows a cumulative density function (CDF) of *Active Gap* for all fund-month observations where the prospectus benchmark does not match the AS benchmark.



**Table A.1: Most common differences between the prospectus and AS benchmarks**

This table shows the most common differences between the prospectus benchmark and the AS benchmark. Panel A shows the ten most common benchmark differences for all fund-months with *Benchmark Mismatch* greater than zero and less than or equal to 60%. Panel B shows the ten most common benchmark differences for all fund-months with *Benchmark Mismatch* greater than 60%. For each benchmark difference listed, the percentage of that sample with that benchmark difference is reported. The median *Active Gap* and the mean *Benchmark Mismatch* are also provided for each benchmark difference.

Panel A:  $0 < \text{Benchmark Mismatch} \leq 60\%$ 

| Prospectus Benchmark | AS Benchmark          | Percentage of Differences | Active Gap | Benchmark Mismatch |
|----------------------|-----------------------|---------------------------|------------|--------------------|
| S&P 500              | S&P 500 Growth        | 20.7%                     | 3.0%       | 32.9%              |
| Russell 1000 Growth  | S&P 500 Growth        | 15.4%                     | 1.8%       | 29.8%              |
| Russell 1000 Value   | S&P 500 Value         | 10.2%                     | 2.1%       | 32.8%              |
| S&P 500              | Russell 1000 Growth   | 8.5%                      | 4.0%       | 43.1%              |
| S&P 500              | S&P 500 Value         | 6.2%                      | 1.9%       | 34.7%              |
| S&P 500              | Russell 1000 Value    | 5.4%                      | 3.0%       | 44.6%              |
| Russell 1000 Value   | S&P 500               | 4.4%                      | 3.5%       | 44.5%              |
| Russell 3000 Growth  | Russell 1000 Growth   | 2.9%                      | 0.9%       | 7.9%               |
| Russell 2000         | Russell 2000 Growth   | 2.8%                      | 2.3%       | 43.0%              |
| Russell Midcap       | Russell Midcap Growth | 2.1%                      | 2.6%       | 44.1%              |

Panel B:  $\text{Benchmark Mismatch} > 60\%$ 

| Prospectus Benchmark  | AS Benchmark          | Percentage of Differences | Active Gap | Benchmark Mismatch |
|-----------------------|-----------------------|---------------------------|------------|--------------------|
| Russell 2000 Value    | S&P 600 Value         | 10.9%                     | 2.1%       | 69.1%              |
| Russell 2000          | S&P 600 Growth        | 10.2%                     | 4.0%       | 77.3%              |
| Russell 2000 Growth   | S&P 600 Growth        | 10.0%                     | 1.8%       | 69.4%              |
| Russell Midcap Growth | S&P 400 Growth        | 4.8%                      | 1.6%       | 76.8%              |
| Russell 2000          | S&P 600 Value         | 4.0%                      | 2.6%       | 75.8%              |
| S&P 500               | Russell Midcap Growth | 3.8%                      | 6.4%       | 90.6%              |
| Russell 2000 Value    | S&P 400 Value         | 3.4%                      | 3.1%       | 88.2%              |
| Russell 2000 Growth   | S&P 400 Growth        | 3.4%                      | 2.5%       | 91.0%              |
| Russell 2000          | S&P 400 Growth        | 2.9%                      | 3.6%       | 92.3%              |
| Russell Midcap        | S&P 400 Growth        | 2.7%                      | 5.1%       | 83.3%              |

**Table A.2: Benchmark returns and *Benchmark Mismatch* – Robustness tests**

This table shows robustness tests associated with Table 3 in the paper, which shows the average difference in annualized return between the AS benchmark and the prospectus benchmark for fund-months in which those benchmarks are different. Each panel shows results separately for fund-months in which *Benchmark Mismatch* is greater than or less than 60%. Panel A shows results by style, as defined by the prospectus benchmark. Panel B shows results using only funds with Russell indexes as prospectus benchmarks and using only Russell indexes as AS benchmarks. Panel C shows results after independently sorting funds into quintiles each month based on the difference between their tracking error with respect to their prospectus benchmark and their tracking error with respect to their current AS benchmark (both measured over the previous 36 months).

