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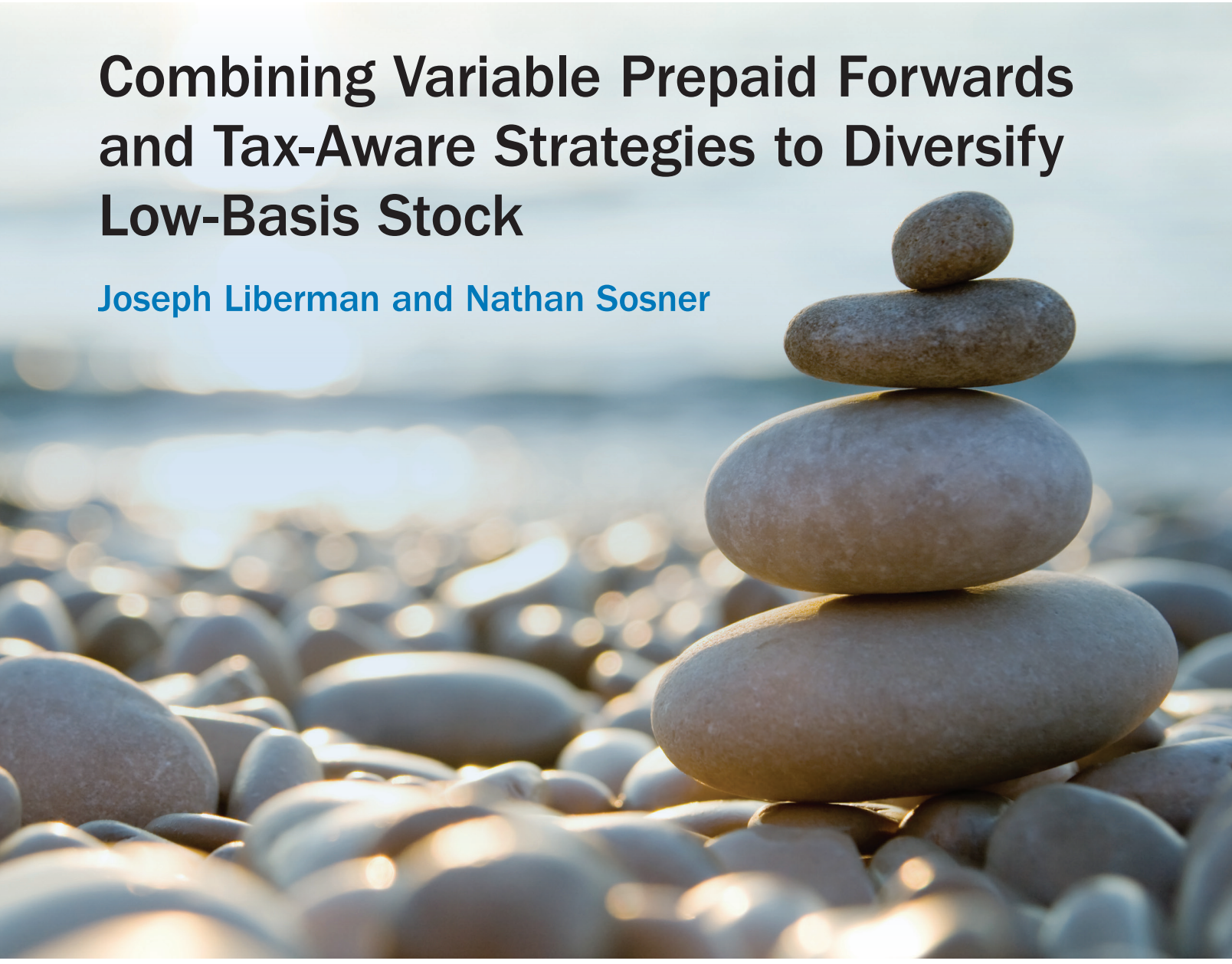

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KEY FINDINGS

- Low-basis stock investors can effectively diversify their concentrated portfolios by combining three financial innovations: variable prepaid forward (VPF) contracts, tax-aware equity portfolio management, and long-short factor investing.
- Combining a VPF with direct investment in a tax-aware long-short factor strategy produces after-tax outcomes superior to all other scenarios, including continuing to hold the stock, fully selling the stock upfront, and combining a VPF with an index fund or a direct-indexing strategy.
- In the context of a VPF transaction, novel tax-aware long-short factor strategies offer two advantages over traditional direct indexing: they have the potential to outperform a passive index before tax, leading to greater long-run pre-tax appreciation, and they tend to realize significantly higher net losses, allowing the investor to offset a larger fraction of the VPF settlement gain.

ABSTRACT

We illustrate how combining variable prepaid forward (VPF) contracts with tax-aware strategies can help diversify low-basis stock and thereby improve after-tax wealth accumulation. We find that direct-indexing strategies have limited ability to offset VPF settlement gains. Thus, in the context of a VPF transaction, direct indexing adds value only when managed at a very low cost. Tax-aware long-short factor strategies offer two advantages over direct indexing. First, they can outperform a passive index before tax. Second, they realize significantly higher net losses than direct-indexing strategies, allowing the investor to offset a larger fraction of the VPF settlement gain. As a result, long-run after-tax wealth outcomes are significantly better when a VPF is combined with tax-aware long-short factor strategies rather than with other alternatives, such as a direct-indexing strategy or a market index fund.

Concentrated stock holdings can be a source of phenomenal wealth, but they also can lead to financial ruin. The primary reason for this wide range of outcomes is the high volatility of individual stocks. A plethora of studies, utilizing everything from Monte Carlo simulations to historical data and specific stock examples, have

demonstrated just how risky holding concentrated stock positions can be (see, for example, Stein et al. 2000; Miller 2002; Boyle et al. 2004; Quisenberry and Welch 2005; Cembalest 2014; Bessembinder 2018; Sosner 2022; and Petajisto 2023).

Despite the theoretical and empirical justification for diversifying concentrated stock holdings as soon as possible, giving such advice in practice is quite challenging, particularly due to the potentially significant tax burden of diversification. To address this dilemma, a variety of tax-efficient solutions for risk reduction have been developed. These solutions range from exchange funds and completion portfolios to various hedging strategies and charitable techniques.[1] In this article, we focus on one such solution: the variable prepaid forward (VPF), and, more specifically, combining a VPF with tax-aware investment strategies.

