FINANCIAL SERVICES REVIEW

Financial Services Review 27 (2018) 257-277

# Improving long-term portfolio risk and return by using appreciated stocks for charitable donations

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**Abstract**

Stock investors who are charitable donors can minimize capital gains taxes and improve portfolio diversification by donating their most appreciated shares instead of cash, and then investing the freed-up cash in the portfolio's least-weighted stocks. The charity is indifferent to the donation method, and the investor receives the same charitable deduction. Monte Carlo simulations show that a donor-investor using this method enjoys substantially higher wealth and lower portfolio risk, particularly over longer time horizons. This strategy can be integrated with tax loss selling and some limited gain harvesting to further increase after-tax returns and reduce risk. © 2018 Academy of Financial Services. All rights reserved.

*JEL classifications:* G11; H24

*Keywords:* Stock donation; Capital gains; Tax-efficient investing; Diversification return; Portfolio risk

## 1. Introduction

It has long been recognized that investors can minimize their tax liabilities and improve after-tax returns by strategically holding and selling different stocks in their portfolios according to the gains and losses each has accrued. Constantinides (1983) shows that investors can experience substantial wealth gains by selling stocks that have declined to capture the tax benefit of the capital loss deduction, and argues that investors should avoid selling winning stocks for as long as possible to delay the payment of capital gains taxes.

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While the tax advantage of selling investments that have dropped is obvious, there has been more debate on what to do with those that have gone up. In a follow-up to his original study, Constantinides (1984) concludes that when the tax rate on long-term capital gains is lower than that on ordinary income (against which losses may be deducted), investors are better off if, in addition to realizing losses every year, they also realize gains in alternating years, thereby resetting the basis on the entire portfolio and planting the seeds for future capital loss realizations. However, Dammon, Dunn, and Spatt (1989) argue that the value of the "tax option" this creates is highly dependent on the particular pattern of realized stock returns and other factors, and is less than Constantinides suggests. Stein, Vadlamudi, and Bouchey (2008) note that the effectiveness of gain harvesting depends on a number of variables, including the difference between long-term and short-term tax rates, the size of the accrued gain, the investor's time horizon, and whether a step-up in basis is expected.

In a study considering both the expected return and risk of several tax-efficient investing strategies, Smith and Smith (2008) note that deferring capital gains as long as possible has the undesirable effect of inhibiting portfolio rebalancing. Because the stocks with accrued gains are not sold, they come to dominate a larger portion of the portfolio over time, and the investor's risk increases because of the loss of diversification. An alternative strategy they propose is to realize all losses, but also harvest enough gains to offset any losses in excess of the $3,000 that may be deducted against ordinary income in a given year. The funds generated from stock sales are then used to purchase more shares of the stocks that make up a smaller part of the portfolio. In a long-term simulation, this produces higher after-tax returns and lower risk than any of the strategies studied by Constantinides (1983, 1984).

A more recent paper by Whitworth and McCormack (2011) suggests that some investors can do better still. According to the Statistics of Income Division of the Internal Revenue Service, 37 million individuals reported a total of $201 billion in itemized charitable deductions for tax year 2015, and actual donations are almost certainly higher because many income tax filers claim the standard deduction instead of itemizing. For stock investors who are regular charitable donors, the tax code provides a way—in addition to the usual charitable deduction—to pay even less in taxes while rebalancing their portfolios, simultaneously increasing after-tax return and reducing risk. Although no one knows beforehand whether a purchased stock will go up or down, an investor can dispose of it optimally after the fact to either minimize the associated tax liability or receive the greatest tax benefit. If the stock drops in value, tax loss selling still makes sense. However, if the stock rises, the investor can use it in lieu of cash to make the originally planned donation. The charity is indifferent to the method of donation, and the donor receives the same charitable deduction at full market value, so long as the stock has been held for more than a year. Moreover, because the investor never actually sells the appreciated stock, its accrued gain is never realized for tax purposes, so no capital gains taxes are ever paid on those shares.[1] The cash originally set aside for the donation (presumably equal in value to the appreciated stock) is now freed up to be invested in the portfolio, and the tax basis on any newly purchased shares will be the current market value. Effectively, then, the investor receives a "step-up in basis," permanently eliminating (rather than merely deferring) the accrued capital gains tax liability on the gifted shares.

In choosing which shares to donate, it is generally best to begin with those having the largest percentage gains, thereby freeing the investor from as much capital gains tax liability

as possible. This maximizes after-tax returns, but it also has another crucial benefit. By disposing of these shares and then investing any freed-up cash in the stocks which have fallen in value (or have not grown as much), funds are reallocated away from the most heavily weighted stocks in the portfolio and toward lesser-weighted ones. This prevents the portfolio from becoming too concentrated, thereby improving diversification and reducing overall risk. Several studies (e.g., Boyle et al., 2004; Feld, 1999; Welch, 2002) note the increased risk associated with highly concentrated stock positions, and Welch (2002) specifically suggests charitable donation as an avenue for lessening one's exposure.

It should be noted that the stock donation strategy—like tax loss selling and gain harvesting—applies only to stocks in regular taxable accounts, because capital gains and losses are not recognized on transactions within tax-deferred or tax-exempt IRAs and 401(k)s. While individuals generally should take advantage of these accounts, many stocks are still optimally held in taxable accounts because (1) the amount that can be contributed to retirement accounts is limited, and (2) when one also owns tax-inefficient investments such as taxable bonds and/or actively managed mutual funds, these generally should be prioritized (i.e., ahead of stocks) for location in tax-advantaged accounts (Horan, 2005; Reichenstein, 2007; Shoven and Sialm, 2003).

It is also important to remember that this strategy works only for those who already intend to make charitable contributions. It makes no sense to become a donor for the sole purpose of avoiding capital gains taxes. However, for those who view their gift as a sunk cost, the additional tax benefit from using appreciated shares in lieu of cash can be substantial, as previous studies have noted. In a detailed examination of this strategy, Whitworth and McCormack (2011) demonstrate that in a one-period framework, the expected after-tax return can actually exceed the expected pretax return. This counterintuitive result derives from the fact that the donor-investor receives a tax deduction if the stock goes down but effectively enjoys a tax-free capital gain if it rises. Other studies (Aperio Group, 2017; Bakija and Heim, 2011; Reichenstein, 2007) have acknowledged the additional tax savings and increased return from donating appreciated stock, and it appears that investors are aware of the benefits as well. Ackerman and Auten (2011) report that in 2005, about 10% of all charitable deductions (26% for the top 1% of income earners) were for donations of stock, which typically had very low cost bases relative to their market values. Welch (2002) also notes that private foundations and community-based donor-advised funds have become increasingly popular vehicles for philanthropically minded investors to dispose of low-basis stock.