Panel A: Effect of Benchmark Mismatch by Style

|               | $0 < \text{BM} \leq 60$ | $\text{BM} > 60$ | High – Low |
|---------------|-------------------------|------------------|------------|
| All           | 0.11%                   | 1.46%            | 1.35%      |
|               | [0.51]                  | [3.08]           | [2.99]     |
| Large Cap     | 0.12%                   | 3.05%            | 2.93%      |
|               | [0.54]                  | [2.78]           | [2.48]     |
| Small/Mid Cap | 0.00%                   | 1.10%            | 1.11%      |
|               | [0.00]                  | [1.89]           | [1.63]     |
| Growth        | 0.52%                   | 1.73%            | 1.21%      |
|               | [0.90]                  | [1.97]           | [1.66]     |
| Value         | -0.32%                  | 0.95%            | 1.26%      |
|               | [-0.83]                 | [1.35]           | [2.17]     |
| Blend         | 0.09%                   | 1.63%            | 1.54%      |
|               | [0.34]                  | [3.18]           | [3.09]     |

Panel B: Russell Benchmarks Only

|     | $0 < \text{BM} \leq 60$ | $\text{BM} > 60$ | High – Low |
|-----|-------------------------|------------------|------------|
| All | 0.10%                   | 0.89%            | 0.79%      |
|     | [0.36]                  | [1.79]           | [2.36]     |

Panel C: Impact of Tracking Error Differential

|              | $0 < \text{BM} \leq 60$ | $\text{BM} > 60$ | High – Low |
|--------------|-------------------------|------------------|------------|
| All          | 0.09%                   | 1.54%            | 1.44%      |
|              | [0.42]                  | [3.19]           | [3.17]     |
| Low TE Diff  | 0.12%                   | 1.60%            | 1.48%      |
|              | [0.33]                  | [2.37]           | [2.44]     |
| 2            | 0.15%                   | 1.43%            | 1.28%      |
|              | [0.53]                  | [2.02]           | [1.86]     |
| 3            | -0.13%                  | 1.14%            | 1.27%      |
|              | [-0.55]                 | [2.05]           | [2.38]     |
| 4            | 0.19%                   | 1.58%            | 1.39%      |
|              | [0.88]                  | [2.94]           | [2.84]     |
| High TE Diff | 0.15%                   | 1.72%            | 1.57%      |
|              | [0.39]                  | [3.19]           | [3.03]     |



**Table A.4: Comparison of the Sensoy (2009) and *Benchmark Mismatch* procedures – Ranges of *Benchmark Mismatch***

This table shows robustness tests associated with Table 5 in the paper, which shows differences in average annualized benchmark returns for fund-months identified as having a benchmark discrepancy using either the *Benchmark Mismatch* (BM) procedure or the Sensoy (2009) procedure (or both). Differences are reported between the prospectus benchmark and the AS benchmark and between the prospectus benchmark and the appropriate benchmark identified by the Sensoy procedure. “-” denotes that the two benchmarks are identical in that particular test. Panel A (B) shows results for funds without (with) a benchmark discrepancy according to Sensoy’s procedure.

**Panel A: Funds without a Sensoy Benchmark Discrepancy**

|                     | BM = 0 | 0 < BM ≤ 20       | 20 < BM ≤ 40      | 40 < BM ≤ 60    | 60 < BM ≤ 80    | BM > 80         |
|---------------------|--------|-------------------|-------------------|-----------------|-----------------|-----------------|
| Prospectus – AS     | -      | -0.15%<br>[-0.94] | -0.08%<br>[-0.26] | 0.60%<br>[1.84] | 1.29%<br>[1.97] | 1.04%<br>[1.50] |
| Prospectus – Sensoy | -      | -                 | -                 | -               | -               | -               |

**Panel B: Funds with a Sensoy Benchmark Discrepancy**

|                     | BM = 0          | 0 < BM ≤ 20     | 20 < BM ≤ 40      | 40 < BM ≤ 60    | 60 < BM ≤ 80    | BM > 80         |
|---------------------|-----------------|-----------------|-------------------|-----------------|-----------------|-----------------|
| Prospectus – AS     | -               | 0.04%<br>[0.30] | -0.03%<br>[-0.06] | 0.39%<br>[1.04] | 1.00%<br>[2.10] | 2.37%<br>[3.25] |
| Prospectus – Sensoy | 0.16%<br>[0.33] | 0.82%<br>[1.13] | -0.11%<br>[-0.18] | 0.50%<br>[1.10] | 0.80%<br>[1.63] | 2.26%<br>[3.15] |