VPF is a relatively simple contract where an investor pledges a stock as collateral for a fixed term and, in return, receives a substantial fraction of the stock's current value in cash. Depending on the stock and the terms of the VPF contract, this cash amount, often referred to as the *prepayment*, can exceed 90 cents on the dollar. During the life of the contract, the investor receives dividends on the stock up to a pre-specified amount, typically anchored to the current level of dividend per share. There are no other exchanges of cash flows until the VPF maturity. All taxes, except those paid on the stock's dividends, are deferred until the VPF maturity.[2]

VPF is an appealing solution from both a pre-tax and tax perspective. From a pre-tax standpoint, a VPF offers three key benefits: First and foremost, it provides downside protection. Furthermore, it allows investors to participate in some of the stock's upside potential. Finally, it immediately generates a significant amount of cash proceeds from the prepayment, which investors can deploy toward diversifying their investment portfolios or for any other purpose. From a tax perspective, a VPF allows investors to defer the recognition of gain to a later date, even while receiving cash proceeds today.

Despite these numerous advantages, VPF transactions are not without challenges. The main problem is the potential tax liability that the investor faces upon the contract's maturity, when most of the VPF prepayment becomes a realized capital gain.[3] As a result, it has long been recognized that the liquidity provided by a VPF is not the end of the journey, but rather the first step toward a comprehensive financial solution.[4]

Farr (2004) goes so far as to say, "Some research suggests that immediate diversification is superior to monetization techniques such as a variable pre-paid forward transaction—unless the proceeds from the monetization are invested in a tax efficient investment strategy." Quisenberry and Welch (2005), using Monte Carlo simulations, show that investing the proceeds from VPF prepayment in a direct-indexing strategy,

[1] For further details on these strategies, see Welch (1999, 2001, 2002, 2003), Kiefer (2000), Miller (2002), Boyle et al. (2004), Quisenberry and Welch (2005), Brunel (2006), Gordon (2009), and Lucas (2020).

[2] Scenarios that can unfold at the VPF maturity and their respective tax treatment are described in great detail in Liberman and Sosner (2025).

[3] In theory, to defer this gain realization, a VPF can be "rolled" at or prior to maturity. As discussed in Liberman and Sosner (2025), rolling a VPF contract requires a high level of expertise and might result in large cash outlays if the stock value either increases substantially or declines. Note, however, that a decline in value is the very risk the investor seeks to address by entering into the VPF in the first place.

[4] In an article published over two decades ago, Welch (2001) quotes Brent Bunger, a principal at Legacy Capital Group, who remarked, "We rarely use the variable-forward trade as a standalone transaction. We use it as an important step in a more comprehensive overall wealth-management plan. We have developed some very creative investment- and tax-management strategies for high-net-worth clients, and the variable prepaid forward frequently is the transaction that allows us to unlock the liquidity in a low-basis position."

which they call a "tax-enhanced" strategy, improves the effectiveness of VPF as a concentrated stock diversification device.

While the concept of investing a VPF prepayment in a direct-indexing strategy was a definite breakthrough two decades ago, recent advances in financial technology have created new opportunities for achieving far better wealth outcomes for low-basis concentrated stock investors. For example, Liberman et al. (2023) show that direct investment (that is, an investment via a separately managed account) in novel tax-aware long-short factor strategies can achieve a cumulative net loss of up to, and exceeding, 100% of the initially invested capital. Such a net loss can fully offset the gain recognized on the VPF maturity.

Furthermore, tax-aware long-short factor strategies can be funded with appreciated assets (see, for example, Sosner and Krasner 2021), and can provide a profitable factor exposure that can be modulated over time in a tax-efficient manner, as demonstrated in Liberman et al. (2023).[5] Equipped with such strategies, investors can use a VPF as the first step on their path to wealth preservation and accumulation.

To preview our results, combining a VPF with direct investment in one of the tax-aware long-short factor strategies modeled in this article produces after-tax outcomes superior to all other scenarios, including continuing to hold the stock, fully selling the stock upfront, and combining a VPF with an index fund or a direct-indexing strategy.

SIMULATION METHODOLOGY

We simulate the following investment scenarios: holding the concentrated stock, selling the stock and investing the proceeds in a market index fund, entering into a VPF contract and investing the VPF prepayment in a market index fund, and entering into a VPF contract and investing the VPF prepayment in a tax-aware strategy. For each scenario, we utilize 100,000 randomly drawn 20-year return histories. For consistency, we use the same set of 100,000 simulated histories for a given investment across all scenarios involving that investment.[6] For example, the 100,000 return histories of the market index fund are identical in all scenarios where we utilize the fund returns. Similarly, the 100,000 return histories of a concentrated stock with specific characteristics remain constant across all scenarios involving a stock with those particular characteristics.

We model the VPF prepayment amounts and tax liabilities as described in Liberman and Sosner (2025). In this article, we only use a VPF with a 100% floor and a 120% ceiling.[7] For pricing the VPF contract, we assume that the options volatility surface is flat, with the options implied volatility being equal to the stock's volatility.[8] We also assume that the stock's basis at the time of VPF's inception is $0, which results in

[5] In a series of research articles, Asness et al. (2014, 2015), Alquist, Israel, and Moskowitz (2018), Alquist et al. (2020), and Aghassi et al. (2023) clarify the facts and dispel the myths about factor investing. Krasner and Sosner (2024) explain how tax-aware long-short factor strategies can simultaneously achieve large net capital losses and significant factor-based pre-tax alpha.

[6] For a quantitatively oriented reader, we use the same seed for generating simulated histories.

[7] In analysis not shown here for the sake of brevity, we have found that VPFs with bands wider than 100–120 benefit the investor only if the stock realizes a relatively low volatility—around 30% or less—and a high level of excess return—beating the market index by 10% or more per year over the long run. Based on our assumptions, this translates into a single stock with a long-run pre-tax information ratio of around 0.4. While not impossible, a reliable ex-ante identification of stocks with such strong risk-adjusted performance is highly improbable. As a result, we limit our discussion to a 100–120 VPF contract.

[8] Liberman and Sosner (2025) show that even when the options volatility skew is substantial, the reduction in the prepayment amount is not large. Therefore, we believe that all our results will hold qualitatively even in the presence of volatility skew.

the gain upon VPF maturity being equal to the prepayment amount (see Liberman and Sosner 2025).