Although most financial planners and tax professionals understand that donating appreciated stock can be advantageous, there have so far been no published studies quantifying the long-term benefits of doing so. Using a Monte Carlo simulation approach, this paper demonstrates that better integration of portfolio management, charitable giving, and tax trading substantially increases returns and reduces risk. Section 2 describes the simulation procedure. Section 3 shows how terminal wealth, standard deviation (SD), diversification, and shortfall risk are affected by stock donation in conjunction with other tax-efficient strategies. Section 4 discusses recent changes in the tax law that may be relevant to investors, and how the strategies in this paper could be affected by future changes. Section 5 discusses the implications of our findings for financial planning.

## 2. Simulation methodology

We assume that an individual initially has annual wages of $100,000 that will grow at 3% per year. Ordinary income is taxed at 24%, while long-term capital gains are taxed at 15%. The individual begins with a $250,000 portfolio invested equally across 25 non-dividend-paying stocks[2] in a regular taxable account. In each year $t$, a simulated return for each stock $i$ is generated as

$$R_{it} = R_{mt} + \varepsilon_{it} \qquad (i = 1, 2, \ldots, 25),$$

where the year $t$ market return $R_{mt}$ is drawn from a normal distribution with mean 8% and SD 20%, and each idiosyncratic stock return component $\varepsilon_{it}$ ($i = 1, 2, \ldots, 25$) is drawn independently from a normal distribution with mean zero and SD 34.641%. The market and idiosyncratic volatilities $\sigma_m = 0.2$ and $\sigma_\varepsilon = 0.34641$ are chosen so that the total SD of each stock $i$ is

$$\sigma_i = \sqrt{\sigma_m^2 + \sigma_\varepsilon^2} = \sqrt{0.2^2 + 0.34641^2} = 0.4 = 40\%$$

and the contemporaneous correlation between returns of any two stocks $i$ and $j$ in the same year is

$$\rho_{ij} = \frac{\sigma_{ij}}{\sigma_i \sigma_j} = \frac{\sigma_m^2}{\sigma_i \sigma_j} = \frac{0.2^2}{0.4 \cdot 0.4} = 0.25.$$

These are the same values for $\sigma_i$ and $\rho_{ij}$ used in the simulation of Smith and Smith (2008). In general, investors attempting to profit from the asymmetric tax treatment of gains and losses should choose stocks with relatively high volatility and low correlation.[3]

Consistent with the extensive literature on market efficiency (Fama, 1970, 1991; Malkiel, 2003), there is no serial correlation between the simulated returns across different years. Therefore, the investor does not attempt to time the market based on a momentum or reversal strategy, but makes trading decisions each year based solely on tax efficiency and portfolio diversification. We consider three possible rules for deciding when to sell stocks:

1. Buy and hold: No stocks are ever sold, regardless of gains or losses incurred.
2. Realize losses only: Each lot of stock that has declined below its original cost basis is sold so that up to $3,000 of capital losses can be deducted against ordinary income each year. Any losses in excess of $3,000 are carried forward to future years.
3. Realize losses and "rebalancing gains": As explained in Smith and Smith (2008), all losses are realized, but the investor also realizes enough gains to offset any losses in excess of $3,000. To keep the portfolio as balanced as possible, shares of the stock comprising the largest portion of the portfolio are sold first until its weight equals that of the second largest stock, then shares of the first two stocks are sold until their respective weights equal that of the third, and so on until (a) all excess losses have been offset, or (b) there are no more gains in the portfolio to realize.[4]

At the end of each year, regardless of how the market has performed, the investor donates a fixed percentage (either 0%, 5%, or 10%) of his or her wage income to charity.

To the maximum extent possible, the investor contributes appreciated shares in lieu of cash, and then replenishes the portfolio with any cash that otherwise would have been donated. This substitution does not change the portfolio's value, but it does erase the accrued capital gains tax liability on the donated shares, effectively raising the basis on that part of the portfolio to current market value. To obtain the maximum tax benefit, the investor uses a "lowest in, first out" technique—donating shares from the lot with the lowest basis-to-value ratio (i.e., largest percentage gain), then the second lowest ratio, and so on until the entire planned donation has been made. If at any point there are no more stocks in the portfolio with accrued gains, then the remainder of the donation is made in cash as originally planned.

Along with the cash that had been earmarked but not used for donation, the individual immediately uses any proceeds from selling stocks (including the tax savings from harvesting capital losses) to purchase new shares. For optimal diversification, funds are invested first in the stock with the smallest portfolio weight until its weight equals that of the second smallest stock, then in the smallest two stocks until their respective weights equal that of the third smallest, and so on until all cash has been invested.[5]

This process is repeated for each year in the investment time horizon (that is assumed to be either 10, 20, 30, 40, or 50 years), after which the portfolio is liquidated and long-term capital gains taxes are finally paid on the difference between its total market value and cost basis.

For each possible selling criterion, charitable contribution level, and time horizon, one million simulations are run as described above. The next section discusses the resulting statistics on terminal wealth, portfolio diversification, and risk for each scenario.

## 3. Simulation results

### *3.1. Mean and median effect on terminal wealth*

Table 1 reports the mean and median ratios of an investor's after-tax terminal wealth from alternative tax-efficient strategies versus a pure buy-and-hold strategy. Results are shown for annual charitable contribution levels of up to 10%, and for time horizons up to 50 years. Regardless of whether the investor realizes capital gains and/or losses, donating appreciated stock instead of cash significantly increases terminal wealth, and the more one regularly donates, the greater the benefit of doing so with stock. For example, as shown in Panel A, an investor who does not harvest capital losses but does donate 10% of his annual wage income can realize a mean (median) wealth increase of 33% (26%) over a 30-year time frame compared with a pure buy-and-hold strategy. The benefits are even greater when using this strategy for longer. Over 40 years, the same investor ends up on average with 62% more wealth versus buy-and-hold, and over 50 years, the mean increase is 107%.

Although larger charitable donors certainly have more of an opportunity to reap the benefits of this strategy, significant gains are still available to smaller donors. In this simulation, a 5% donor realizes about two-thirds of the wealth gain enjoyed by a 10% donor. For example, a 5% donor who contributes stock in lieu of cash enjoys a mean wealth increase

