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Tax-Managed Factor Strategies

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In an influential article published a quarter-century ago, Rob Jeffrey and Rob Arnott asked if an investor's alpha is big enough to cover its taxes. We address this question for an indexing strategy and six factor tilts. In historical back-tests over the period from June 1995 to March 2018, average value added by tax management exceeded 1.5% per year at a 10-year horizon for all the strategies we considered. Tax-managed beta-1 factor tilts generated average tax alpha between 1.6% and 1.9% per year, while average tax alpha for the tax-managed indexing strategy was 2.3% per year. These remarkable results depend on the availability of short-term capital gains to offset. To a great extent, they can be attributed to loss harvesting and implicit tax arbitrage.

Introduction

In 1993, Rob Jeffrey and Rob Arnott asked a provocative question: Is an investor's alpha big enough to cover its taxes? Arnott and Jeffrey pointed out that alpha generation typically requires high turnover, which erodes pre-tax alpha by increasing taxes, but this important fact tended to be overlooked by investors and researchers. Twenty-five years later, the situation has not changed too much, as Arnott and co-authors explain in two updates to the original commentary.[1] The financial literature is still dominated by the study of tax-exempt investing, and the top priority of most fund and wealth managers is still the delivery of strong pre-tax returns. Managers who appreciate the importance of taxes remain rare.

There is no mystery about the inclination to neglect taxes. They are a severe and complicated drag on performance, and after-tax portfolio construction and analysis require a level of customization that goes far beyond institutional standards. Any empirical study of after-tax performance necessarily rests on numerous specific assumptions, so individuals may question the relevance of such a study to their particular situations. Nevertheless, a small but critical body of research laying out effective principles of after-tax portfolio management is emerging.[2]

Some principles of tax-aware investing, such as locating high-tax investments in tax-deferred accounts or using tax-free municipal bonds (instead of their taxable counterparts) as investments and benchmarks, are no more than common sense. Other principles of tax-aware investing may rely on more sophisticated mathematics and economics, as well as more detailed knowledge of the complex and ever-changing US tax code. An example of the latter would be *loss harvesting*, which is a tax-aware option that combines delayed realization of capital gains with immediate realization of capital losses.[3] A second timing option, known as gain management or *tax arbitrage*, involves the realization of long-term gains in order to facilitate the harvesting of short-term losses.[4]

While loss harvesting and tax arbitrage have been practiced for decades, historical evaluations of the benefits of these practices have begun to emerge only recently.[5] A baseline is established in Bergstresser and Pontiff (2013), which measures the damage done to tax-indifferent indexing strategies and factor tilts in the US market over the period June

[1] The "Is Your Alpha Big Enough?" series includes Jeffrey and Arnott (1993); Arnott, Berkin, and Bouchey (2011); and Arnott, Kalesnik, and Schuesler (2018).
[2] Dammon et al. (2004), Wilcox et al. (2006), Reichenstein (2006), Fabozzi (2013), and Geddes et al. (2015) are among the growing collection of works that summarize principles of tax-managed investing.
[3] Tax-loss harvesting first appears in the academic literature in Constantinides (1983).
[4] Tax arbitrage first appears in the academic literature in Constantinides (1984). A simulation-based study of tax arbitrage is in Stein et al. (2008).
[5] There are a number of simulation-based studies of the efficacy of loss harvesting. Berkin and Ye (2003) use simulation to conclude that loss harvesting based on highest-in, first-out (HIFO) accounting is elevated in a market with high stock-specific risk, low return, and high dividend yield. Geddes (2011) and Geddes and Tymoczko (2015) compare the tax benefits of indexed exchange-traded funds (ETFs) to tax-managed separately managed accounts (SMAs). Berkin and Luck (2010) analyze after-tax performance of "extended mandate" equity portfolios, which allow short positions.

1927 to June 2009. Israel and Moskowitz (2012) demonstrate the benefits of loss harvesting by comparing tax-managed to tax-indifferent strategies over a shorter period, July 1974 to June 2010. In that article and in this study, *tax managed* refers to the combination of disciplined loss harvesting with a standard investment objective, such as indexing or tilting toward a factor.[6] Goldberg and Leshem (2014) find substantial tax alpha in six tax-managed factor tilts in US and global markets at 10-, 15-, and 20-year horizons over the period of January 1994 to December 2013.

Summary of Our Contributions

In the present study, we document the performance of after-tax return and risk profiles of an indexing strategy and six factor tilts over the period June 1995 to March 2018.[7] We focus on active return, and our results rely on a number of methodological innovations. We mitigate the substantial impact of period dependence on results by launching each strategy frequently over a long horizon, generating ranges of outcomes obtained in different market climates.[8] We construct each portfolio with a one-step optimization that balances the competing imperatives of constraining factor exposures, harvesting losses, and minimizing tracking error (TE) to a diversified benchmark.[9] We develop an after-tax performance attribution scheme that decomposes estate/donation and liquidation active returns into factor alpha, tax alpha, and tracking return. We measure the implicit tax arbitrage that occurs in tax-managed factor tilts.

Our results span several dimensions. First, we compare after-tax performance of tax-managed versions to tax-indifferent versions of each strategy. In back-tests, average value added by tax management during the period studied exceeded 1.50% per year at 10-year horizon for all the strategies we considered. This finding illustrates the potential power of loss harvesting and lets us move on to the more nuanced topic of the loss-harvesting capacities of different strategies.

Historically, tax management has generated more alpha in an indexing strategy than in factor strategies. Therefore, a factor strategy is a rational choice for a taxable investor only when its alpha is big enough to outpace the tax drag from additional turnover. The issue is crystallized in a long-only value tilt, where factor alpha depends on price appreciation of stocks with low valuations. If this strategy is not continuously managed and monitored, the long-only value-tilted portfolio will shed individual stocks that become too expensive relative to peers, and these sales may generate tax obligations that can erode the strategy tilt's performance.

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[6] Sialm and Sosner (2018) find that including short positions in a tax-managed equity portfolio can improve performance.
[7] The start date of our investment horizon is dictated by data constraints. Specifically, we chose the earliest date that would allow us to run back-tests in both the US and global markets. Bouts of market turbulence between 2000 and 2010 may have tended to elevate estimates of tax alpha.
[8] The importance of focusing on an investment horizon of practical relevance is emphasized in Goldberg and Leshem (2014) and Goldberg et al. (2017). Unlike tax-exempt strategies, otherwise identical tax-managed strategies launched a month apart can have materially different return/risk profiles.
[9] We scale the one-step portfolio optimization pioneered in Goldberg and Leshem (2014).

Nevertheless, in our historical back-tests, tax alpha in a tax-managed value tilt was roughly 70% of tax alpha in a tax-managed indexing strategy. From the perspective of tax alpha, the factor tilts we looked at fell into two groups, *beta-1 strategies* and *lower-risk strategies*. Tax alpha was relatively abundant in most runs of our beta-1 strategies but was generated less frequently in lower-risk strategies. These observations indicate to us that, even without factor alpha, the tax management would cover the turnover, but it would not perform as well as the tax-managed index-tracking strategy.

For the purpose of evaluating different strategies, we frame the trade-off between factors and tax in terms of a *hurdle rate*, the factor alpha that is required to overcome the tax alpha sacrificed relative to an indexing strategy. Translating the results about tax alpha described above, hurdle rates in our back-tests were reduced in beta-1 strategies relative to lower-risk strategies.

The inclusion of loss harvesting in index-tracking and factor strategies adds risk, which we quantify in our research as tracking error against a diversified benchmark, or total volatility. The incremental risk due to loss harvesting is the difference in risk between a tax-managed strategy and its tax-indifferent counterpart.

While the vast majority of the tax alpha in a tax-managed index-tracking portfolio is due to the realization of short-term capital losses, the imbalance is more extreme in a tax-managed factor strategy, whose returns are boosted by implicit tax arbitrage. All the tax-managed strategies profiled would have seen a reduction in tax alpha if a client were to have offset the short-term losses against long-term gains.

Outline of This Article

In the next section of this study, we review the basics of after-tax portfolio analytics and portfolio construction. In the two sections that follow, we outline our historical study and then describe our empirical findings in the US market. Our results give a detailed picture of the after-tax return and risk profiles of a 10-year tax-managed index-tracking strategy and six factor tilts launched between June 1995 and March 2018. After a brief summary, we give an overview of analogous results for the global market and for a California-based US investor in two appendixes.[10] A final appendix provides the details of our portfolio construction methodology.