In the base case, we assume a VPF with a term of two years. The VPF is incepted at the beginning of year 1, and the gain upon VPF maturity is realized two years later, at the beginning of year 3. This allows the net losses of the tax-aware strategies to accumulate over a period of three years. We assume that the investor does not have any capital gains from other sources, and therefore, cumulative losses realized by tax-aware strategies offset the gain realized upon VPF maturity.

Following the VPF maturity, both the strategy and the concentrated stock shares retained by the investor in the physical settlement of the VPF are held for the remainder of the 20-year period, at the end of which all investments are liquidated.[9] Again, because we assume that the investor has no capital gains from other sources, cumulative losses realized by the tax-aware strategy after VPF maturity are carried forward to offset the gains from the liquidation of the strategy and the retained shares of the stock at the end of the 20-year investment period. Whenever taxes need to be paid, they are paid with the proceeds from liquidating positions in the investment portfolio.

To simulate the VPF prepayments and the strategy, market, and stock returns, we make the following assumptions. We assume the prevailing interest rate of 3% and the two-year VPF financing spread of 1.5%. We draw market index fund returns from a lognormal distribution with an arithmetic mean return of 8% and a volatility of 15%. This implies a Sharpe ratio of 0.33 for the market index fund. For the concentrated stock, we assume a beta of one to the market index. In the base case, we assume that the stock has an idiosyncratic volatility of 48%, resulting in a total volatility of 50%, and zero alpha. In some scenarios, we vary the stock's idiosyncratic volatility while always maintaining a beta of one to the market index.

For tax-aware strategies, we utilize the set of strategies described in Liberman et al. (2023). For our 100,000 simulated histories, we generate their pre-tax returns under the assumption of a tracking error (TE) of 1% for the direct-indexing strategy and 2%, 4%, and 6% for the 150/50, 200/100, and 250/150 relaxed-constraint tax-aware strategies, respectively. We assume the pre-tax alpha to be –30 bps for the direct-indexing strategy (due to fees and transaction costs), while for the relaxed-constraint strategies, we assume a net of fees and costs pre-tax information ratio of 0.3, which translates into a net of fees and costs alpha of 0.6%, 1.2%, and 1.8% for the 150/50, 200/100, and 250/150 strategies, respectively.

We draw annual pre-tax returns for each investment from a lognormal distribution. We first make a draw from an i.i.d. normal distribution with a mean of $\mu - \frac{\sigma^2}{2}$ and a variance of σ^2. We then take the exponent of the normal variates (see Sosner 2022, Appendix C, for further details). For example, for the market index fund, $\mu = 8\%$ and $\sigma = 15\%$; for the concentrated stock, in the base case, $\mu = 8\%$ and $\sigma = 50\%$; and for the 250/150 6% TE strategy, $\mu = 9.8\%$ and $\sigma = 16.2\%$.[10] For simplicity, we assume that all returns are price returns, and both the concentrated stock and market index have a dividend yield of 0%.

[9] The investor can enter into a secondary VPF transaction on the shares remaining after settling the original VPF, if any remain. However, since the original VPF already provides a substantial level of diversification, for the sake of simplicity, we do not model secondary VPF transactions. Furthermore, we find that, on average, the concentrated stock position accounts for less than 5% of the 20-year cumulative wealth. This is for two reasons. First, in expectation, the investor only receives a small fraction of the stock position at the VPF maturity. Second, due to higher volatility, the distribution of the value of the stock position tends to shift to the left compared to that of the lower volatility diversified strategy, resulting in a reduction in the relative weight of the stock in the overall investment portfolio.

[10] We calculate the total volatility of the strategy in this case as $\sqrt{15\%^2 + 6\%^2} = 16.2\%$, where 15% is the volatility of the market index and 6% is the TE of the strategy.

If the market index fund has an unrealized loss at year-end, we realize this loss and immediately repurchase the fund. This simple year-end loss-harvesting is intended to represent the potential for some limited tax management, even for index fund investors. For the gain and loss realization histories of the tax-aware strategies, we draw with replacement 100,000 times from the set of 27 10-year histories constructed as described in Liberman et al. (2023). Years 11 to 20 in our 20-year simulations are filled forward with year 10 gain and loss realizations.

When investments are liquidated at the end of the 20-year simulation period, we make the following assumptions about the tax character of the liquidation gains. For the concentrated stock, market index fund, and direct-indexing strategy, we consider all liquidation gains are considered long-term. For the long-short tax-aware strategies, we classify 80%, 70%, and 60% of the liquidation gains as long-term for the 150/50, 200/100, and 250/150 strategies, respectively, with the remaining gains classified as short-term.

Finally, we assume that the investor is subject to 30.8% and 47.8% tax rates on long-term and short-term capital gains, respectively. This includes federal tax rates of 23.8% and 40.8%, respectively, and a 7% state tax rate applicable to both long-term and short-term capital gains.

MAIN RESULT: THE BENEFIT OF LONG-SHORT TAX-AWARE FACTOR STRATEGIES

Low-basis concentrated stock investors face a difficult dilemma: On one hand, holding the stock is highly perilous to their wealth (see Appendix). On the other hand, liquidating the stock may result in a substantial tax burden. Investors can utilize a VPF transaction to enhance the tax efficiency of the transition from concentrated stock to a diversified portfolio. In this section, we explore combinations of a two-year VPF with various investment strategies that are seeded with the VPF prepayment. We use "continuing to hold the stock" and "theoretical tax-free transition to an index fund" scenarios as comparison benchmarks.

Exhibit 1, Panel A, shows pre-liquidation cumulative after-tax return distributions for various scenarios. The first three boxes provide benchmarks for analyzing the merits of the VPF transaction: holding a concentrated stock with 50% volatility, the theoretical tax-free transition to a market index fund, and selling the stock upfront and investing the proceeds in the market index fund, which we will refer to as a "Sell Upfront" scenario. In the latter scenario, the stock liquidation tax is paid at the end of year 1.[11] The remaining five boxes show alternative VPF scenarios.