Table 1 Mean (median) ratio of terminal wealth from tax-efficient investment strategies vs. buy-and-hold

| Years invested | Percentage of income donated via appreciated stock | | |
|---|---|---|---|
| | 0% | 5% | 10% |
| | Panel A: Realize no losses or gains (buy and hold) | | |
| 10 | 1.00 (1.00) | 1.03 (1.03) | 1.05 (1.05) |
| 20 | 1.00 (1.00) | 1.09 (1.08) | 1.15 (1.13) |
| 30 | 1.00 (1.00) | 1.21 (1.16) | 1.33 (1.26) |
| 40 | 1.00 (1.00) | 1.42 (1.27) | 1.62 (1.43) |
| 50 | 1.00 (1.00) | 1.73 (1.41) | 2.07 (1.67) |
| | Panel B: Realize all losses each year | | |
| 10 | 1.01 (1.01) | 1.04 (1.04) | 1.06 (1.06) |
| 20 | 1.04 (1.02) | 1.12 (1.10) | 1.18 (1.16) |
| 30 | 1.08 (1.03) | 1.27 (1.19) | 1.39 (1.30) |
| 40 | 1.13 (1.04) | 1.51 (1.32) | 1.71 (1.49) |
| 50 | 1.22 (1.06) | 1.87 (1.49) | 2.20 (1.74) |
| | Panel C: Realize all losses and offsetting gains | | |
| 10 | 1.03 (1.02) | 1.05 (1.04) | 1.06 (1.06) |
| 20 | 1.11 (1.08) | 1.16 (1.13) | 1.19 (1.17) |
| 30 | 1.26 (1.17) | 1.36 (1.27) | 1.42 (1.33) |
| 40 | 1.48 (1.27) | 1.69 (1.47) | 1.79 (1.57) |
| 50 | 1.78 (1.39) | 2.18 (1.74) | 2.36 (1.89) |

of 21% after 30 years, compared with a 33% increase for a 10% donor. This non-linearity in the relationship between donation level and terminal wealth exists because for higher annual giving amounts, there is a greater chance (particularly in down market years) of not having enough appreciated stocks for the full intended donation, and thereby being unable to take full advantage of the accompanying tax benefits.

It is certainly possible for a donor-investor to do even better by using tax-efficient selling rules. In all but the strongest bull markets, a portfolio is likely to have at least a few losing investments. As is clear from Panel B of Table 1, simply realizing those capital losses and investing the tax savings has a long-term positive impact on the portfolio. As a comparison across columns shows, the investor who harvests capital losses still derives about the same incremental wealth increase from donating appreciated stock. Both can be done simultaneously, since the accrued gains on the donated shares are never actually realized for tax purposes and therefore do not affect the investor's capital loss deduction.

As shown in Panel C, a strategy of harvesting enough gains each year to offset any capital losses in excess of $3,000 improves portfolio performance even more. At first, it seems counterintuitive that realizing capital gains early could help. However, these gains do not incur a tax liability, as they are used only to offset losses that cannot be deducted against ordinary income in that year and would otherwise have to be carried forward to future years. While this does eliminate the possibility of deducting those losses in future years, it is quite likely that at least a few stocks in the portfolio will decline next year. For such declines to translate into deductible losses, those stocks cannot be trading too far above their cost bases—otherwise, the decline will simply turn a larger accrued gain into a smaller one. Selling some stocks with gains resets the basis on that part of the portfolio, "planting seeds" for potential future loss deductions.

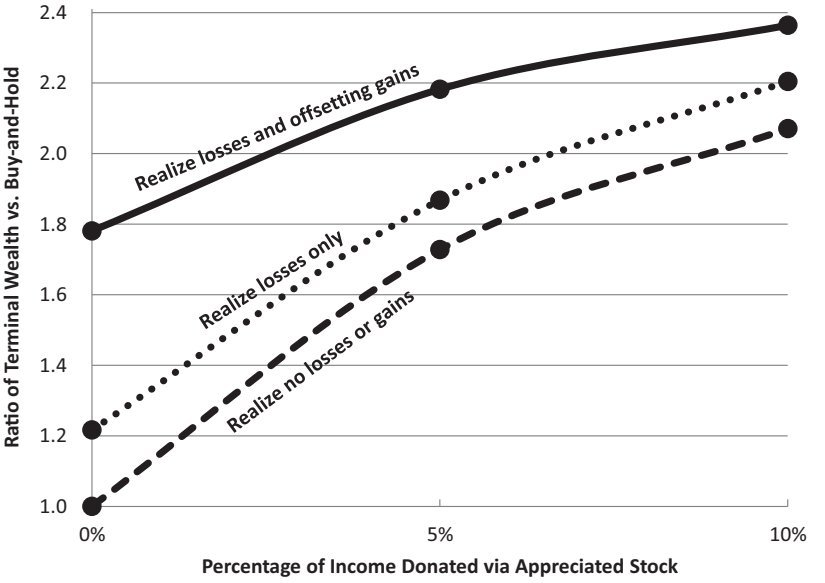


Fig. 1. Mean ratio of terminal wealth versus buy-and-hold for alternative investment strategies (50-year horizon).

An investor who realizes offsetting gains can also benefit from donating appreciated stock, and it is better to use both strategies than merely one or the other. However, the additional benefit of donating appreciated shares is smaller when one already realizes offsetting gains, and vice versa. For example, consider an individual with a 30-year horizon who realizes only capital losses and donates 5% of her income to charity in cash (i.e., 0% in stock). As shown in Panels B and C, she can increase her mean terminal wealth ratio from 1.08 to 1.26 by also realizing offsetting gains, or to 1.27 by donating appreciated stock instead of cash—an improvement of 18 or 19 percentage points relative to the buy-and-hold benchmark. However, if she further decides to implement both strategies simultaneously, her mean ratio increases to 1.36—still an improvement, but only an additional 9 or 10 percentage points. This happens because both strategies use the stocks that have increased in value most and now comprise a larger percentage of the portfolio. In some cases (particularly in bear markets), there may not be enough winning stocks to fully execute both strategies, which explains the result noted above. However, in many years the investor will be able to do both, and certainly should whenever possible.

Fig. 1 summarizes the results presented in the above table for a 50-year investor, clearly illustrating the long-term wealth gains available to those who donate appreciated stock. Regardless of the selling rule(s) used (i.e., whether the investor harvests losses and/or gains), a 5% donor's terminal wealth is much greater than that of a non-donor, and a 10% donor does better still (although the additional improvement from 5% to 10% is somewhat smaller). Fig. 1 also illustrates that for each charitable donation level (0%, 5%, and 10%), one is clearly better off recognizing capital losses, and better still recognizing offsetting gains as well. The benefit of harvesting losses is similar regardless of how much one donates. The incremental benefit of harvesting offsetting gains is positive for all donation levels, but as previously discussed, it is somewhat smaller for stock donors than for non-donors.