**Table A.5: Comparison of tracking error procedures and the *Benchmark Mismatch* procedure**

This table shows differences in average annualized benchmark returns for fund-months identified as having a benchmark discrepancy using either the *Benchmark Mismatch* procedure or a given tracking error procedure. The tracking error procedures are based on a comparison between a fund's tracking error with respect its prospectus benchmark and a fund's tracking error with respect to the benchmark that produces the lowest tracking error. Both measures of tracking error are calculated over the previous 36 months. The 'Median' procedure identifies a benchmark discrepancy whenever (i) the benchmark that produces the lowest tracking error is not the prospectus benchmark and (ii) the difference between those two benchmarks' tracking errors is above the 50th percentile among funds clearing the de minimis hurdle (0.1% per year) in that period. The 'Top Quintile' procedure is similar, except that it uses the 80th percentile instead of the 50th. Differences are reported between the prospectus benchmark and the AS benchmark and between the prospectus benchmark and the lowest tracking error benchmark. A "--" in a cell indicates that the two benchmarks are identical in that particular test. *t*-statistics are reported in brackets below each coefficient and are calculated using standard errors independently double clustered by fund and year-month.

| Tracking Error Procedure  |                 | Median  |         | Top Quintile |         |
|---------------------------|-----------------|---------|---------|--------------|---------|
| Benchmark Discrepancy?    | BM              | Yes     | No      | Yes          | No      |
|                           | Tracking Error  | No      | Yes     | No           | Yes     |
| Benchmark-Adjusted Return | Prospectus      | -0.08%  | -0.76%  | 0.12%        | -0.83%  |
|                           |                 | [-0.16] | [-1.50] | [0.24]       | [-1.12] |
|                           | AS              | -1.31%  | -       | -1.30%       | -       |
|                           |                 | [-3.33] |         | [-3.66]      |         |
|                           | Tracking Error  | -       | -1.38%  | -            | -1.51%  |
|                           |                 |         | [-4.67] |              | [-3.41] |
| Differences               | Prospectus – AS | 1.23%   | -       | 1.42%        | -       |
|                           |                 | [2.17]  |         | [2.67]       |         |
|                           | Prospectus – TE | -       | 0.62%   | -            | 0.67%   |
|                           |                 |         | [1.13]  |              | [0.87]  |

**Table A.6: Factor exposure differences between the AS and prospectus benchmarks – Including a constant in the model**

This table repeats Table 6, but includes a constant in the model:

$$Return_{AS,t} - Return_{pro,t} = \alpha + \beta * Factor_t + \varepsilon_t.$$

Panel A: Benchmark Return Difference by Style

| Style:     | All     | Large   | Sm-mid  | Growth  | Value   | Blend   |
|------------|---------|---------|---------|---------|---------|---------|
| Prospectus | 0.75%   | 1.28%   | 0.30%   | 0.87%   | -0.41%  | 0.66%   |
|            | [1.37]  | [0.90]  | [0.60]  | [1.25]  | [-0.60] | [1.09]  |
| AS         | -0.66%  | -1.21%  | -0.71%  | -0.50%  | -1.18%  | -1.05%  |
|            | [-1.34] | [-2.00] | [-1.32] | [-0.61] | [-2.29] | [-2.08] |
| Difference | 1.41%   | 2.49%   | 1.01%   | 1.37%   | 0.77%   | 1.71%   |
|            | [3.55]  | [2.17]  | [1.87]  | [1.93]  | [1.24]  | [3.36]  |

Panel B: Explanatory Power - CPZ7 Model

| Style:              | All    | Large  | Sm-mid | Growth | Value   | Blend  |
|---------------------|--------|--------|--------|--------|---------|--------|
| R <sup>2</sup>      | 21.8%  | 81.5%  | 46.0%  | 54.5%  | 40.2%   | 38.1%  |
| Total Factor Return | 0.38%  | 1.30%  | 0.24%  | 0.47%  | -0.21%  | 0.64%  |
|                     | [2.07] | [1.26] | [0.66] | [0.90] | [-0.53] | [2.04] |