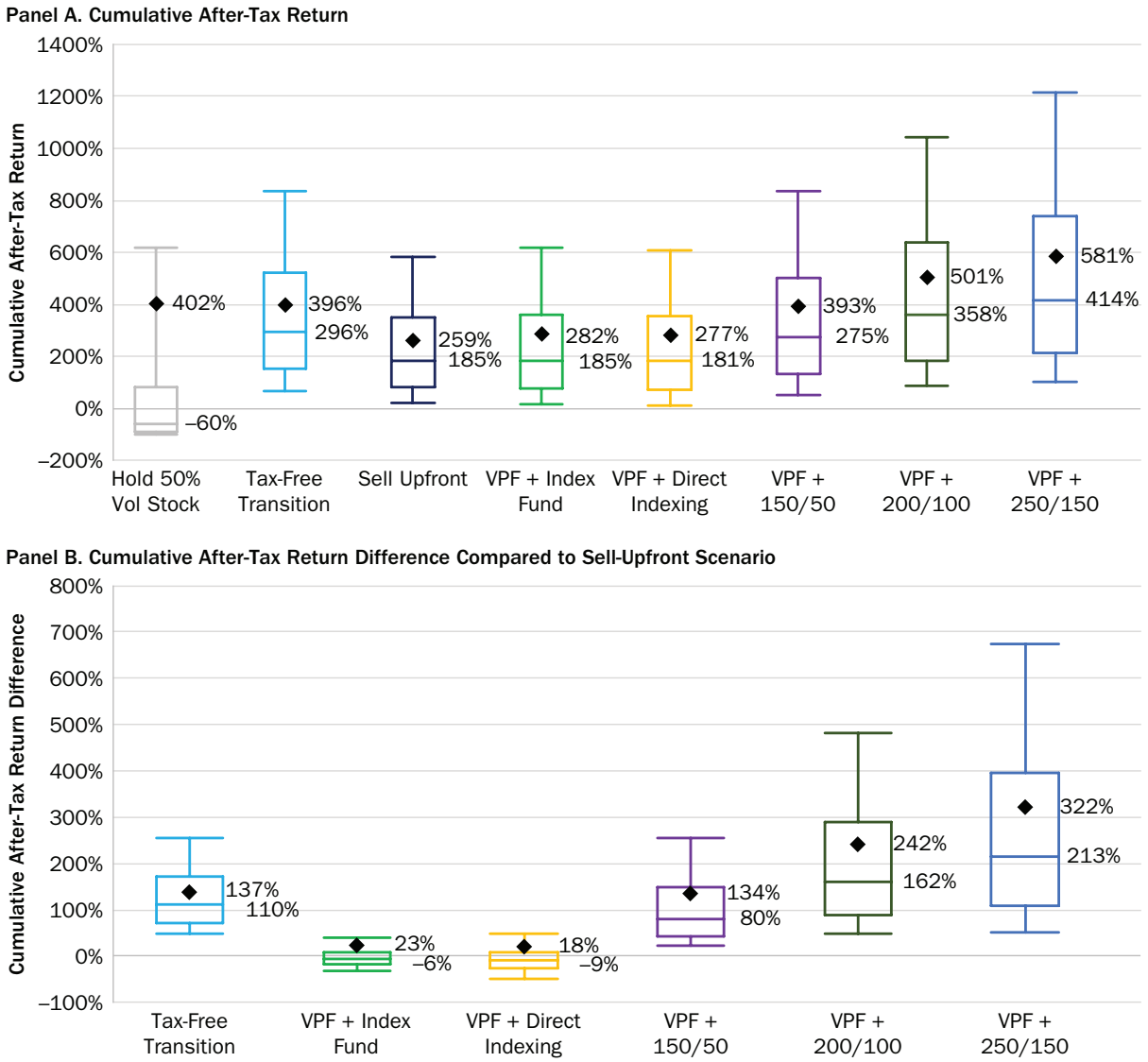
To facilitate the comparison of different scenarios to the "Sell Upfront" scenario, Exhibit 1, Panel B, shows differences from the "Sell Upfront" scenario. The first box shows the difference between the theoretical tax-free transition and "Sell Upfront." The other five boxes show differences between alternative VPF scenarios and "Sell Upfront."

Comparing the first of the five VPF scenarios, "VPF + Index Fund," with the "Sell Upfront" scenario isolates the benefit of the VPF. In this scenario, as in "Sell Upfront," the VPF prepayment is invested in the market index fund. As seen in Panel B, compared to selling the stock upfront, the VPF combined with an index fund achieves a slightly higher mean cumulative after-tax return and a slightly lower median cumulative after-tax return. In other words, investing the VPF prepayment in the index fund may not justify the complexity of entering into a VPF contract. Simply selling the stock

[11] If the market index fund has a loss at the end of the year, the loss is realized and used to partially offset the stock liquidation gain realized earlier in the year.

EXHIBIT 1

Cumulative After-Tax Return Distribution under Alternative Scenarios



NOTES: The exhibit shows the distribution of 20-year cumulative after-tax returns (Panel A) and return differences (Panel B). A difference compared to the "Sell Upfront" scenario is computed for each simulation, and the distribution of differences across simulations is shown in Panel B. The box denotes the 25th, 50th, and 75th percentiles. The whiskers denote the 10th and 90th percentiles. The marker represents the mean cumulative return (Panel A) and return difference (Panel B).

upfront and investing the sale proceeds in an index fund produces similar after-tax wealth outcomes.

In the second VPF scenario, the VPF proceeds are invested in the traditional direct-indexing strategy. The direct-indexing strategy realizes capital losses that offset part of the gain recognized upon VPF maturity. As discussed in Liberman et al. (2023), the net losses realized by direct-indexing strategies are relatively small and, as a result, can only offset a small fraction of the gain recognized upon the settlement of the VPF contract. The limited gain offset provided by the direct-indexing strategy, coupled with higher fees and transaction costs, makes investing the VPF prepayment in a direct-indexing strategy slightly inferior to the previous scenario in which the VPF

prepayment is invested in a low-cost market index fund. Simply selling the stock upfront and investing in an index fund remains an equally good option, particularly for investors seeking to avoid complexity.

In the following three scenarios depicted in Exhibit 1, the VPF prepayment is invested in different versions of tax-aware long-short factor strategies: 150/50 at 2% TE, 200/100 at 4% TE, and 250/150 at 6% TE. As the TE and leverage increase, these strategies achieve progressively higher pre-tax alpha and cumulative net losses. The pre-tax alpha enhances pre-tax strategy returns compared to the market index, while the higher tax losses offset a larger fraction of the VPF settlement gain.