Table 2 Ratio of standard deviation of terminal wealth from tax-efficient investment strategies vs. buy-and-hold

| Years invested | Percentage of income donated via appreciated stock | | |
|---|---|---|---|
| | 0% | 5% | 10% |
| | | Panel A: Realize no losses or gains (buy and hold) | |
| 10 | 1.00 | 0.99 | 0.98 |
| 20 | 1.00 | 0.95 | 0.94 |
| 30 | 1.00 | 0.91 | 0.86 |
| 40 | 1.00 | 0.86 | 0.80 |
| 50 | 1.00 | 0.83 | 0.75 |
| | | Panel B: Realize all losses each year | |
| 10 | 1.01 | 0.99 | 0.99 |
| 20 | 1.01 | 0.97 | 0.95 |
| 30 | 1.01 | 0.92 | 0.87 |
| 40 | 1.01 | 0.86 | 0.79 |
| 50 | 0.99 | 0.83 | 0.72 |
| | | Panel C: Realize all losses and offsetting gains | |
| 10 | 0.98 | 0.98 | 0.98 |
| 20 | 0.95 | 0.94 | 0.93 |
| 30 | 0.91 | 0.85 | 0.82 |
| 40 | 0.87 | 0.80 | 0.77 |
| 50 | 0.80 | 0.68 | 0.59 |

### *3.2. Effect on standard deviation of terminal wealth*

In addition to increasing after-tax returns, the stock donation strategy advocated here has a very desirable side effect: it reduces risk through improved diversification. If left alone over time, a handful of stocks will eventually grow to dominate a disproportionate share of a portfolio. This follows from Bessembinder's (2018) observation that long-horizon compounded returns are skewed even if single-period returns are not. While the investor is certainly better off because of the gains of these past winners, the portfolio then becomes over-dependent on their future performance, which cannot be guaranteed. Regularly donating the most appreciated shares helps reduce portfolio imbalances while never actually realizing gains for tax purposes. The cash which otherwise would have been donated is then invested in the least-weighted stocks to further facilitate rebalancing.

As shown in Table 2, the stock donation strategy does reduce risk versus a buy-and-hold benchmark, and the more charitable one is, the greater the benefit. For example, the SD (in dollars) of terminal wealth after 40 years for an investor who realizes losses and donates 10% of his annual income via appreciated stock is only 79% of what it would be for a buy-and-hold investor who donates only cash. As previously noted, one does not have to be a large donor to benefit from this. If the same investor donated only 5% of his income, his SD would be 86% of its buy-and-hold level, thereby still realizing about two-thirds the risk reduction that a 10% donor could. As expected, the longer the investment period, the greater the benefit. Over relatively short periods of 10 years or less, SD is not much different from what it would be using a buy-and-hold approach. However, the improvement becomes substantial over longer periods.

Table 3 Mean portfolio concentration index (sum of squared weights) from alternative investment strategies

| Years invested | Percentage of income donated via appreciated stock | | |
|---|---|---|---|
| | 0% | 5% | 10% |
| | | Panel A: Realize no losses or gains (buy and hold) | |
| 10 | 0.10 | 0.07 | 0.06 |
| 20 | 0.18 | 0.09 | 0.07 |
| 30 | 0.26 | 0.12 | 0.09 |
| 40 | 0.33 | 0.15 | 0.10 |
| 50 | 0.38 | 0.17 | 0.13 |
| | | Panel B: Realize all losses each year | |
| 10 | 0.09 | 0.06 | 0.05 |
| 20 | 0.16 | 0.09 | 0.07 |
| 30 | 0.23 | 0.12 | 0.09 |
| 40 | 0.28 | 0.15 | 0.11 |
| 50 | 0.33 | 0.17 | 0.13 |
| | | Panel C: Realize all losses and offsetting gains | |
| 10 | 0.05 | 0.05 | 0.04 |
| 20 | 0.08 | 0.06 | 0.05 |
| 30 | 0.12 | 0.07 | 0.06 |
| 40 | 0.17 | 0.09 | 0.07 |
| 50 | 0.22 | 0.11 | 0.09 |

An additional clarification is in order here. The risk reduction *relative to portfolio value* is actually greater than the values in Table 2 might suggest, because average terminal wealth is higher with the tax-efficient strategies. Even if all ratios in the table were equal to 1.00 (indicating no change in the dollar amount of the SD), that would still represent a reduction in risk as a percentage of total wealth. The fact that the ratios are actually less than 1.00 for stock donors (particularly over longer periods) is indicative of an even greater improvement in the risk-to-reward ratio.

A quick comparison of Panels A and B shows that realizing losses in itself, while still a good idea, does not substantially reduce risk, as tax-loss selling contributes to only limited portfolio rebalancing and does not address the handful of big winners that tend to be most responsible for portfolio imbalances. However, Panel C shows that gain harvesting has a significant risk-reduction effect. An investor who normally harvests only losses and donates 5% of her income in cash can reduce her 40-year SD to 86% of its buy-and-hold level by donating stock instead, or to 87% by also harvesting "rebalancing gains." Of course, there is no reason she cannot do both. However, the additional benefit would be smaller, reducing SD to 80% of its buy-and-hold equivalent—an additional decrease of only 6 or 7 percentage points. This is because, as previously discussed, the two strategies overlap somewhat, both tending to dispose of the most appreciated shares.

### *3.3. Portfolio concentration*

Table 3 provides more direct evidence on the degree to which the tax-efficient strategies discussed in this paper prevent a portfolio from becoming too concentrated over time. To

measure concentration, we compute the sum of the squares of the individual weights of each stock in the portfolio at the end of the simulated investment horizon.[6] In the ideal scenario of a perfectly diversified portfolio (i.e., with equal amounts invested in each of the 25 stocks), the index would be 1/25, or 0.04, whereas the most unbalanced portfolio possible (i.e., completely concentrated in just one stock) would have an index of 1.00.

There certainly is a tendency for portfolios left to themselves to become more unbalanced over time. As shown in Panel A, a pure buy-and-hold portfolio after 10 years will on average have a concentration index of 0.10, which is equivalent to all of the wealth being spread across just 10 of the 25 stocks. After 30 years the average index rises to 0.26, approximately equivalent to having all portfolio wealth concentrated in only four stocks. Over longer time frames, this imbalance becomes worse still.

Fortunately, all of the tax-advantaged strategies presented improve diversification. As shown by comparing the first column of Panels A and B, even just realizing losses helps some, because selling the losing stocks and then investing the proceeds equally across all of them makes at least that portion of the portfolio better balanced. Far greater diversification improvements, however, are achievable either by donating appreciated stocks, harvesting some capital gains, or ideally both. As shown in Panels A and B, even a 5% charitable donor can significantly slow the growth in portfolio concentration over time simply by giving appreciated stock; 10% donors can mitigate the imbalance to an even greater extent. As shown by the first column of Panels B and C, the gain recognition strategy is effective in reducing portfolio concentration, even for non-donors. Of course, better diversification is achievable by using all strategies simultaneously. In the best possible scenario simulated here, a 10% donor who harvests losses and offsetting gains will still have an almost perfectly balanced portfolio after 10 years of investing, with a concentration index effectively equal to the ideal value of 0.04; and although the portfolio does grow slightly more concentrated over time, he or she is still reasonably diversified after 50 years, with a concentration index of only 0.09. This compares quite favorably to a 50-year buy-and-hold investor, with the optimal strategy achieving $(0.38 - 0.09)/(0.38 - 0.04) \approx 85\%$ of the potential improvement in diversification.

The extent to which these tax-efficient strategies keep portfolio imbalances in check is also apparent in Fig. 2, which shows how much of the portfolio is invested in its most heavily weighted stock after progressively longer time horizons. As indicated by the gray dashed line, a pure buy-and-hold portfolio becomes unbalanced fairly quickly. After 10 years, one of the 25 stocks will come to make up approximately 20% of the portfolio. After 30 years, that weight grows to an average of 41%, and over longer periods it approaches and exceeds 50%. This leaves the portfolio very vulnerable to any large losses subsequently incurred by that one stock.