Mechanics and Analysis of Tax-Managed Equity Portfolios

Calculating Historical Risk and Return

After-tax return calculations depend on investor-specific information such as cost basis, disposition, and tax rates. We calculate returns in both the estate/donation and liquidation

[10] The tax assumptions for the global portfolios described in Appendix A and the US portfolios described in the main body of this article are in Table 2. Tax assumptions for California investors are in Table B1.

dispositions. The "estate/donation" scenario assumes that the portfolio is bequeathed or donated tax free at the end of the investment horizon. The "liquidation scenario" assumes the portfolio is dissolved at horizon end, triggering a lump-sum tax payment as a result of that liquidation. We assume short-term capital gains are taxed at 40.8% and both long-term capital gains and dividends are taxed at 23.8%, the highest federal tax rates as of January 2018.[11] The tax benefits are most relevant to a Texas-based investor but are understated for an investor in California.[12] We also assume that our investor has enough short- and long-term capital gains to make optimal use of harvested losses. Therefore, our results are overstated for an investor with only long-term gains to offset. Further, a taxable investor with no gains to offset would surely be better served by a low-cost exchange-traded fund (ETF) than a loss-harvesting separately managed account (SMA) or partnership, as the ETF would have lower risk and a lower management fee.

At each monthly rebalancing, we compute after-tax return as the sum of tax alpha, the return benefit of loss harvesting, and pre-tax return. Since long-horizon return is obtained by compounding, after-tax returns are overstated for an investor who promptly consumes the benefits of loss harvesting and are understated for an investor who injects fresh cash from loss harvesting into the strategy on a regular basis.[13]

After-tax active return calculations require information about a benchmark that may not be readily available. We handle this by assuming the benchmark is taxed as though it were an ETF that makes no capital gains distributions,[14] leading to the further assumption that tax payments on gains due to benchmark delistings and corporate actions are deferred until the sale of the benchmark ETF. Calculating after-tax active return requires a post-tax benchmark return. For the estate/donation disposition, the benchmark dividend is taxed, and no capital gains are realized. For liquidation tax calculations, we keep track of the basis of the ETF, including initial capital and dividend reinvestment.

The addition of tax alpha to pre-tax returns of a tax-managed strategy generates a positive skew in the after-tax return distribution.[15] Consequently, both volatility and tracking error of after-tax returns are artificially widened by extreme, positive returns. We address this by measuring risk of a tax-managed strategy as incremental tracking error to a benchmark, relative to an otherwise equivalent tax-indifferent strategy.

[11] In effect, we are looking at historical after-tax through the lens of the current tax environment.
[12] State taxes are 0.0% in Texas, and they are 13.3% for short- and long-term gains in California.
[13] The injection of fresh cash into a tax-managed strategy elevates cost basis and, as a consequence, increases the benefits of future loss harvesting.
[14] The mechanism of redemption and creation of units in an ETF make the distribution of capital gains relatively rare.
[15] Due to the right skew, conditional value-at-risk (CVaR) may be a better risk measure for after-tax returns than volatility.

Constructing Tax-Managed and Tax-Indifferent Portfolios

The tax-managed portfolios presented in this article have been optimized to minimize risk while harvesting losses and achieving strategy goals.[16] Risk is tracking error against a diversified benchmark for the indexing strategy and five of the six factor strategies. For Minimum Volatility plus Value (Min Vol Value), risk is volatility. A sample objective function is specified in Formula (1).

$$\min \ \lambda \, w_A^T \Sigma w_A + T(\Delta w) - L(\Delta w),$$

$$\text{s. t.}$$
$$w_A^T \, 1 = 0,$$
$$w \geq 0,$$
$$w_A^T \, X = C,$$

$$\text{where:}$$
$$w = portfolio \ weights,$$
$$w_A = active \ weights,$$
$$\Delta w = changes \ in \ portfolio \ weights,$$
$$L(\Delta w) = value \ of \ the \ losses \ in \ portfolio \ (which \ depend \ on \ cost \ basis \ and \ tax \ rates),$$
$$T(\Delta w) = transaction \ cost,$$
$$\Sigma = asset \ covariance \ matrix,$$
$$X = exposure \ of \ assets \ to \ value,$$
$$1 = vector \ of \ all \ 1s,$$
$$C = target \ exposure,$$
$$\lambda = risk \ aversion.$$

(1)

The pre-tax active return of a tax-managed strategy arises from both the specification of the strategy (for example, a value tilt) and from loss harvesting. To disaggregate the two effects, we have constructed tax-indifferent strategies, which do not harvest losses but are otherwise identical to the tax-managed strategies. The optimization for constructing a tax-indifferent strategy is the same as for the corresponding tax-managed strategies, with $L(\Delta w)$ set to 0.

The term $w_A^T \Sigma w_A$ in Formula (1) is forecast tracking error, which controls the deviation of the portfolio from its benchmark. The forecast asset covariance matrix, Σ, is constructed with a factor model that takes account of portfolio and benchmark exposure to the market, to industries, and to styles such as value, size, momentum, and quality.[17]

[16] Strategy goals may include targeting factor exposures or satisfying sector constraints and position limits.
[17] In this study, we use Barra's US Total Market Equity Model for Long-Term Investors (USSLOWL), which is documented in Bayraktar et al. (2014).

Attributing After-Tax Returns

After-tax active return (ATAR) can be attributed to the impact of loss harvesting and the underlying investment thesis. There are two elements to the impact of loss harvesting. The more prominent element is tax alpha, the after-tax value of harvested losses. Less prominent but also substantial in some cases is pre-tax residual, which is the difference between a tax-managed strategy and its otherwise equivalent tax-indifferent counterpart. This leads to a three-term attribution formula:[18]

$$\text{After-tax active return} = \text{Tax alpha} + \text{Pre-tax residual} + \text{Factor alpha} \qquad \textbf{(2)}$$

In special cases, after-tax active return can be simplified. For a tax-managed index-tracking portfolio strategy, alpha is 0. For a tax-indifferent factor tilt, pre-tax residual is 0 and the strategy alpha comes from the factors.

The pre-tax active return of a tax-managed strategy is the sum of the pre-tax residual and the strategy alpha. The tax impact is the sum of tax alpha and pre-tax residual. This leads two useful variants of Formula (2):

$$\begin{aligned}\text{After-tax active return} &= \text{Tax alpha} + \text{Pre-tax return} \\ &= \text{Tax impact} + \text{Factor alpha}\end{aligned} \qquad \textbf{(3)}$$

Mitigating the Impact of Period Dependence on Results

Historical results are affected by the idiosyncrasies of their analysis period in ways that can be difficult to assess. However, long-horizon after-tax returns exhibit extreme dependence on start date, and that means that performance in substantially overlapping periods can differ dramatically.[19] We exploit this feature of after-tax returns to generate a large number of distinct after-tax observations of a 10-year taxable strategy by shifting the start date by three months. We present the results in the form of box-plots, which highlight median outcomes, 25th and 75th percentiles, and worst and best cases.

Measuring Tax Arbitrage

Loss harvesting amounts to the immediate realization of losses and delayed realization of gains. But when the ratio of short-term to long-term tax rates is high, it can be beneficial to implement a tax arbitrage by realizing long-term gains in order to facilitate future harvesting of short-term losses. Tax arbitrage occurs implicitly in factor-tilted portfolios, as trading required to satisfy factor constraints can result in realized gains.[20]

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[18] In the liquidation disposition, it is important to be sure that all tax-related effects are incorporated in tax alpha. This includes both the intraperiod taxes on dividends and capital gains as well as the lump-sum payment from the realization of all capital gains at the end of the investment horizon. This applies to both the portfolio and its benchmark.

[19] For example, five-year tax alpha for a Russell 1000-tracking ATBAT (After-Tax Back-Testing Analysis Tool) run started in July 2008 was 4.61%, whereas it was 0.55% for an analogous run started in March 2009.

[20] Berkin and Luck (2010) find implicit tax arbitrage in simulated tax-managed extended equity mandates such as 130/30 portfolios.

Study Outline

We evaluate the performance of an index-tracking strategy and six factor-tilted strategies at a 10-year horizon in the US market. We launch each strategy on a quarterly basis over the period from June 1995 to March 2018, resulting in 52 runs for each strategy. Our menu of factor tilts and their benchmarks are in Table 1.[21] We use the Russell 1000 as both a universe and performance benchmark for our index-tracking strategy and five out of six factor tilts. In order to have a broad enough universe of smaller companies, we expand to the Russell 3000 for Small Value. Strategies are rebalanced monthly, and we assume a round-trip trading cost of 12 basis points. We assume strategies are taxed at the highest federal rates, which are listed in Table 2. Implementation details are in Appendix B.[22]

	Universe and Performance Benchmark
Index Tracking	R1000
Value	R1000
Value Momentum	R1000
Small Value	R3000
Multi-Factor	R1000
Quality	R1000
Min Vol Value	R1000

Table 1: *Menu of factor tilts.*

Tax Rate	
Short-Term	40.8%
Long-Term	23.8%
Dividends	23.8%

Table 2: Assumed tax rates are at the highest federal level as of January 2018.