Due to these two enhancements, the cumulative after-tax returns achieved with long-short strategies are substantially higher than those in the previous scenarios. In fact, as seen in Panel A, the mean and median cumulative returns in the 150/50 strategy scenario are approximately 50% higher than those in the "Sell Upfront" scenario and nearly match those of the theoretical tax-free transition. Panel B shows that the mean and median differences from the "Sell Upfront" scenario are 134% and 80% of the starting stock position value, respectively. Moreover, even the 10th percentile of the difference is positive, indicating that the 150/50 strategy scenario outperforms the "Sell Upfront" scenario in the vast majority of our simulations.

The other two long-short strategies deliver even higher cumulative after-tax returns. Panel A shows that the VPF combined with the 200/100 strategy roughly doubles the mean and median cumulative returns compared to the "Sell Upfront" scenario. Meanwhile, the 250/150 strategy achieves mean and median cumulative returns about 2.5 times higher than those of the "Sell Upfront" scenario, approximately double those of the VPF-with-direct-indexing scenario, and about 50% higher than those observed in the theoretical tax-free transition. As further seen in Panel B, even the 10th percentile differences of the 200/100 and 250/150 strategies from the "Sell Upfront" scenario are high and positive, at approximately 50%.

In sum, we do not find conclusive evidence that a VPF combined with an index fund or a direct-indexing strategy outperforms an upfront sale of the stock and investment of the sale proceeds in an index fund. In contrast, a VPF combined with long-short strategies results in a significant outperformance of the upfront sale and reinvestment of proceeds in an index fund.

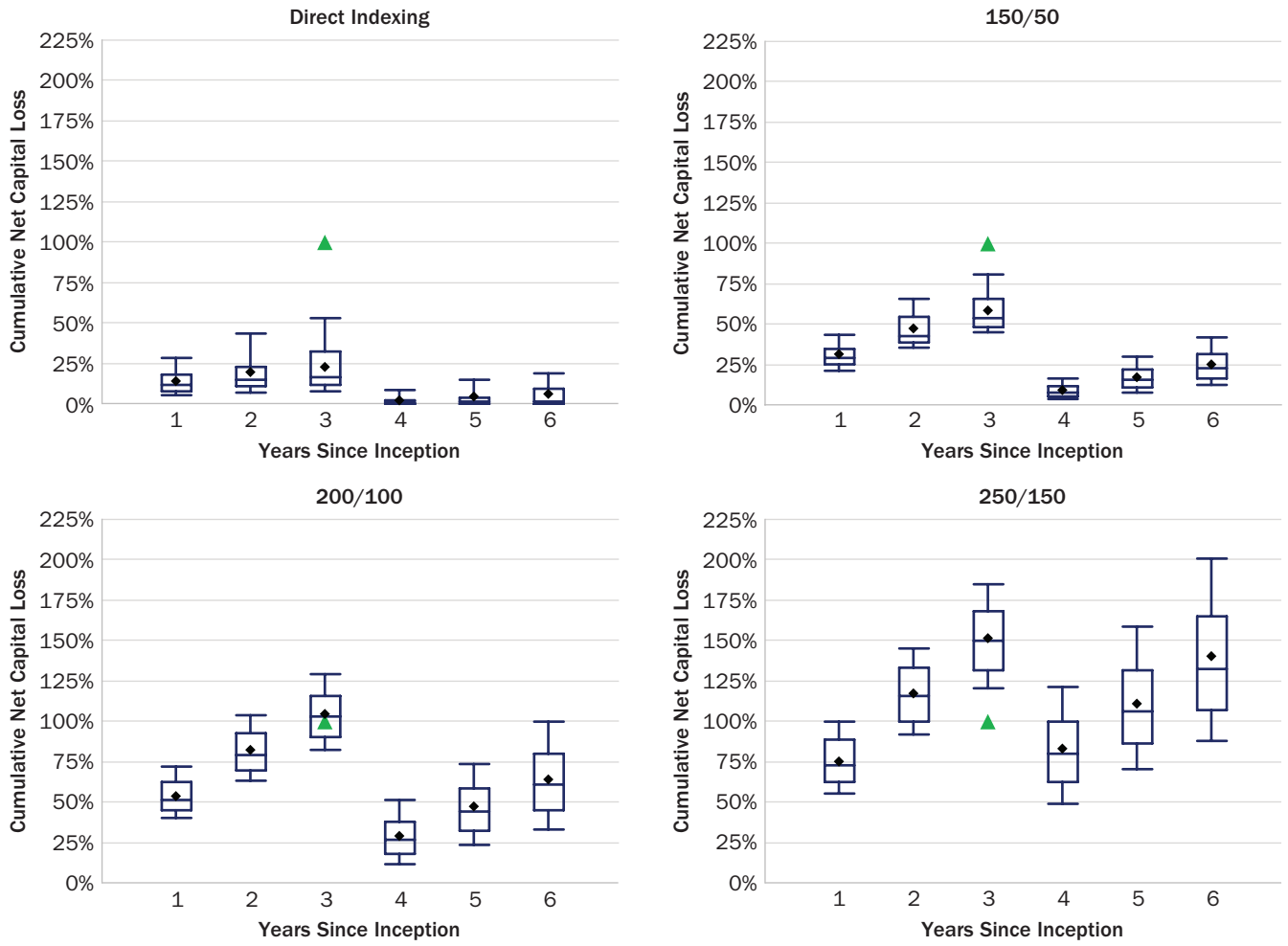
A CLOSER LOOK AT THE LOSS REALIZATION PROPERTIES OF TAX-AWARE STRATEGIES

Since loss realization is a component of the solution, let's take a closer look at the cumulative net capital losses realized by tax-aware strategies. In Exhibit 2, we compare cumulative net capital losses of the direct-indexing strategy and the three tax-aware long-short factor strategies for the period of three years before and after the VPF settlement tax liability becomes due in year 3. The green triangular marker in the exhibits shows the amount of cumulative net loss needed to offset the gain recognized upon the VPF maturity. Since we have assumed a $0 basis for the stock, this amount equals the prepayment. Cumulative net capital losses are shown as a percentage of the prepayment amount, which is invested in the tax-aware strategies immediately upon the inception of the VPF. In year 3, the cumulative net loss offsets the VPF settlement gain, with any remaining loss carried forward to year 4. If the year-3 cumulative loss is fully utilized to offset the VPF settlement gain, loss accumulation in year 4 starts from zero.