Fortunately, as the remaining lines on the graph show, the portfolio can be made much less dependent on the performance of any individual stock by harvesting some gains from the most heavily weighted stocks and/or donating some of the most appreciated shares. As expected, doing both simultaneously leads to the best possible outcome regardless of the investment horizon. As shown by the darker solid line, a 10% stock donor who realizes losses and offsetting gains will on average have just 15% invested in his or her most heavily

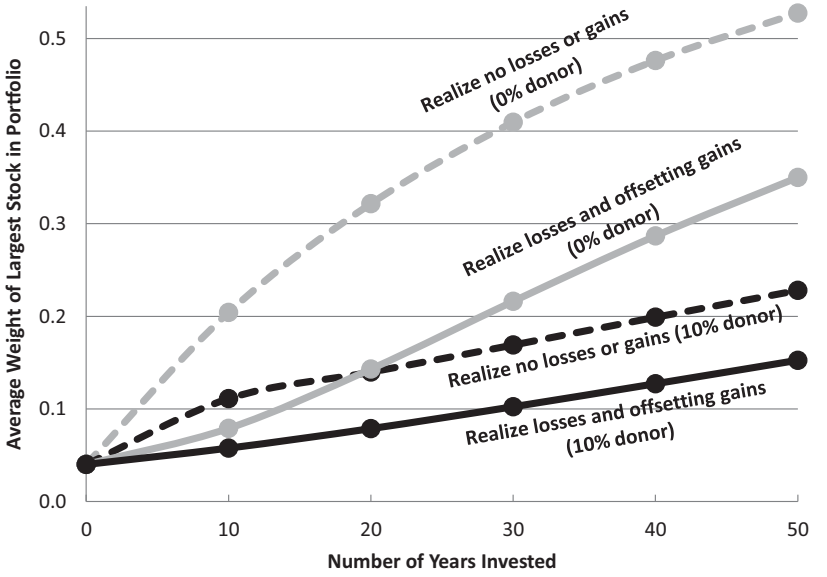


Fig. 2. Growth in weight of largest stock for alternative investment strategies.

weighted stock even after 50 years, which is considerably less concentrated than either of the non-donor outcomes shown.[7]

### *3.4. Diversification's contribution to portfolio return*

The fact that diversification reduces risk without reducing average returns is often referred to as the "only free lunch in investing." However, Booth and Fama (1992) show that diversification actually *improves* a portfolio's long-term compounded return—an effect that Willenbrock (2011) suggests might be a "free dessert" (see also Bouchey et al., 2012; Erb and Harvey, 2006). Therefore, the increased terminal wealth from various tax-efficient strategies is attributable not only to the tax savings themselves, but also to the "diversification return" just noted.

To determine how much of the wealth gain is due to diversification, we track within each iteration of the simulation the value of a portfolio which enjoys none of the incremental tax benefits of the tax-advantaged portfolio, yet is equally diversified. This non-tax-advantaged portfolio also begins with $250,000 spread equally across the same 25 stocks. Like a buy-and-hold portfolio, it benefits neither from tax loss selling nor from the effective "step-up in basis" on shares donated to charity. However, each year, its total value is costlessly redistributed across the 25 stocks so that the resulting individual weights are identical to those in the tax-efficient portfolio. At the end of the investment horizon, the non-tax-advantaged portfolio is also liquidated, and taxes are paid on any gains over the original $250,000 cost basis. The difference in terminal values between this non-tax-advantaged portfolio and the more concentrated buy-and-hold portfolio is due to the "diversification return," while the difference in value between the tax-efficient portfolio and the equally diversified non-tax-advantaged portfolio is directly attributable to tax benefits.

Table 4 Mean (median) increase in terminal wealth vs. buy-and-hold due to tax and diversification effects

| Years invested | Effect | Percentage of income donated via appreciated stock | | |
|---|---|---|---|---|
| | | 0% | 5% | 10% |
| | | Panel A: Realize no losses or gains (buy and hold) | | |
| 10 | Tax savings | 0.00 (0.00) | 0.02 (0.02) | 0.04 (0.03) |
| | Diversification | 0.00 (0.00) | 0.01 (0.01) | 0.01 (0.02) |
| 20 | Tax savings | 0.00 (0.00) | 0.03 (0.03) | 0.07 (0.05) |
| | Diversification | 0.00 (0.00) | 0.06 (0.05) | 0.08 (0.08) |
| 30 | Tax savings | 0.00 (0.00) | 0.05 (0.04) | 0.09 (0.08) |
| | Diversification | 0.00 (0.00) | 0.16 (0.12) | 0.24 (0.18) |
| 40 | Tax savings | 0.00 (0.00) | 0.08 (0.05) | 0.13 (0.09) |
| | Diversification | 0.00 (0.00) | 0.34 (0.22) | 0.49 (0.34) |
| 50 | Tax savings | 0.00 (0.00) | 0.10 (0.06) | 0.18 (0.12) |
| | Diversification | 0.00 (0.00) | 0.63 (0.35) | 0.89 (0.55) |
| | | Panel B: Realize all losses each year | | |
| 10 | Tax savings | 0.01 (0.01) | 0.03 (0.03) | 0.05 (0.04) |
| | Diversification | 0.00 (0.00) | 0.01 (0.01) | 0.01 (0.02) |
| 20 | Tax savings | 0.02 (0.02) | 0.06 (0.05) | 0.09 (0.08) |
| | Diversification | 0.02 (0.00) | 0.06 (0.05) | 0.09 (0.08) |
| 30 | Tax savings | 0.04 (0.03) | 0.10 (0.07) | 0.15 (0.12) |
| | Diversification | 0.04 (0.00) | 0.17 (0.12) | 0.24 (0.18) |
| 40 | Tax savings | 0.04 (0.03) | 0.15 (0.10) | 0.21 (0.16) |
| | Diversification | 0.09 (0.01) | 0.36 (0.22) | 0.50 (0.33) |
| 50 | Tax savings | 0.07 (0.04) | 0.21 (0.13) | 0.30 (0.20) |
| | Diversification | 0.15 (0.02) | 0.66 (0.36) | 0.90 (0.54) |
| | | Panel C: Realize all losses and offsetting gains | | |
| 10 | Tax savings | 0.01 (0.01) | 0.03 (0.02) | 0.04 (0.04) |
| | Diversification | 0.02 (0.01) | 0.02 (0.02) | 0.02 (0.02) |
| 20 | Tax savings | 0.02 (0.02) | 0.06 (0.04) | 0.08 (0.08) |
| | Diversification | 0.09 (0.06) | 0.10 (0.09) | 0.11 (0.09) |
| 30 | Tax savings | 0.04 (0.03) | 0.08 (0.07) | 0.12 (0.10) |
| | Diversification | 0.22 (0.14) | 0.28 (0.20) | 0.30 (0.23) |
| 40 | Tax savings | 0.06 (0.04) | 0.13 (0.10) | 0.18 (0.15) |
| | Diversification | 0.42 (0.23) | 0.56 (0.37) | 0.61 (0.42) |
| 50 | Tax savings | 0.09 (0.05) | 0.19 (0.13) | 0.26 (0.19) |
| | Diversification | 0.69 (0.34) | 0.99 (0.61) | 1.10 (0.70) |

Table 4 reports how much of the increase in terminal value for each strategy (relative to a buy-and-hold portfolio) is due to tax savings and diversification, respectively. The overall results indicate that most of the additional long-term value is in fact attributable to the improved diversification these strategies create. However, there is still significant value generated by the tax savings themselves.