At each rebalancing, we construct portfolios by minimizing forecast tracking error to the appropriate benchmark or minimizing volatility, subject to constraints mandated by factor exposures as outlined above.

Empirical Findings in the US Market

Tax-Managed Versus Tax-Indifferent Strategies

The most basic question for a taxable equity investor is whether the rewards from loss harvesting are worth the associated incremental risk and fees. This is addressed in Table 3, which shows after-tax performance of tax-managed and tax-indifferent versions of each of our strategies in the US market. We look at after-tax active return and its components averaged over 52 10-year runs launched over the period from June 1995 to March 2018. On average, incremental after-tax active return delivered by tax management ranged from 1.50% per year for Quality to 2.16% for the index-tracking strategy.

[21] All strategies are benchmarked against diversified indexes. Active returns to lower-risk strategies are not beta adjusted.
[22] Strategy settings used for simulation and live performance differ since the latter is customized to individual investors.

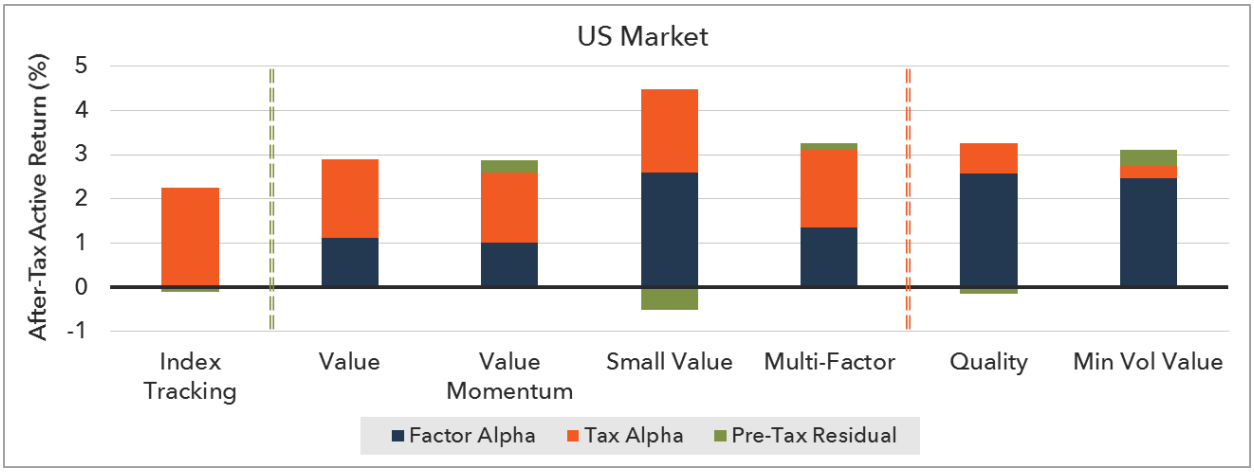
By construction, factor alpha is identical in each pair of tax-managed and tax-indifferent strategies. The difference in performance comes from the two sources of tax impact: tax alpha and pre-tax residual.

	Tax Managed	Tax Indifferent
Index Tracking		
After-Tax Active Return	2.15	–0.01
Factor Alpha	0.00	0.00
Tax Alpha	2.26	–0.01
Pre-Tax Residual	–0.10	0.00
Value		
After-Tax Active Return	2.91	1.26
Factor Alpha	1.13	1.13
Tax Alpha	1.77	0.12
Pre-Tax Residual	0.00	0.00
Value Momentum		
After-Tax Active Return	2.87	1.19
Factor Alpha	1.01	1.01
Tax Alpha	1.59	0.18
Pre-Tax Residual	0.27	0.00
Small Value		
After-Tax Active Return	3.98	2.08
Factor Alpha	2.60	2.60
Tax Alpha	1.89	–0.52
Pre-Tax Residual	–0.51	0.00
Multi-Factor		
After-Tax Active Return	3.26	1.66
Factor Alpha	1.35	1.35
Tax Alpha	1.75	0.31
Pre-Tax Residual	0.15	0.00
Quality		
After-Tax Active Return	3.12	1.62
Factor Alpha	2.58	2.58
Tax Alpha	0.68	–0.96
Pre-Tax Residual	–0.14	0.00
Min Vol Value		
After-Tax Active Return	3.10	1.13
Factor Alpha	2.47	2.47
Tax Alpha	0.27	–1.34
Pre-Tax Residual	0.37	0.00

Table 3: Ten-year average estate/donation after-tax active return for an indexing strategy and six factor tilts in the US market (tax managed versus tax indifferent). June 1995–March 2018. Source: Aperio Group, LLC.

Average Performance of Tax-Managed Strategies

Figure 1 presents the average after-tax active return of the tax-managed versions of the strategies graphically. Overall, the best average performance was delivered by the Small Value strategy, but more than half the after-tax active return was due to factor alpha. On the basis of tax alpha, the strategies divide into the three groups. The highest average tax alpha was delivered by the indexing strategy. Each of the four beta-1 strategies captured at least 70% of the tax alpha in the indexing strategy, but the two lower-risk strategies captured less than 35%. The division is marked in the performance charts shown below.



	Index Tracking	Value	Value Momentum	Small Value	Multi-Factor	Quality	Min Vol Value
Index Return	5.83	5.83	5.83	5.92	5.83	5.83	5.83
After-Tax Active Return	2.15	2.91	2.87	3.98	3.26	3.12	3.10
Factor Alpha	0.00	1.13	1.01	2.60	1.35	2.58	2.47
Tax Alpha	2.26	1.77	1.59	1.89	1.75	0.68	0.27
Pre-Tax Residual	-0.10	0.00	0.27	-0.51	0.15	-0.14	0.37

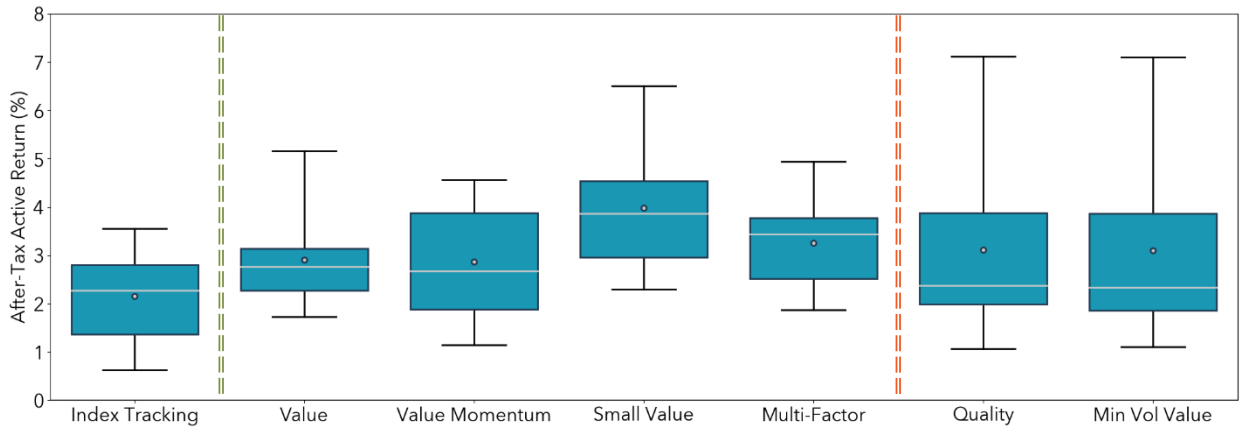
Figure 1: *Ten-year average estate/donation after-tax active return for a tax-managed indexing strategy and six factor tilts in the US market. June 1995–March 2018. Source: Aperio Group, LLC.*

After-Tax Active Return and Its Components

Figure 2 shows box plots of estate/donation after-tax active return for a tax-managed indexing strategy and six factor tilts in the US market. Each box plot shows the full range of outcomes observed for the 52 10-year historical simulations. The white line in each box is the median, and the dot marks the average. The top and bottom of the box correspond to the 75th and 25th percentile, respectively, and the maximum and minimum observations are marked by horizontal black lines.