Panel C: Explanatory Power - CPZ7+ Model

| Style:              | All    | Large  | Sm-mid | Growth | Value  | Blend  |
|---------------------|--------|--------|--------|--------|--------|--------|
| R <sup>2</sup>      | 47.8%  | 85.5%  | 54.6%  | 63.5%  | 65.5%  | 54.2%  |
| Total Factor Return | 1.19%  | 1.69%  | 1.11%  | 1.23%  | 0.81%  | 1.41%  |
|                     | [4.31] | [1.60] | [2.79] | [2.17] | [1.61] | [3.77] |

**Table A.7: Factor exposure differences between the AS and prospectus benchmarks – Individual factor exposures**

This table shows the individual factor exposures from the model in Table 6. Panel A (B) shows the exposures from using the CPZ7 (CPZ7+) model.

Panel A: CPZ7

| Style: | All              | Large            | Sm-mid           | Growth           | Value            | Blend            |
|--------|------------------|------------------|------------------|------------------|------------------|------------------|
| S5RF   | -0.01<br>[-1.05] | 0.02<br>[1.20]   | -0.01<br>[-0.82] | -0.03<br>[-3.03] | 0.00<br>[0.03]   | 0.00<br>[0.04]   |
| RMS5   | 0.10<br>[3.84]   | 0.66<br>[10.92]  | -0.06<br>[-1.94] | 0.05<br>[1.38]   | 0.03<br>[0.73]   | 0.20<br>[7.74]   |
| R2RM   | -0.11<br>[-6.20] | 0.17<br>[5.49]   | -0.20<br>[-8.36] | -0.11<br>[-4.73] | -0.10<br>[-3.83] | -0.07<br>[-3.41] |
| S5VS5G | -0.02<br>[-0.95] | -0.01<br>[-0.45] | -0.01<br>[-0.49] | 0.02<br>[0.53]   | -0.10<br>[-2.84] | -0.04<br>[-1.71] |
| RMVRMG | -0.02<br>[-0.90] | 0.04<br>[0.50]   | -0.07<br>[-2.64] | 0.03<br>[1.03]   | 0.02<br>[0.48]   | -0.09<br>[-4.02] |
| R2VR2G | 0.02<br>[0.79]   | -0.14<br>[-2.17] | 0.07<br>[2.81]   | 0.13<br>[3.57]   | -0.15<br>[-3.49] | 0.04<br>[1.56]   |
| UMD    | 0.02<br>[2.23]   | 0.02<br>[1.49]   | 0.03<br>[2.17]   | 0.05<br>[3.42]   | -0.02<br>[-1.64] | 0.03<br>[2.48]   |