As seen previously in Table 1, donating appreciated stock improves mean and median terminal wealth, regardless of whether one realizes capital losses and/or gains. A comparison across the columns of Table 4 shows that this wealth increase is due to tax savings and a diversification return, and that both effects are greater over longer horizons. This is expected since donating more stock causes more of the portfolio to be stepped-up in basis, while also reallocating more wealth from the most-weighted to the least-weighted

stocks, reducing portfolio concentration. As an example, consider an investor with a 50-year horizon who realizes capital losses only. Table 1 shows that such an investor who donates 10% of his income via appreciated stock enjoys a mean terminal wealth ratio of 2.20, but this ratio for a non-donor is only 1.22. These values represent total wealth increases of 120% and 22%, respectively, versus a pure buy-and-hold investor. Table 4 shows that of the non-donor's 22% wealth increase, 7% is directly due to tax loss deductions, while 15% is due to slightly better diversification. Likewise, of the stock donor's 120% wealth increase, 30% is due to tax benefits, and the remaining 90% is due to much better diversification.

Table 4 also reveals the tax and diversification effects simply from realizing capital losses and/or gains. Comparing Panel B versus Panel A shows that while tax-loss selling does create a modest diversification return for non-donors, the value of loss harvesting for stock donors is almost entirely limited to the tax benefit itself. Conversely, comparing Panel C versus Panel B shows that Smith and Smith's (2008) gain harvesting strategy improves portfolio value through diversification rather than tax savings. The incremental diversification return is larger for non-donors, because investors who donate appreciated stock have already achieved much of the potential diversification improvement. The incremental tax effect from harvesting gains is very small and in some cases slightly negative. This result can be understood by considering the tax arguments both for and against the gain recognition strategy. While offsetting gains against losses does effectively reset the cost basis on those shares and can create future opportunities to deduct losses, the strategy can backfire if no shares (or very few) decline the following year, leaving the investor with little or no capital loss deduction. In such a case, it would have been better to carry at least some of the excess loss forward and deduct it the following year. It is important to note, however, that the gain harvesting strategy is still sound, as the increase in the diversification return outweighs any decrease in the tax savings component.

### *3.5. Shortfall risk*

One practical risk measure is the probability of failing to earn a specified minimum return. For each of the strategy combinations simulated, Table 5 reports the probability of earning a negative return and thereby ending up with less than the original investment at the end of the horizon. Given the simulation parameters, a pure buy-and-hold portfolio has a 20% chance of losing money over 10 years. As expected, the risk of loss declines when investing over longer periods; however, it remains as high as 10% even after 50 years. This is understandable because, as explained previously, the portfolio becomes quite concentrated if it is never rebalanced. As shown in Panel B, shortfall risk is slightly reduced when the investor merely realizes capital losses, partly because of the limited rebalancing that occurs and partly because of the tax savings that somewhat mitigate the losses. However, greater reductions in shortfall risk are achievable by harvesting some gains and/or using stock for planned charitable contributions. Both help to rebalance the portfolio significantly, and donating appreciated stock erases some of the portfolio's accrued capital gains tax liability. Using all of these strategies reduces shortfall risk, but the extent of the reduction depends on the investment time frame. Over relatively short periods (i.e., 10 years), most of the shortfall

Table 5 Zero-return shortfall risk from alternative investment strategies

| Years invested | Percentage of income donated via appreciated stock | | |
|---|---|---|---|
| | 0% | 5% | 10% |
| | | Panel A: Realize no losses or gains (buy and hold) | |
| 10 | 0.20 | 0.18 | 0.17 |
| 20 | 0.14 | 0.11 | 0.09 |
| 30 | 0.12 | 0.06 | 0.05 |
| 40 | 0.11 | 0.04 | 0.03 |
| 50 | 0.10 | 0.02 | 0.01 |
| | | Panel B: Realize all losses each year | |
| 10 | 0.19 | 0.18 | 0.17 |
| 20 | 0.13 | 0.10 | 0.08 |
| 30 | 0.10 | 0.06 | 0.04 |
| 40 | 0.08 | 0.03 | 0.02 |
| 50 | 0.07 | 0.02 | 0.01 |
| | | Panel C: Realize all losses and offsetting gains | |
| 10 | 0.18 | 0.17 | 0.17 |
| 20 | 0.11 | 0.10 | 0.09 |
| 30 | 0.07 | 0.05 | 0.05 |
| 40 | 0.04 | 0.03 | 0.03 |
| 50 | 0.03 | 0.02 | 0.01 |

risk of a buy-and-hold strategy is attributable simply to the risk that the market (and by extension, most stocks in the portfolio) will perform poorly; it is not due to excessive unsystematic risk because the portfolio is still fairly diversified. Therefore, the stock donation strategy and the gain recognition strategy reduce shortfall risk only slightly (from 20% to 17%). Over longer periods of 30–50 years, however, overall market returns are unlikely to be negative, but a portfolio left to itself very well could become so concentrated in a few stocks as to leave the entire portfolio vulnerable to an adverse event at one of those companies. This is where the charitable donation and gain harvesting strategies become very helpful by limiting the buildup of idiosyncratic risk in the portfolio. As shown in Table 5, the risk of losing money over 30 years declines from 12% for a buy-and-hold portfolio to 5% for an investor who uses all of the tax-efficient strategies presented. Over 50 years, the benefits are even more striking, as the risk of loss can be reduced from 10% to only 1%.

Comparing Panels B and C versus Panel A, we see that a non-donor can reduce shortfall risk somewhat by realizing losses, and even more so by also realizing offsetting gains. However, someone who donates appreciated stock is already very close to the minimum achievable shortfall risk for the given time horizon; that is, a stock donor could not substantially reduce this probability any further through harvesting losses and/or gains. As pointed out earlier in this paper, an investor does not have to be a large charitable donor to benefit from using appreciated stock for whatever donations he or she does make, and this is especially true when it comes to reducing shortfall risk. A comparison across columns of Table 5 shows that a 5% donor enjoys almost the same shortfall risk reduction that a 10% donor would.