This chart adds color to the averages shown in Figure 1. For example, median after-tax active return for the Multi-Factor strategy was higher than the average after-tax active return for that strategy, and the relationship is reversed for the Small Value strategy. The reversal is explained by the long right tail of the Small Value after-tax active returns. On the basis of the interquartile range, the results were most consistent for Value, as shown by the compressed

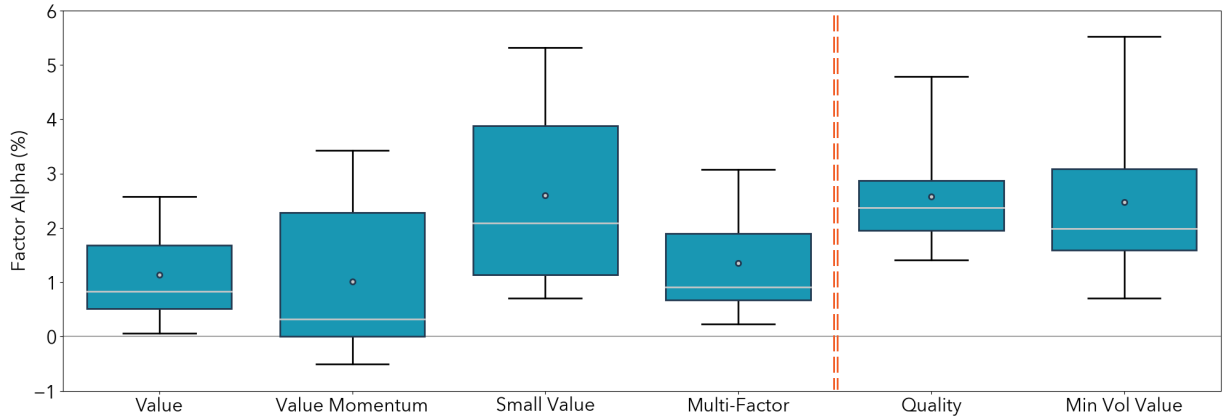
box plot. Results were less consistent for the lower-risk strategies, as shown by the deep box plots. In subsequent figures, we look at ranges of the components of after-tax active return.



Portfolio	Index Tracking	Value	Value Momentum	Small Value	Multi-Factor	Quality	Min Vol Value
Median	2.27	2.76	2.68	3.87	3.44	2.37	2.34

Figure 2: *Ten-year estate/donation after-tax active return for a tax-managed indexing strategy and six factor tilts in the US market. June 1995–March 2018. Source: Aperio Group, LLC.*

Factor alpha is shown in Figure 3. The results vary across strategies, both in the medians and dispersion of outcomes. Factor alpha in the low-volatility strategies, Quality and Minimum Volatility plus Value, compared favorably to the beta-1 strategies on the basis of their high median levels. Of course, there is no guarantee that the low-volatility anomaly, or any anomaly, will persist in the future.



Portfolio	Value	Value Momentum	Small Value	Multi-Factor	Quality	Min Vol Value
Median	0.84	0.32	2.09	0.92	2.37	1.98

Figure 3: *Ten-year estate/donation factor alpha for six factor tilts in the US market. June 1995–March 2018. Source: Aperio Group, LLC.*

The box plots in Figure 3 neglect the temporal evolution of factor alpha. In Figure 4, we show rolling 10-year factor alpha for our six tilts in the US market. It declined steadily for the beta-1 factor tilts since June 1995, although there was no obvious trend for the lower-risk strategies.

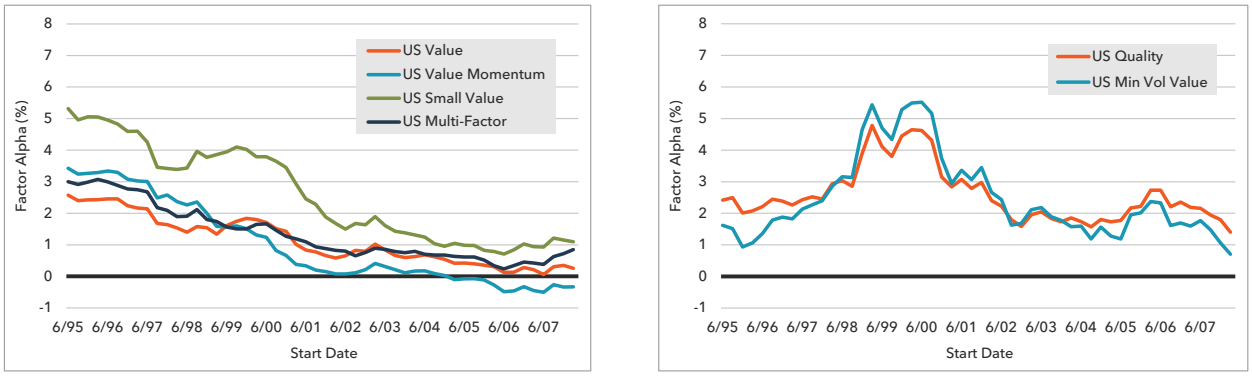
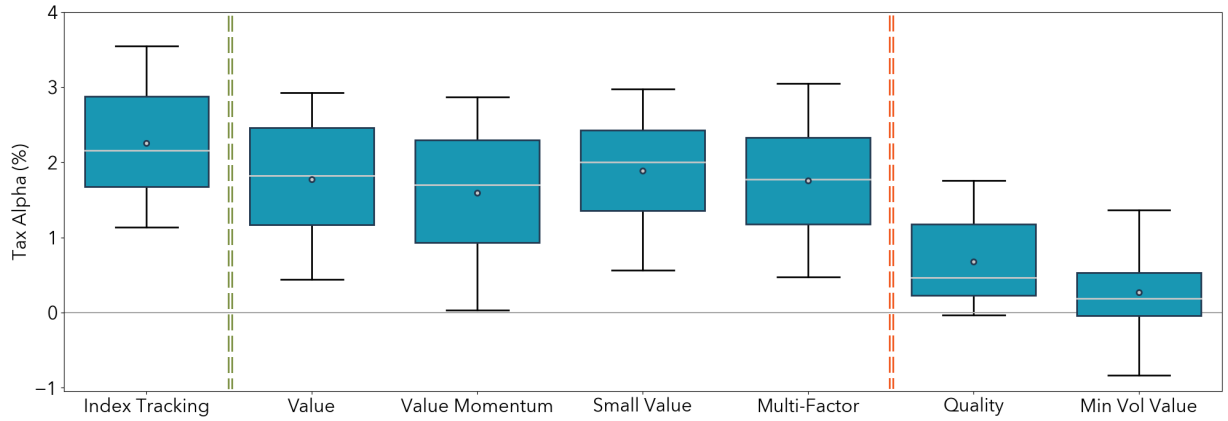


Figure 4: *Rolling 10-year estate/donation factor alpha for six factor tilts in the US market. Source: Aperio Group, LLC.*

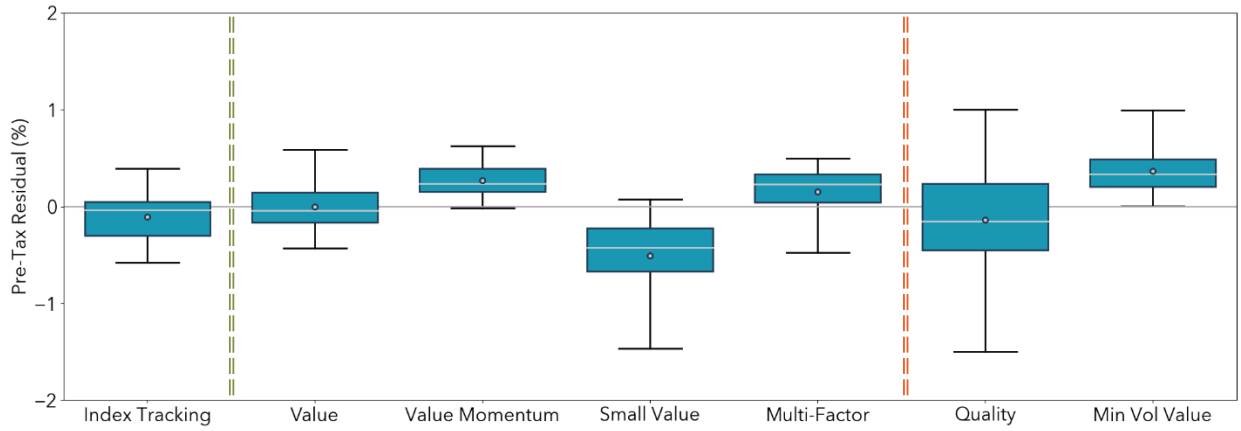
Estate/donation tax alpha for the indexing strategy and six factor tilts in the US market is shown in Figure 5. There was a pronounced difference in tax alpha between the beta-1 strategies and lower-risk strategies, which are characterized by smaller portfolios composed of less-volatile stocks.