As seen in Exhibit 2, by the end of the third year since inception, the direct-indexing strategy only offsets an insignificant fraction of the VPF settlement gain. The mean and median cumulative net losses are about 25% and 15%, respectively, while the

EXHIBIT 2

Cumulative Net Capital Loss of the Tax-Aware Strategies in Comparison to the VPF Settlement Gain



NOTES: The exhibit shows the distribution of cumulative net capital losses over time, measured as a percentage of the initially invested capital. In year 3, the cumulative loss offsets the VPF settlement gain, with any remaining loss carried forward to year 4. If the year-3 cumulative loss is fully utilized to offset the VPF settlement gain, the loss accumulation in year 4 starts from zero. The box denotes the 25th, 50th, and 75th percentiles. The whiskers denote the 10th and 90th percentiles. The black diamond-shaped marker represents the mean cumulative loss. The green triangular marker represents the loss needed to fully offset the VPF settlement gain.

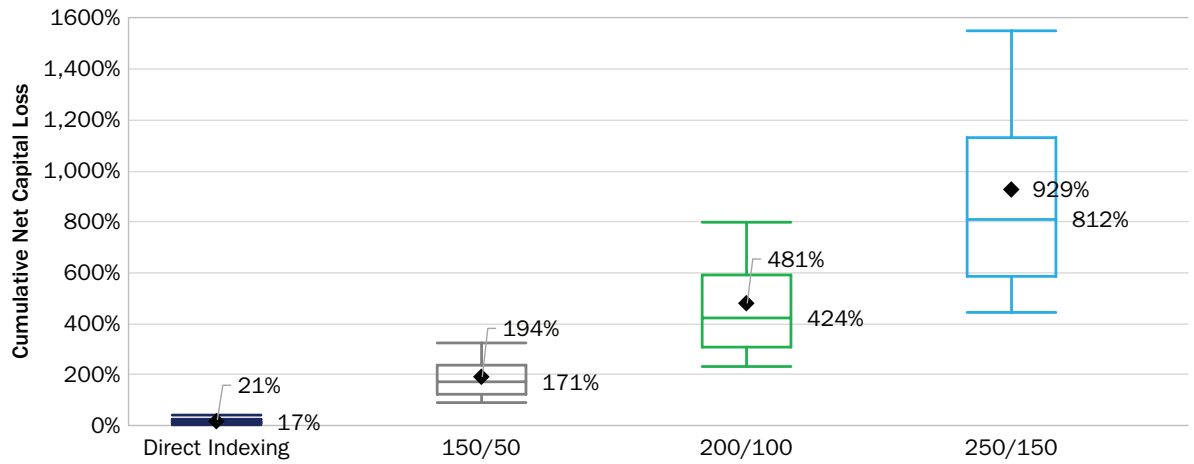
90th percentile loss is around half of the amount required to offset the settlement gain.

Compared to direct indexing, the tax-aware long-short factor strategies are significantly more likely to offset the VPF settlement gain. Over the initial three years, which is the relevant period for offsetting this gain, both the mean and median cumulative net losses are greater than 50% for the 150/50 strategy and reach approximately 100% for the 200/100 strategy. In the case of the 250/150 strategy, the entire 10th to 90th percentile range of cumulative net losses lies above 100%. As a result, the higher TE and leverage strategies not only realize losses sufficient to offset the entire VPF settlement gain but may even have excess losses in year 3, which are carried forward to future years.

Note that after offsetting the VPF settlement gain, all strategies continue accumulating losses. Under our assumptions, these losses are carried forward and are used to offset the liquidation gain at the end of the 20-year period. For completeness,

EXHIBIT 3

Cumulative Net Capital Loss of the Tax-Aware Strategies at the End of the 20-Year Period



NOTES: The exhibit shows the distribution of 20-year cumulative net capital losses, measured as a percentage of the initially invested capital. The cumulative losses are reduced by the amount used to offset the VPF settlement gain. The box denotes the 25th, 50th, and 75th percentiles. The whiskers denote the 10th and 90th percentiles. The marker represents the mean cumulative loss.

Exhibit 3 shows the 20-year cumulative net losses for the four tax-aware strategies. These cumulative net losses are reduced by the fraction of the VPF settlement gain offset in year 3 and are presented as a percentage of the initially invested capital, which, in our case, equals the VPF prepayment amount.

CHOOSING THE TERM OF THE VPF CONTRACT

Given the propensity of tax-aware strategies to accumulate realized losses over time, how beneficial would it be to extend the term of the VPF? On one hand, a longer VPF term provides the strategy with more time to realize losses, thereby reducing the tax burden upon VPF settlement. On the other hand, it leads to higher financing costs of the VPF transaction: a longer VPF term translates into a longer period during which a financing spread is charged and may also lead to an increase in the financing spread itself.

Exhibit 4 shows the *VPF financing cost* and the distribution of *total cost*, which includes the VPF financing and tax costs. The former increases mechanically with the VPF's term to maturity. For each of the four tax-aware strategies, the exhibit plots the present value of costs at different VPF maturities.[12] The total costs are represented by box-and-whiskers plots, and VPF financing costs are shown with green round markers. For comparison, the dotted line shows the present value of the tax cost of the "Sell Upfront" scenario, in which the concentrated stock is sold immediately and the sale proceeds are invested in the *market index fund*.[13]