Table 6 provides more specific information on what losses a particularly unlucky investor might experience, whether due to exceptionally poor market performance or to

Table 6 Fifth (first) percentile terminal wealth values relative to original investment

| Years invested | Percentage of income donated via appreciated stock | | |
|---|---|---|---|
| | 0% | 5% | 10% |
| | Panel A: Realize no losses or gains (buy and hold) | | |
| 10 | 0.62 (0.42) | 0.65 (0.45) | 0.68 (0.47) |
| 20 | 0.60 (0.36) | 0.73 (0.46) | 0.79 (0.49) |
| 30 | 0.60 (0.32) | 0.89 (0.51) | 1.00 (0.56) |
| 40 | 0.59 (0.29) | 1.14 (0.60) | 1.32 (0.69) |
| 50 | 0.59 (0.27) | 1.50 (0.73) | 1.78 (0.85) |
| | Panel B: Realize all losses each year | | |
| 10 | 0.63 (0.43) | 0.66 (0.46) | 0.69 (0.48) |
| 20 | 0.63 (0.38) | 0.76 (0.48) | 0.83 (0.53) |
| 30 | 0.67 (0.36) | 0.94 (0.55) | 1.07 (0.63) |
| 40 | 0.72 (0.35) | 1.22 (0.66) | 1.44 (0.79) |
| 50 | 0.77 (0.34) | 1.61 (0.83) | 1.96 (1.02) |
| | Panel C: Realize all losses and offsetting gains | | |
| 10 | 0.65 (0.45) | 0.67 (0.46) | 0.68 (0.48) |
| 20 | 0.73 (0.44) | 0.77 (0.47) | 0.80 (0.50) |
| 30 | 0.88 (0.47) | 0.97 (0.54) | 1.03 (0.58) |
| 40 | 1.08 (0.53) | 1.27 (0.64) | 1.37 (0.72) |
| 50 | 1.34 (0.60) | 1.72 (0.80) | 1.88 (0.91) |

large losses by the portfolio's most heavily weighted stocks. For each strategy, the table reports after-tax terminal wealth relative to the original $250,000 investment given a fifth- or first-percentile scenario.[8] As seen in Panel A, an unlucky buy-and-hold investor can experience substantial losses. Over a 30-year horizon, such an individual has a 5% chance of ending up with less than $149,207 (about 60% of the starting investment) and a 1% chance of ending up with less than $79,499 (about 32% of the starting investment). These fifth- and first-percentile values are actually worse for longer horizons, reflecting the fact that portfolio concentration and risk grow over time with a pure buy-and-hold approach.

While losses are still possible under the charitable donation strategy, their likelihood and potential severity is reduced, especially over longer horizons. For example, a 10% stock donor who harvests no gains or losses over 30 years would have fifth- and first-percentile terminal wealth values of $250,485 and $140,841 (approximately 100% and 56% of the original investment, as shown in Panel A). Therefore, a 10% donor does significantly better than the non-donor when both experience the same degree of bad luck. Furthermore, because the stock donation strategy greatly limits the growth in portfolio concentration over time, the donor's fifth- and first-percentile outcomes are better over longer horizons, not worse. After 50 years, the 10% donor would still have an overall gain (ending up with 178% of starting wealth) even in a fifth-percentile scenario and a relatively small loss (finishing with 85% of the original investment) with a first-percentile outcome.

A comparison of Panels A and B shows that in every case, an unlucky investor who harvests capital losses performs better than one who does not. This finding is intuitive because the resulting tax savings help to mitigate whatever losses have occurred. A comparison of Panels B and C finds mixed results on whether harvesting gains can further

improve the outcomes of unlucky investors. The strategy is helpful in this respect for non-donors, as it helps maintain better balance in a portfolio that would otherwise become very concentrated and more risky over time. However, a 10% stock donor's fifth- and first-percentile wealth values are both made slightly *worse* by gain harvesting, even though the average investor's results (seen previously in Table 1) are made better. To understand this somewhat counterintuitive finding, note that a portfolio that has performed poorly will by definition have relatively few appreciated shares, and if most of these shares are donated to charity, the resulting portfolio will be reasonably diversified already, so that gain harvesting would not improve diversification much more. In addition, offsetting current-year losses in this manner can occasionally prevent the investor from being able to deduct capital losses in the following year(s), and the fifth- and first-percentile values in Panel C likely reflect scenarios where the strategy backfires in this manner.

## 4. Impact of recent and potential future tax law changes

In 2017, Congress passed the Tax Cuts and Jobs Act (TCJA), amending certain provisions of the tax code that affect investors and charitable donors, and without question, it will enact other tax reforms in the future. Therefore, it makes sense to consider the effects of recent and potential future tax policy changes on the strategies presented in this paper.

One key TCJA provision approximately doubled the standard deduction while limiting or disallowing many non-charitable itemized deductions. This will result in more taxpayers taking the standard deduction and fewer itemizing. In addition, because the TCJA generally reduced marginal tax rates, any itemized deductions that are taken will result in smaller tax savings. Because of these factors, charitable donations are likely to decline somewhat, so that fewer individuals can enjoy the tax and diversification benefits previously noted. Nevertheless, many people will continue to donate to charity. For example, higher-income taxpayers still have relatively high marginal rates and may already have enough deductible home mortgage interest and property tax payments to equal or exceed the standard deduction. These individuals still benefit from the itemized charitable deduction. Many others will continue to donate for philanthropic reasons irrespective of tax incentives. Burman and Randolph (1994) find that the level of charitable donations is only weakly related to the associated tax savings. Consistent with this result, Greene and McClelland (2001) report that about 60% of individual contributions are to religious organizations, and Bradley, Holden, and McClelland (2000) find that these are much less sensitive to tax rates than contributions to other organizations.

It is important to clarify that the incremental benefits of the stock donation strategy do not depend on the ordinary income tax rate, or even whether the charitable deduction can be taken at all. While these factors may influence whether and how much people donate, they do not impact the capital gains tax savings and improved portfolio diversification from making any intended contributions with stock instead of cash. However, the strategy's value does depend on the long-term capital gains tax rate. While the TCJA did not materially affect the capital gains rate, it has been modified before and likely will be again at some point in the future. If new legislation were to completely eliminate preferentially low rates on

long-term gains (as the 1986 Tax Reform Act did), it would negatively affect investors' terminal wealth, but it would also increase the value of the charitable donation strategy in mitigating the impact of capital gains taxes. Likewise, if capital gains taxes were reduced further, it would positively affect terminal wealth, but the tax savings from donating appreciated stock would be smaller. In 2018, some policymakers discussed the possibility of allowing investors to compute capital gains relative to higher, inflation-adjusted cost bases. Such a policy would have effects similar to lowering the statutory rate, especially for shares that had been held longer.

One provision that was considered but not included in the final TCJA bill would have required investors who own multiple lots of a stock to use a "first-in, first-out" (FIFO) method when disposing of shares, thereby eliminating the ability to specifically identify which lot(s) they wish to sell or donate. Requiring investors to sell older (usually lower-basis) lots first would generally increase their taxes, but charitable donors would be especially well-positioned to mitigate the negative effects on their portfolios by first donating shares from the older, low-basis lots, so that any subsequent stock sales could be from higher-basis lots.