Portfolio	Index Tracking	Value	Value Momentum	Small Value	Multi-Factor	Quality	Min Vol Value
Median	2.16	1.82	1.70	2.00	1.77	0.46	0.19

Figure 5: *Ten-year estate/donation tax alpha for a tax-managed indexing strategy and six factor tilts in the US market. June 1995–March 2018. Source: Aperio Group, LLC.*

Figure 6 shows pre-tax residual, the pre-tax return difference between the tax-managed and tax-indifferent versions of the strategies. This component of return arises from the incorporation of loss harvesting into a strategy. It has tended to be relatively tame---median values ranged between -0.50% and 0.35%. While interquartile ranges tended to be compressed, there were some extreme values.

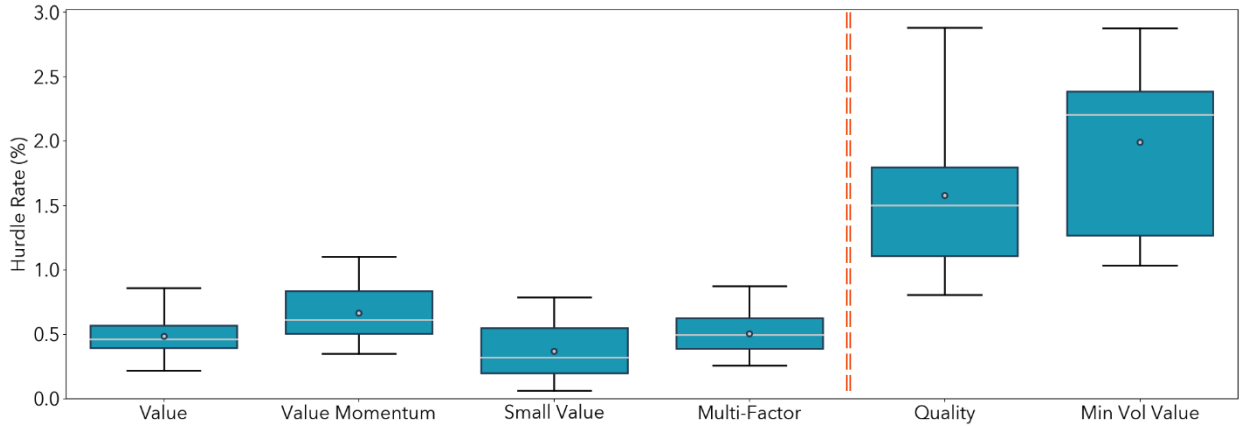


Portfolio	Index Tracking	Value	Value Momentum	Small Value	Multi-Factor	Quality	Min Vol Value
Median	–0.03	–0.04	0.24	–0.42	0.23	–0.15	0.33

Figure 6: *Ten-year estate/donation pre-tax residual for a tax-managed indexing strategy and six factor tilts in the US market. June 1995–March 2018. Source: Aperio Group, LLC.*

An investor choosing from among tax-managed strategies may think in terms of the *hurdle rate,* which is the difference between tax alpha in a tax-managed index-tracking strategy and in a factor strategy. In order for a tilt to be a rational choice for a taxable investor, its pre-tax active return, which includes both factor alpha and the pre-tax residual, must exceed the hurdle rate.

Figure 7 shows ranges of hurdle rates faced by six factor tilts over the period June 1995 to March 2018. Hurdle rates tended to be higher and less consistent in strategies with lower risk, which is a simple restatement of the results in Figure 5.

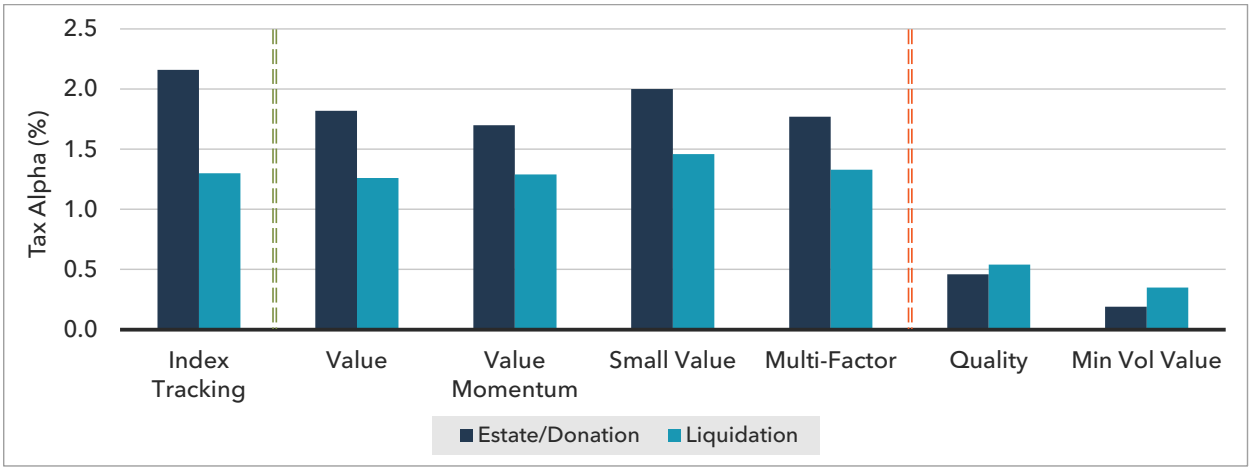


Portfolio	Value	Value Momentum	Small Value	Multi-Factor	Quality	Min Vol Value
Median	0.46	0.61	0.32	0.50	1.50	2.20

Figure 7: *Ten-year estate/donation hurdle rates (measured with tax alpha) for six tax-managed factor tilts in the US market. June 1995–March 2018. Source: Aperio Group, LLC.*

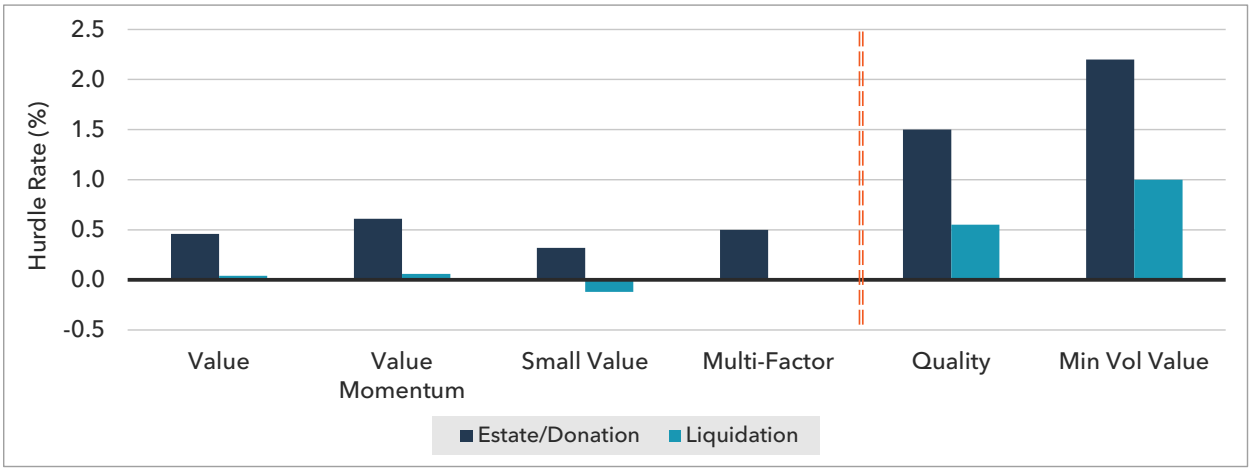
Estate/Donation Versus Liquidation Returns

The results shown in Figures 1 through 7 are for the estate/donation disposition, in which taxes are not paid during the investment horizon. In the liquidation disposition, taxes are merely deferred to the end of the horizon. In Figure 8, we show mean values of tax alpha in the two dispositions. Liquidation tax alpha depends on the difference between the after-tax return of the portfolio and the after-tax return of the benchmark after paying the tax on the embedded capital gains in the portfolio. For the beta-1 strategies, the embedded capital gains liability was higher in the portfolio than in the benchmark, resulting in liquidation tax alphas that were lower than estate/donation tax alphas. For the lower-volatility strategies, the embedded capital gains in the benchmark proxy ETF were higher than in the portfolio, resulting in liquidation tax alphas being higher than estate/donation tax alphas. We translate these results into hurdle rates in Figure 9. Median hurdle rates were lower in the liquidation disposition.