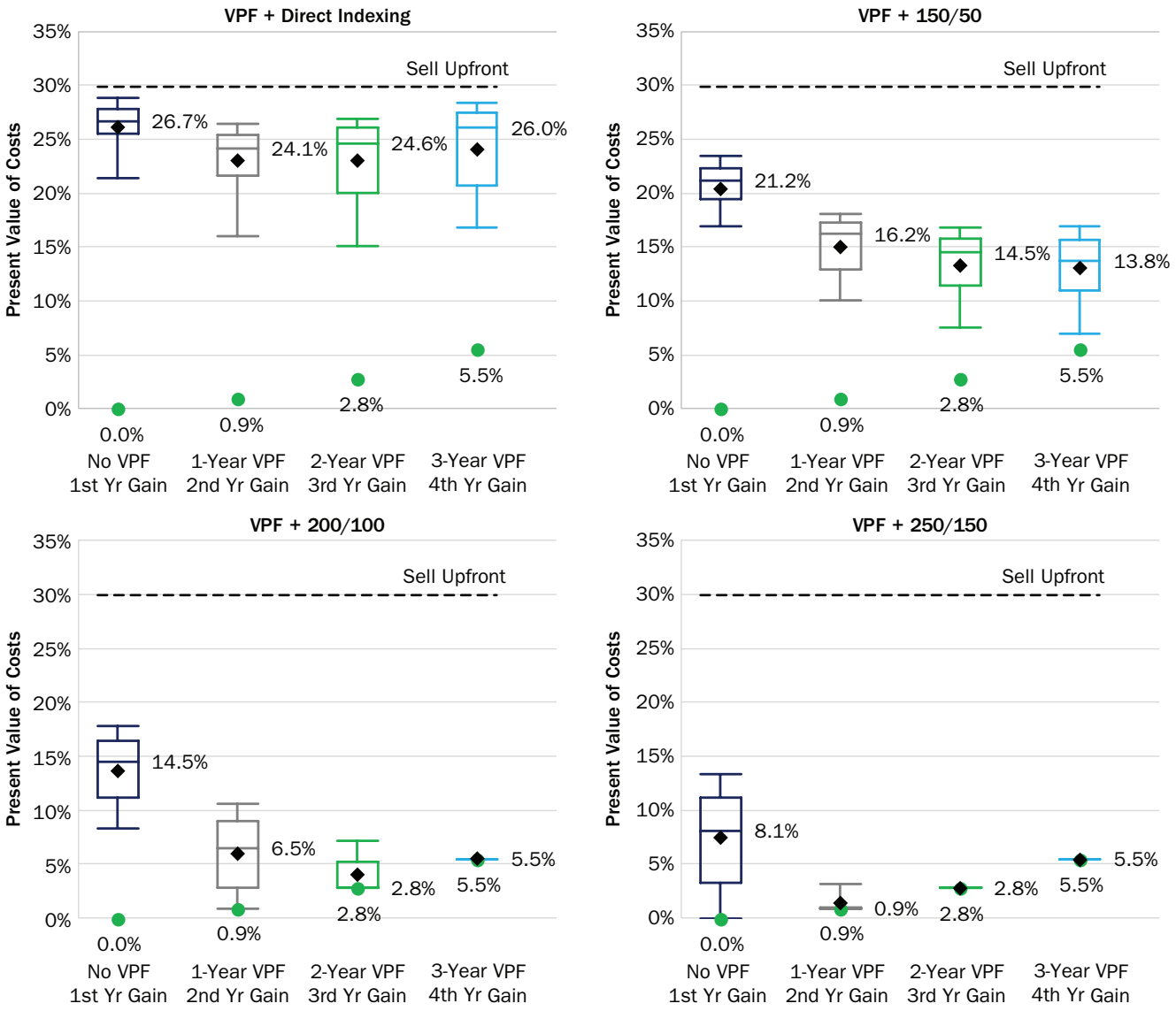
Each box in Exhibit 4 represents a different scenario. The "No VPF" scenario can be viewed as a comparison benchmark: The stock is sold on day 1, the sale proceeds are invested in a tax-aware strategy, and taxes on the stock liquidation are paid at the

[12] Present value is computed by multiplying the future value in year T by e^{-rt}, where r is the prevailing interest rate of 3%.

[13] In the "Sell Upfront" scenario, the total tax of 30.8%—23.8% federal plus 7% state—is paid on the entire value of the stock at the end of year 1. It is, therefore, discounted to the present by multiplying 30.8% by $e^{-0.03}$, which results in the present value of 29.9%.

EXHIBIT 4

Present Value of Total Costs and VPF Financing Costs for Different Tax-Aware Strategies



NOTES: The exhibit shows the distribution of the present value of costs. The box denotes the 25th, 50th, and 75th percentiles of total cost, which includes the tax and VPF financing cost. The whiskers denote the 10th and 90th percentiles of total cost. The black diamond-shaped marker represents the mean total cost. The green round marker represents the VPF financing cost.

end of year 1. In this scenario, the investor does not incur any VPF financing costs. The loss realized over the course of the first year can offset some of the gain realized upon selling the stock on the first day of the year. As a result of this loss realization, the total cost, which, in this case only includes the tax cost, is lower than selling on day 1 and investing the proceeds in a market index fund ("Sell Upfront").[14]

[14] For "Sell Upfront," represented by the dotted line in Exhibit 4, we show the median outcome. Although a loss is realized if the market index fund is at a loss at the end of year 1, the ability of the market index fund to realize losses is very limited. As a result, the distribution of total costs around the median is very narrow.

The remaining three scenarios in Exhibit 4 show the results for VPFs with terms to maturity of one, two, and three years. These three VPFs result in a taxable gain in years 2, 3, and 4, respectively. The respective bank financing spreads for the three VPFs are assumed to be 1.0%, 1.5%, and 2.0% per year. The present value of financing these VPF contracts until maturity is 0.9%, 2.8%, and 5.5%, respectively.

Compared to selling the stock outright and investing the proceeds in an index fund, the direct-indexing strategy combined with a VPF reduces the total cost. The reduction is relatively small. Furthermore, extending the VPF's term to maturity increases the VPF financing cost without a corresponding reduction in the tax cost. This is due to the limited ability of the direct-indexing strategy to realize losses, as shown in Exhibit 2.

In contrast to direct indexing, combining long-short strategies with a VPF results in a meaningful reduction in the total cost. The benefit of extending the term of the VPF beyond one year depends on the specific long-short strategy implementation. For the 150/50 strategy, extending the VPF term to two years adds value. However, extending it farther leads only to marginal improvement as the increase in VPF financing costs begins to offset the reduction in tax costs.

For the 200/100 strategy, extending the VPF term to two years significantly reduces the total cost, even though the VPF financing cost triples compared to the one-year term. When the VPF term is extended to three years, the 200/100 strategy offsets the VPF settlement gain with high likelihood, but due to the increase in the VPF financing cost, the mean and median total cost increase compared to the two-year term.

For the 250/150 strategy, increasing the VPF term beyond one year reduces the tax cost to zero with high likelihood. However, the mean and median total cost increase due to a higher VPF financing cost. As a result, a one-year VPF seems to offer the best solution.