## 5. Conclusion and implications for financial planning

The results of this paper strongly suggest that a stock investor who regularly contributes to charity should donate appreciated shares from his portfolio that are equal in value to whatever cash donation he was willing to make, and then use the freed-up cash to purchase more of the least-weighted stocks in the portfolio. The donated shares must have been held for more than a year and should be the investor's most appreciated stocks. There is no disadvantage to the charity or to the donor-investor, but there are two significant advantages. First, this increases after-tax returns by allowing the investor to escape capital gains taxes on the biggest winners in the portfolio. Second, regularly donating the most appreciated stocks and reallocating funds to lesser-weighted stocks counteracts the portfolio's tendency to become increasingly concentrated over time. This improvement in diversification not only reduces risk—as evidenced by a lower standard deviation of terminal wealth and a reduced probability of losing money over the investment horizon—but also creates a substantial "diversification return." The combined wealth increase from the tax savings and improved diversification is not trivial. Depending on the amount donated and the time horizon, the investor can realistically end up with more than double the portfolio value of someone who holds the same stocks but donates only in cash.

Financial planners certainly should ensure that their more philanthropic clients understand why donating appreciated stock is better than donating cash. However, charitable organizations may also wish to suggest this method to their contributors. Because some donors likely make decisions based on a gift's after-tax cost, it is possible that they might choose to donate more when made aware of the additional tax savings.

Investors who donate appreciated stock can and should still use other known tax-efficient strategies. For example, harvesting losses is still beneficial, because the accrued gain on a donated stock is never realized for tax purposes and therefore does not reduce the investor's

capital loss deduction. In addition, investors should still, if possible, recognize enough gains from the most heavily weighted stocks in the portfolio to offset any losses in excess of the $3,000 that can be deducted against ordinary income in a year. This helps further rebalance the portfolio, reducing risk and increasing its long-term realized return.

At times, real-world constraints may limit investors' ability to fully implement the above recommendations. For example, portfolio managers who are concerned with tracking error relative to a value-weighted index may not be able to sell or donate as much of a stock as would be optimal, if that stock is weighted heavily in the index. Nevertheless, the risk and return of such portfolios can still be improved by implementing tax-efficient strategies to the extent permitted. Of course, some real-world investors may be able to exploit the asymmetric tax treatment of gains and losses even *more* effectively—for example, by purchasing securities whose returns are negatively correlated with each other, effectively ensuring that he or she will be able to make donations from whichever shares rise in value while simultaneously deducting losses on the others.

It is important to note that the conclusions in this paper are derived from a Monte Carlo simulation based on certain assumptions that, while reasonable, do not perfectly represent every investor's situation. For example, to be consistent with Smith and Smith (2008), we assume that no additional savings are contributed to the portfolio beyond the initial $250,000. However, many investors do save regularly using a dollar-cost averaging approach, which in itself can promote portfolio diversification, perhaps lessening the incremental impact of the charitable donation strategy. We also assume that annual giving is a function only of wage income, but some donors likely consider their wealth level also, giving more or less when their portfolios have performed exceptionally well or poorly. Finally, we assume that the investor realizes and pays taxes on all gains at the end of the horizon. In reality, withdrawals from the portfolio are likely to occur at multiple points in time (e.g., throughout retirement), and some of the gains may never be taxed because of the step-up in basis at death. It will be useful for future studies to model different approaches a tax-savvy investor might take to saving, charitable giving, and portfolio withdrawals. It should also be considered that while the simulated stock returns used in this study follow a joint normal distribution with constant risk and return parameters, actual stock return distributions can change over time and exhibit some degree of non-normality. It is possible that a bootstrapping approach with historical resampling may shed additional light on how well tax-efficient strategies work given how stock prices have actually behaved.

While the above issues are important and should be considered in future research, this paper presents strong simulation-based evidence that investors should donate appreciate stock in lieu of cash while continuing to use the tax-loss selling and gain harvesting strategies previously documented in the literature. Doing so substantially increases average returns and reduces risk. It is normally difficult to accomplish both of these objectives simultaneously, as capital market theory suggests higher returns are only available for those willing to accept more risk. While most who attempt to time the market or predict which stocks will outperform others find at best limited success, investors can work within the tax code to consistently improve performance without trying to outguess the market. Given the demonstrated benefits, one certainly should do so to the maximum extent possible.

## Notes

1 Private foundations pay a small excise tax of 1–2% on their net investment income, which includes accrued gains on shares received from donors. However, donor-advised funds and public charities are not subject to the tax.

2 Although the tax-efficient strategies in this paper can be used with dividend-paying stocks, they are most effective when all of the investor's return is in the form of capital gains. To the extent stocks in the portfolio pay dividends (converting capital gains into current income), the investor is less able to defer gains and/or eliminate accrued tax liabilities through stock donations.

3 Empirical research suggests that these values are realistic, and that investors may be able to find stocks with even higher SDs and lower correlations. Statman (1987) reports a 49% average individual volatility for a sample of NYSE/AMEX-listed stocks, and the findings of Campbell et al. (2001) suggest similar or higher volatilities depending on the time period examined. Chan, Karceski, and Lakonishok (1999) find an average correlation of 0.28 between any two random stocks, and Campbell et al. (2001) report similar or lower correlations.

4 If the investor owns multiple lots of the same firm's stock (purchased in different years), shares are sold first from the lot with the highest basis-to-value ratio (i.e., the lowest percentage gain).

5 This procedure results in slightly better diversification compared with Smith and Smith's (2008) method of investing the funds equally across the 10 least-weighted stocks. In practice, either method would need to consider the wash sale rule, which disallows any loss deduction on the shares just sold if identical shares are immediately repurchased. One could effectively circumvent this restriction by purchasing shares in a different company with similar risk and return characteristics, or by placing the sale proceeds in a money market fund until the 30-day wash sale period expires (after which shares of the original firm could be bought again).

6 The same method is used to compute the Herfindahl-Hirschman Index (HHI), an indicator of how concentrated market power is within an industry (with low values indicating strong competition, and high values indicating near-monopolistic conditions where very few firms control most of the industry). Fraser and Jennings (2010) use a modification of the HHI to compute a "Degree of Diversification" measure for endowment fund portfolios.

7 Although omitted from the graph for readability, a base strategy of realizing only losses results in essentially the same maximum stock weights as realizing neither losses nor gains. Therefore, tax loss selling by itself does not materially affect a portfolio's dependence on its largest stock.

8 In cases where the portfolio's final value is below its cost basis, after-tax value is computed assuming the net loss is immediately offset against long-term gains on other property. If the investor does not have enough gains, then the excess loss is carried forward to future years. In such cases, the effective after-tax value will be somewhat higher or lower depending on the type of income against which losses are eventually deducted and when the deductions occur.

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