Portfolio	Index Tracking	Value	Value Momentum	Small Value	Multi-Factor	Quality	Min Vol Value
Estate/Donation	2.16	1.82	1.70	2.00	1.77	0.46	0.19
Liquidation	1.30	1.26	1.29	1.46	1.33	0.54	0.35

Figure 8: *Median tax alpha for a 10-year tax-managed indexing strategy and six factor tilts in the US market. June 1995–March 2018. Source: Aperio Group, LLC.*

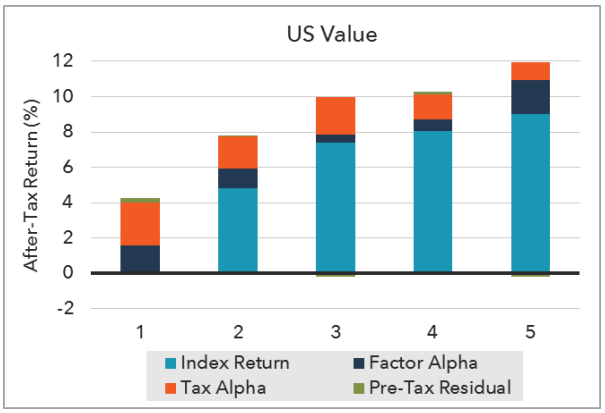


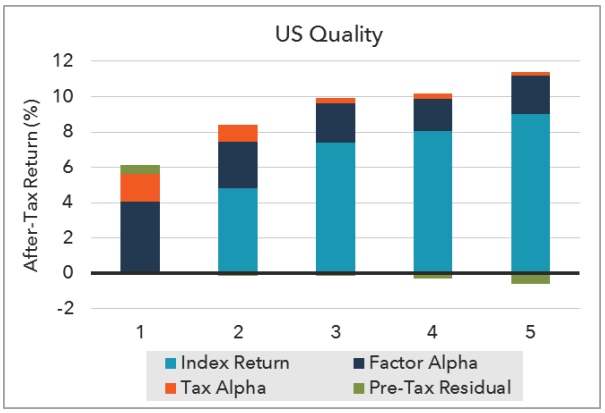
Portfolio	Value	Value Momentum	Small Value	Multi-Factor	Quality	Min Vol Value
Estate/Donation	0.46	0.61	0.32	0.50	1.50	2.20
Liquidation	0.04	0.06	–0.12	–0.01	0.55	1.00

Figure 9: *Median hurdle rates for six factor tilts in the US market. June 1995–March 2018. Source: Aperio Group, LLC.*

Regimes

Like put options and other defensive strategies, loss harvesting has been most effective in turbulent, declining markets.[23] We quantify this for a beta-1 strategy, Value, and a lower-risk strategy, Quality. We sorted 10-year returns to Value and Quality into quintiles on the basis of performance of the underlying index. In Figure 10, we show the average index return along with average tax alpha, factor alpha and pre-tax residual for the tilts. For both strategies, tax alpha (orange bars) tended to improve as index performance diminished. Factor alpha in Quality showed a similar tendency, consistent with the defensive nature of lower-risk strategies. For Value, in contrast, there was no apparent relationship between factor alpha and index return.





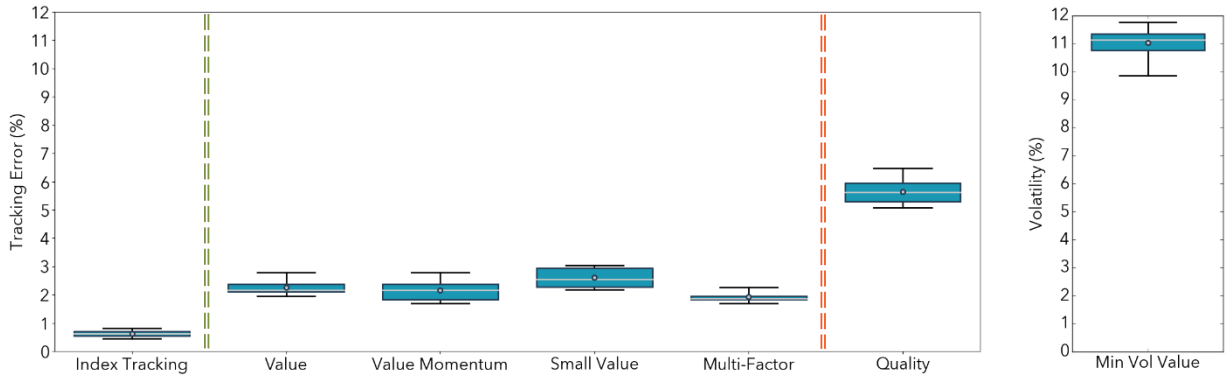
[23] The association of volatility and market decline is known as the leverage effect, and it was first documented in Black (1976).

Figure 10: *Ten-year index return, factor alpha, and tax alpha of tax-managed factor tilts in the estate/donation disposition averaged over quintiles by index return, June 1995–March 2018. Left panel: US Value. Right panel: US Quality. Source: Aperio Group, LLC.*

Risk

Loss harvesting tends to increase risk. We look at its effect on tracking error, the width of the distribution of pre-tax returns relative to a diversified benchmark, for an indexing strategy, Value, Value Momentum, Small Value, Multi-Factor, and Quality, and on total volatility for Minimum Volatility plus Value. A baseline is in Figure 11, which shows realized risk of tax-managed tilts.[24]

Tracking error was higher for Quality than for the beta-1 strategies, illustrating the unavoidable trade-off between absolute and relative risk in equity markets. The lowest tracking error was achieved for the tax-managed index, which was not afflicted by tilt constraints.



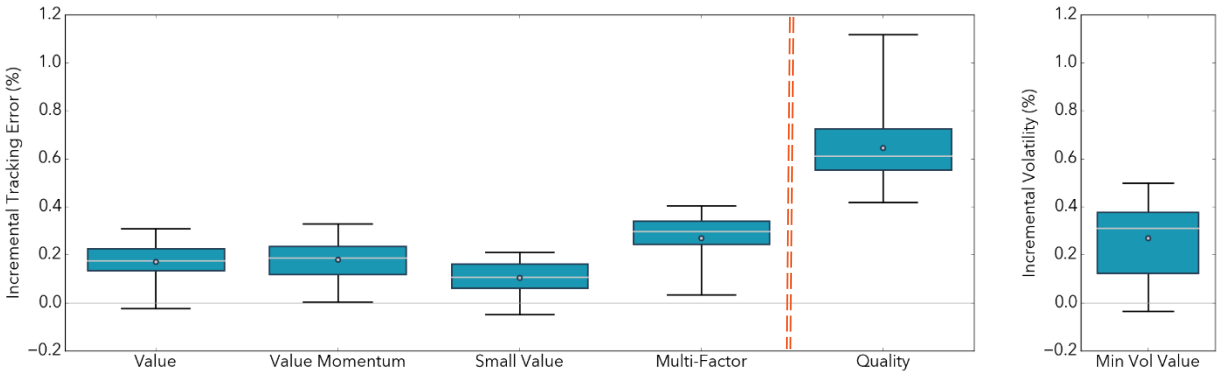
Portfolio	Index Tracking	Value	Value Momentum	Small Value	Multi-Factor	Quality
Median	0.62	2.16	2.17	2.56	1.87	5.62

Min Vol Value
11.13

Figure 11: *Realized risk (TE or volatility) for a tax-managed indexing strategy and six factor tilts over a 10-year horizon in the US market. June 1995–March 2018. Source: Aperio Group, LLC.*

In Figure 12, we look at the difference in risk between tax-managed and tax-indifferent factor tilts. The difference is the incremental risk due to loss harvesting. There are differences in scale between Figure 11, measured in percent, and in Figure 12, measured in tenths of a percent.

[24] Tracking error is the standard deviation of the difference in return between a portfolio and its benchmark before taking account of taxes. Incorporation of tax alpha introduces a substantial right skew, which calls for a nuanced risk assessment.



Portfolio	Value	Value Momentum	Small Value	Multi-Factor	Quality
Median	0.18	0.19	0.11	0.30	0.61

Min Vol Value
0.31

Figure 12: *Difference in realized risk (TE or volatility) between tax-managed and tax-indifferent versions of six factor tilts at a 10-year horizon in the US market. June 1995–March 2018. Source: Aperio Group, LLC.*

The Relative Abundance of Tax Alpha in Beta-1 Strategies

Figures 5 and 7 show that tax alpha was more abundant in strategies with higher absolute risk. Here, we provide two potential explanations for this finding.