Panel B: CPZ7+

| Style: | All              | Large            | Sm-mid           | Growth           | Value            | Blend            |
|--------|------------------|------------------|------------------|------------------|------------------|------------------|
| S5RF   | 0.01<br>[0.68]   | 0.04<br>[2.80]   | 0.00<br>[-0.10]  | -0.03<br>[-2.47] | 0.04<br>[3.42]   | 0.02<br>[1.68]   |
| RMS5   | 0.12<br>[5.14]   | 0.67<br>[12.75]  | -0.03<br>[-0.84] | 0.07<br>[1.96]   | 0.04<br>[1.44]   | 0.22<br>[8.60]   |
| R2RM   | -0.07<br>[-4.00] | 0.22<br>[8.85]   | -0.17<br>[-6.80] | -0.07<br>[-2.93] | -0.03<br>[-1.79] | -0.04<br>[-1.65] |
| S5VS5G | 0.05<br>[2.22]   | 0.08<br>[2.38]   | 0.02<br>[0.69]   | 0.07<br>[2.13]   | 0.03<br>[1.00]   | 0.04<br>[1.61]   |
| RMVRMG | -0.10<br>[-4.61] | -0.02<br>[-0.33] | -0.12<br>[-4.44] | -0.04<br>[-1.27] | -0.08<br>[-2.26] | -0.18<br>[-7.27] |
| R2VR2G | -0.01<br>[-0.35] | -0.13<br>[-2.01] | 0.03<br>[0.92]   | 0.07<br>[1.88]   | -0.15<br>[-4.99] | 0.02<br>[0.76]   |
| UMD    | 0.01<br>[1.00]   | 0.01<br>[0.65]   | 0.03<br>[1.66]   | 0.05<br>[2.95]   | -0.04<br>[-2.95] | 0.00<br>[0.11]   |
| RMW    | 0.13<br>[4.53]   | 0.11<br>[1.72]   | 0.10<br>[2.45]   | 0.19<br>[3.57]   | 0.15<br>[3.87]   | 0.12<br>[3.60]   |
| CMA    | -0.01<br>[-0.22] | -0.02<br>[-0.66] | -0.04<br>[-1.33] | -0.02<br>[-0.51] | 0.03<br>[0.98]   | 0.00<br>[-0.12]  |
| MGMT   | -0.01<br>[-0.21] | -0.04<br>[-1.28] | 0.06<br>[1.93]   | 0.03<br>[0.79]   | -0.07<br>[-3.03] | 0.00<br>[-0.06]  |
| PERF   | -0.01<br>[-0.35] | 0.02<br>[0.85]   | -0.02<br>[-1.15] | -0.03<br>[-1.14] | 0.03<br>[1.38]   | 0.02<br>[1.37]   |
| QMJ    | 0.06<br>[1.98]   | 0.06<br>[1.76]   | 0.04<br>[1.31]   | 0.01<br>[0.29]   | 0.12<br>[3.41]   | 0.05<br>[1.37]   |
| BAB    | 0.02<br>[2.02]   | -0.02<br>[-1.03] | 0.01<br>[0.77]   | 0.02<br>[1.71]   | 0.00<br>[-0.23]  | 0.01<br>[1.38]   |
| LIQ    | 0.00<br>[-0.69]  | 0.01<br>[1.64]   | 0.02<br>[2.02]   | -0.01<br>[-1.14] | 0.00<br>[0.51]   | -0.02<br>[-2.45] |

**Table A.8: Factor exposure differences between the AS and prospectus benchmarks – Replacing CPZ7 with Carhart (1997)**

This table repeats Table 6, but uses the Carhart (1997) factors as the base model, rather than the CPZ7 factors.

**Panel A: Benchmark Return Difference by Style**

| Style:     | All     | Large   | Sm-mid  | Growth  | Value   | Blend   |
|------------|---------|---------|---------|---------|---------|---------|
| Prospectus | 0.75%   | 1.38%   | 0.23%   | 0.91%   | -0.57%  | 0.66%   |
|            | [1.38]  | [0.97]  | [0.47]  | [1.32]  | [-0.84] | [1.09]  |
| AS         | -0.65%  | -1.10%  | -0.75%  | -0.46%  | -1.27%  | -1.07%  |
|            | [-1.33] | [-1.83] | [-1.41] | [-0.56] | [-2.55] | [-2.14] |
| Difference | 1.40%   | 2.48%   | 0.98%   | 1.37%   | 0.70%   | 1.74%   |
|            | [3.57]  | [2.18]  | [1.83]  | [1.91]  | [1.05]  | [3.41]  |

**Panel B: Explanatory Power - Carhart Model**

| Style:              | All    | Large  | Sm-mid  | Growth | Value   | Blend  |
|---------------------|--------|--------|---------|--------|---------|--------|
| R <sup>2</sup>      | 9.1%   | 61.8%  | 38.1%   | 50.6%  | 46.3%   | 17.0%  |
| Total Factor Return | 0.03%  | 1.61%  | -0.30%  | 0.08%  | -0.43%  | 0.31%  |
|                     | [0.26] | [1.80] | [-0.91] | [0.15] | [-0.94] | [1.45] |

**Panel C: Explanatory Power - Carhart+ Model**

| Style:              | All    | Large  | Sm-mid | Growth | Value   | Blend  |
|---------------------|--------|--------|--------|--------|---------|--------|
| R <sup>2</sup>      | 29.0%  | 67.8%  | 45.7%  | 62.4%  | 63.5%   | 27.7%  |
| Total Factor Return | 0.55%  | 1.57%  | 0.31%  | 1.02%  | -0.06%  | 0.57%  |
|                     | [2.59] | [1.66] | [0.85] | [1.80] | [-0.11] | [2.09] |