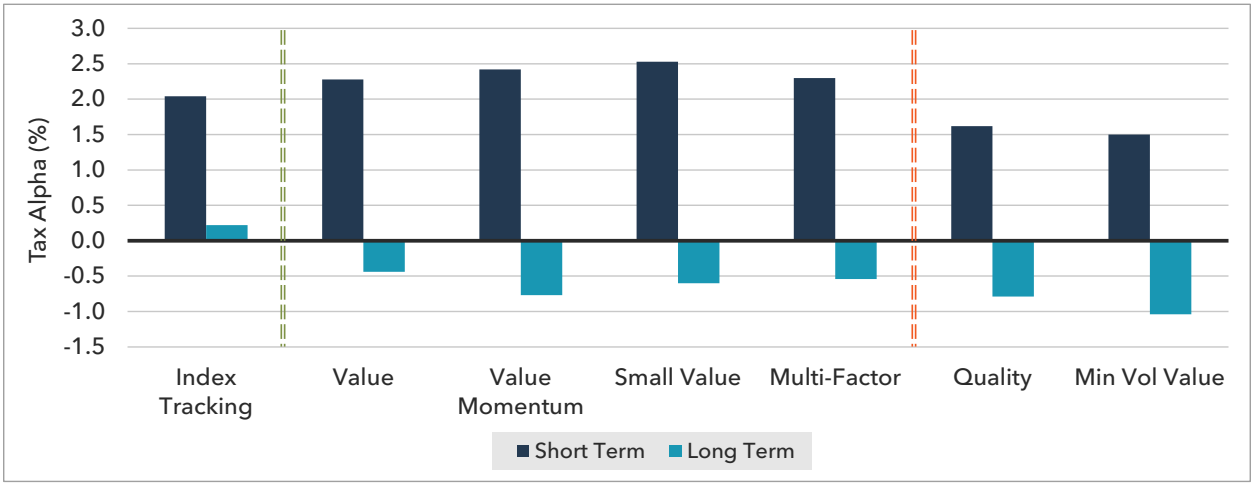
Loss harvesting tends to be less effective when the universe of securities is sufficiently small, or when the securities themselves are sufficiently low volatility. We believe this supposition is supported by the results set forth in Table 4, which shows the median number of stocks in each US strategy over the study period, as well as the median strategy volatility. Relative to the lower-risk strategies, the index-tracking and beta-1 strategies have more securities and higher average forecast security volatility.

	Number of Securities	Forecast Volatility (%)
Index Tracking	743	14.79
Value	274	14.88
Value Momentum	245	14.89
Small Value	596	15.29
Multi-Factor	323	14.86
Quality	100	11.62
Min Vol Value	129	10.84

Table 4: *Median number of stocks and median forecast volatility for a tax-managed indexing strategy and six factor tilts in the US market. June 1995–March 2018. Source: Aperio Group, LLC.*

The Implicit Tax Arbitrage in Tax-Managed Factor Tilts

Based on prior research, we believed that the observed outcomes in the present study of tax alpha in the beta-1 strategies seemed high. Our deeper investigation put this observation into perspective and potentially provides an explanation. The optimization in Formula (1) executes an implicit tax arbitrage, selectively realizing long-term gains in order to satisfy strategy constraints in the most tax-effective means possible. The realization of gains raises the cost basis of the portfolio, facilitating the harvesting of short-term losses. With respect to the factor-tilted strategies, and in contrast to our index-tracking strategy, tax alpha was the net result of short-term losses and long-term gains. Consequently, we believe that the full benefits of loss harvesting in a factor tilt can be enjoyed only by investors with ample short-term gains to offset. The decomposition of average tax alpha into short- and long-term components in shown in Figure 13.[25]



Portfolio	Index Tracking	Value	Value Momentum	Small Value	Multi-Factor	Quality	Min Vol Value
Short-Term	2.04	2.28	2.42	2.53	2.30	1.62	1.50
Long-Term	0.22	-0.44	-0.77	-0.60	-0.54	-0.79	-1.04

Figure 13: *Decomposition of 10-year average estate/donation tax alpha into short-term and long-term components.US market, June 1995–March 2018. Source: Aperio Group, LLC.*

[25] The decomposition in Figure 13 was obtained by compounding returns to a synthetic strategy consisting of pre-tax return plus the value of short-term losses.

Fees

The results in this article have been presented gross of management fees, which vary widely (to say the least) across the financial services industry. Median after-tax active return to the seven US strategies under different fee scenarios are presented in Table 5.

	Index Tracking	Value	Value Momentum	Small Value	Multi-Factor	Quality	Min Vol Value
No Fee	2.27	2.76	2.68	3.87	3.44	2.37	2.34
30 bps	1.97	2.46	2.38	3.57	3.14	2.07	2.04
70 bps	1.57	2.06	1.98	3.17	2.74	1.67	1.64
100 bps	1.27	1.76	1.68	2.87	2.44	1.37	1.34

Table 5: *Ten-year median estate/donation after-tax active return for an indexing strategy and six factor tilts under different fee scenarios. US market, June 1995–March 2018. Source: Aperio Group, LLC.*

Summary

Is an investor's alpha big enough to cover its taxes? It's been a quarter-century since Rob Arnott and Rob Jeffrey first posed this question, and we're making some progress toward answering it. In this article, we have added to the literature by looking historically at loss harvesting in an indexing strategy and six factor tilts in the US equity market over the period June 1995 to March 2018. We focused on a 10-year horizon, and we generated 52 outcomes for each strategy by varying the start date. Unlike standard back-tests that give point estimates, our analysis gives an indication of the range of possibilities.

We found that regular loss harvesting substantially increased after-tax active return in all seven strategies we examined. Tax alpha was most abundant in the tax-managed index-tracking strategy, and it was also substantial in the four beta-1 strategies with factor constraints. In lower-risk strategies, which are composed of fewer and less-volatile securities, tax alpha was diminished.

Our results illustrate the potential value of loss harvesting, especially in relation to the incremental risk that it generates. But it's important for a taxable investor who wants to apply our results to keep the most impactful underlying assumptions in mind. The value of loss harvesting is diminished by fees, which can be large enough as to materially affect the value of loss harvesting. State taxes increase the value of loss harvesting. Liquidation generally diminishes the value of loss harvesting, and tax alpha tends to diminish as the investment horizon grows.

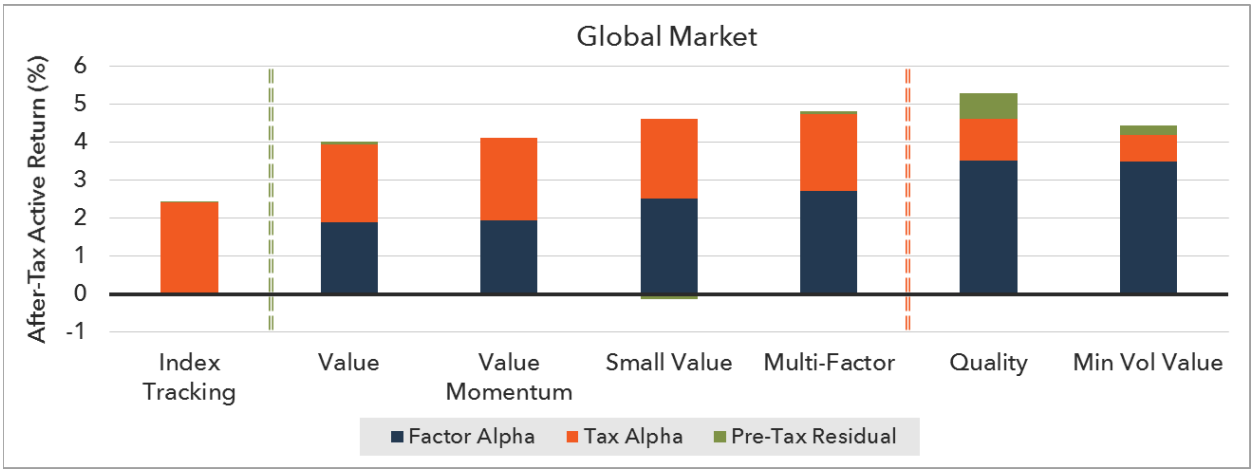
A taxable investor choosing a tilt might benefit from looking at his alpha assumptions side-by-side with the strategy's hurdle rate, which is the value of tax management sacrificed relative to the indexing strategy. Hurdle rates were relatively small in the beta-1 strategies we examined and were larger in the lower-risk strategies.

Our analysis assumes an adequate supply of short- and long-term capital gains to be offset. Historical after-tax returns for an investor with only long-term capital gains would have been diminished relative to what we've shown in this article, and an investor with no capital gains would surely have been better off in a low-cost ETF than in a loss-harvesting account. The implicit tax arbitrage that drives tax alpha in factor strategies may make them inappropriate for an investor who does not have short-term gains to offset.

In conclusion, tax management is beneficial, but the wide spectrum of circumstances in which taxable investors may find themselves means that customization may be essential. One size does not fit all.

Appendix A: Global Markets

Figure A1 shows average after-tax active return and its components for global tax-managed versions of the index-tracking strategy and six factor tilts. A comparison with Figure 1 shows that index performance was slightly lower in the global market than in the US market, but after-tax active return in the global market was higher for all strategies, often by a wide margin.



	Index Tracking	Value	Value Momentum	Small Value	Multi-Factor	Quality	Min Vol Value
Index Return	5.52	5.52	5.52	5.52	5.52	5.52	5.52
After-Tax Active Return	2.43	4.02	4.09	4.50	4.81	5.29	4.44
Factor Alpha	0.00	1.89	1.95	2.52	2.73	3.52	3.50
Tax Alpha	2.42	2.05	2.16	2.09	2.00	1.11	0.70
Pre-Tax Residual	0.01	0.08	-0.03	-0.12	0.07	0.66	0.24

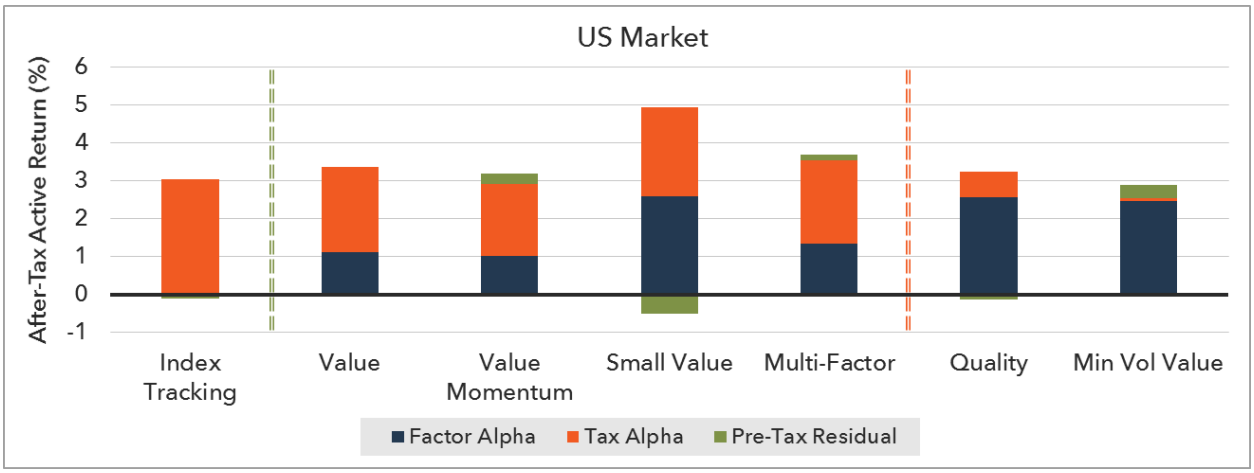
Figure A1: *Ten-year average estate/donation after-tax active return for a tax-managed indexing strategy and six factor tilts for the global market. June 1995–March 2018. Source: Aperio Group, LLC.*

Appendix B: California Tax Rates

Loss-harvesting can add more value in a state with high taxes like California than in a no-tax state like Texas. Assumed tax rates for a California investor are shown in Table B1. Figure B1 shows average after-tax active return and its components for California tax-managed versions of the index-tracking strategy and six factor tilts.

Tax Rate	
Short-Term	54.1%
Long-Term	37.1%
Dividend	37.1%

Table B1: *Assumed tax rates are at the highest federal plus California level as of January 2018.*



	Index Tracking	Value	Value Momentum	Small Value	Multi-Factor	Quality	Min Vol Value
Index Return	5.83	5.83	5.83	5.92	5.83	5.83	5.83
After-Tax Active Return	2.94	3.36	3.19	4.44	3.70	3.11	2.90
Factor Alpha	0.00	1.13	1.01	2.60	1.35	2.58	2.47
Tax Alpha	3.05	2.23	1.91	2.35	2.19	0.67	0.07
Pre-Tax Residual	–0.10	0.00	0.27	–0.51	0.15	–0.14	0.37

Figure B1: *Ten-year average estate/donation after-tax active return for a tax-managed indexing strategy and six factor tilts under California tax rates. June 1995–March 2018. Source: Aperio Group, LLC.*

Appendix C: Strategy Specification

Aperio's ATBAT (After-Tax Back-Testing Analysis Tool) platform constructs portfolios with Barra models and software. We used the Barra US Total Market Equity Model for Long-Term Investors (USSLOWL) for all US back-tests and the Barra Global Total Market Equity Model for Long-Term Investors (GEMLTL) for all global back-tests. The optimizer settings that we used in this study are included below. This appendix does not include comprehensive documentation of Barra. More information is available in Barra documentation.[26]

[26] Documentation on Barra models is in Bayraktar et al. (2014) and Morozov et al. (2015).

General Settings

Model	
Barra Model	USSLOWL for US strategies; GEMLTL for global strategies
Optimization	
Type	After-Tax
Initial Cash	10,000,000
Transactions	Buy From Universe Only
Transaction Costs	
Buy Costs (%)	0.06%
Sell Costs (%)	0.06%
Holdings	
General Holding Upper Bound (%)	100 for Index Tracking; 1.5 for Min Vol Value; 3 for other tilts
General Holding Lower Bound (%)	0
Taxes	
Short-Term Tax Rate (%)	40.8
Long-Term Tax Rate (%)	23.8
Tax Lot Relief	Min Tax Liability

Reference Portfolios

US

	Value	Value Momentum	Small Value	Multi-Factor	Quality	Min Vol Value
Objective	Min TE	Min TE	Min TE	Min TE	Min TE	Min Var
Benchmark	R1000	R1000	R3000	R1000	R1000	Cash
Universe	R1000	R1000	R3000	R1000	R1000	R1000
Target Beta	1	1	1	1	0.75	N/A
Sector Constraints	benchmark +/- 1	benchmark +/- 1	benchmark +/- 1		benchmark +/- 10	performance benchmark +/- 5
Industries				benchmark +/- 5		
Risk Index Tilts						
Book-to-Price	+	+	+	+		+
Earnings Yield	+	+	+	+	+	+
Momentum		+		+		
Residual Volatility					+	
Beta					+	
Earnings Quality					+	
Profitability				+	+	
Management Quality				+		
Leverage					+	
Size			+	+	+	

Global

	Value	Value Momentum	Small Value	Multi-Factor	Quality	Min Vol Value
Objective	Min TE	Min TE	Min TE	Min TE	Min TE	Min Var
Benchmark	MSCI ACWI	MSCI ACWI	MSCI ACWI	MSCI ACWI	MSCI ACWI	Cash
Universe	MSCI ACWI	MSCI ACWI	MSCI ACWI	MSCI ACWI	MSCI ACWI	MSCI ACWI
Target Beta	1	1	1	1	0.75	N/A
Sector Constraints	benchmark +/- 2	benchmark +/- 2	benchmark +/- 2		benchmark +/- 10	performance benchmark +/- 5
Country Constraints						performance benchmark +/- 5
Risk Indexes						
Book-to-Price	+	+	+	+	+	+
Earnings Yield	+	+	+	+	+	+
Momentum		+		+		
Residual Volatility					+	
Beta					+	
Earnings Variability					+	
Earnings Quality					+	
Profitability				+	+	
Investment Quality				+		
Leverage					+	
Size			+	+	+	

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Disclosure

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The Russell 1000® Index is an equity benchmark for US stock performance. It is a capitalization-weighted index covering the largest 1,000 publicly traded US stocks. The index represents approximately 90% of the total market capitalization of the US stock market.

The Russell 3000® Index is an equity benchmark for US stock performance. It is a capitalization-weighted index covering the largest 3,000 publicly traded US stocks. The index represents approximately 98% of the total market capitalization of the US stock market.

The MSCI ACWI Index is an equity benchmark for global stock performance. It is a capitalization-weighted index covering large and midsize companies. The index includes approximately 2,800 stocks from 23 developed-market countries and 24 emerging-market countries.

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