Exhibit 5 shows cumulative after-tax returns at a 20-year investment horizon for the same VPF-strategy combinations as in Exhibit 4. In all cases except for one, mean and median cumulative returns are improved by the presence of a VPF. The only exception is the "Three-Year VPF with 250/150" scenario: The 250/150 strategy realizes a substantial cumulative loss rather quickly, so deferring the VPF settlement gain recognition until year 4 does not justify the additional financing cost of a three-year VPF.

Compared to selling the stock outright and investing in a tax-aware strategy, the contribution of a VPF is small when it is combined with the direct-indexing strategy. This is particularly true for the median return.

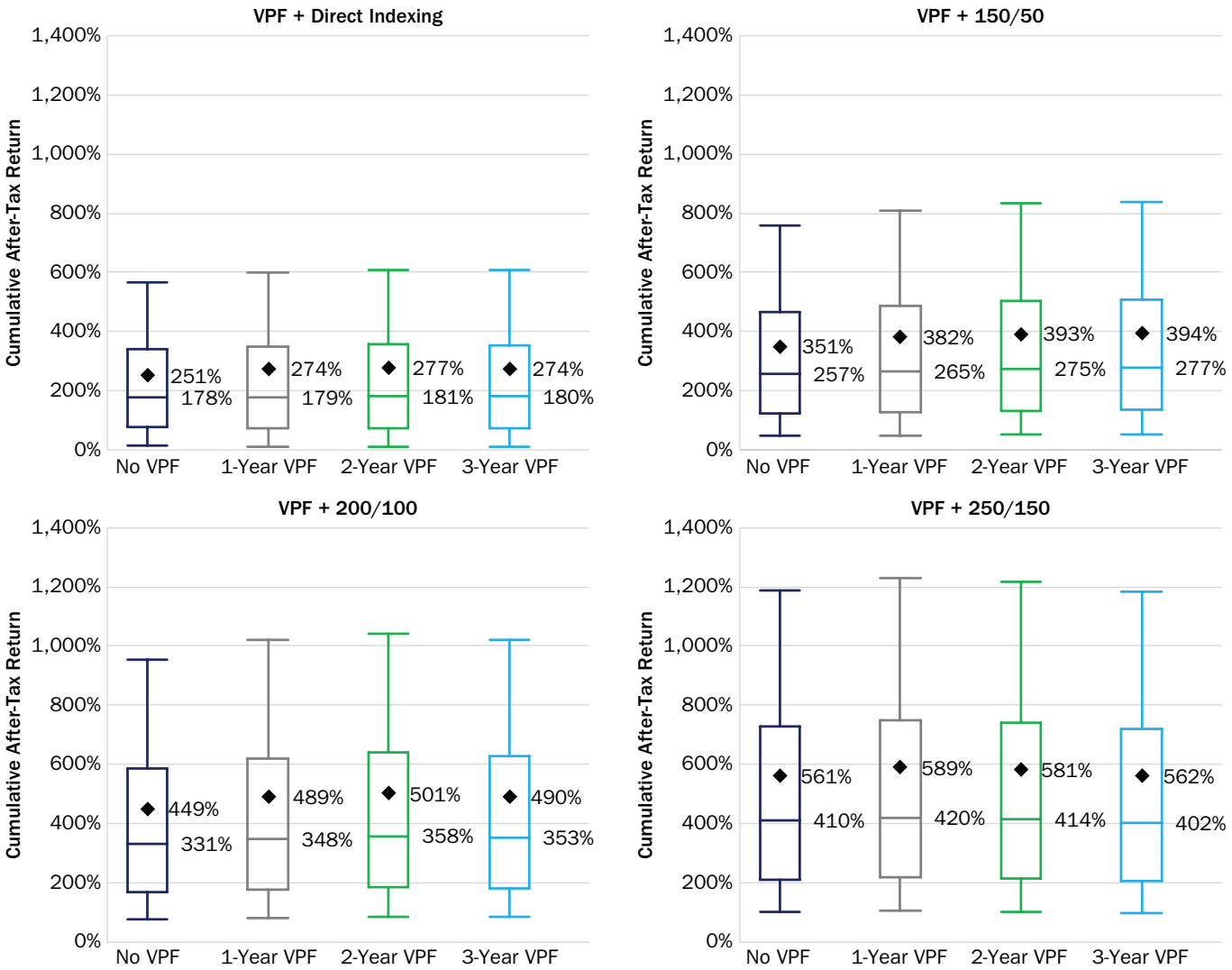
The benefits of the VPF transaction are higher when the prepayment is invested in one of the long-short strategies. Regarding the VPF term, for the 150/50 strategy, the benefit of VPF is maximized with a three-year contract. For the 200/100 strategy, the optimal VPF term is two years, while for the 250/150 strategy, the optimal VPF term is one year.[15]

Although the presence of the VPF generally improves after-tax wealth outcomes—and calibrating the VPF term offers further improvements (for example, a three-year

[15] Tax-aware long-short factor strategies with leverage greater than 325/225 and TE higher than 8% may realize a net loss exceeding 100% of the invested capital in just one year. These strategies also offer a correspondingly higher expected return derived from factor-investing alpha. An investor who sells low-basis stock early in the year and invests the proceeds in such a strategy may not need a VPF, as the gain from selling the stock could be fully offset by the loss realized by the strategy in the first year. However, a VPF might still be useful if the sale occurs later in the year, as it can defer gain recognition until the following year, allowing the strategy to realize a cumulative net loss sufficient to offset the gain from selling the stock.

EXHIBIT 5

Cumulative After-Tax Return Distribution for Different Tax-Aware Strategies, 20-Year Horizon



NOTES: The exhibit shows the distribution of 20-year cumulative after-tax returns. The box denotes the 25th, 50th, and 75th percentiles. The whiskers denote the 10th and 90th percentiles. The marker represents the mean cumulative return.

VPF for 150/50, a two-year VPF for 200/100, and a one-year VPF for 250/150)—the primary impact comes from the strategy itself. Higher-leverage strategies take higher tracking-error risk, which is compensated by higher pre-tax returns derived from factor-strategy alpha. Additionally, higher-leverage strategies realize larger capital losses. These higher returns and realized losses lead to greater after-tax wealth.[16]

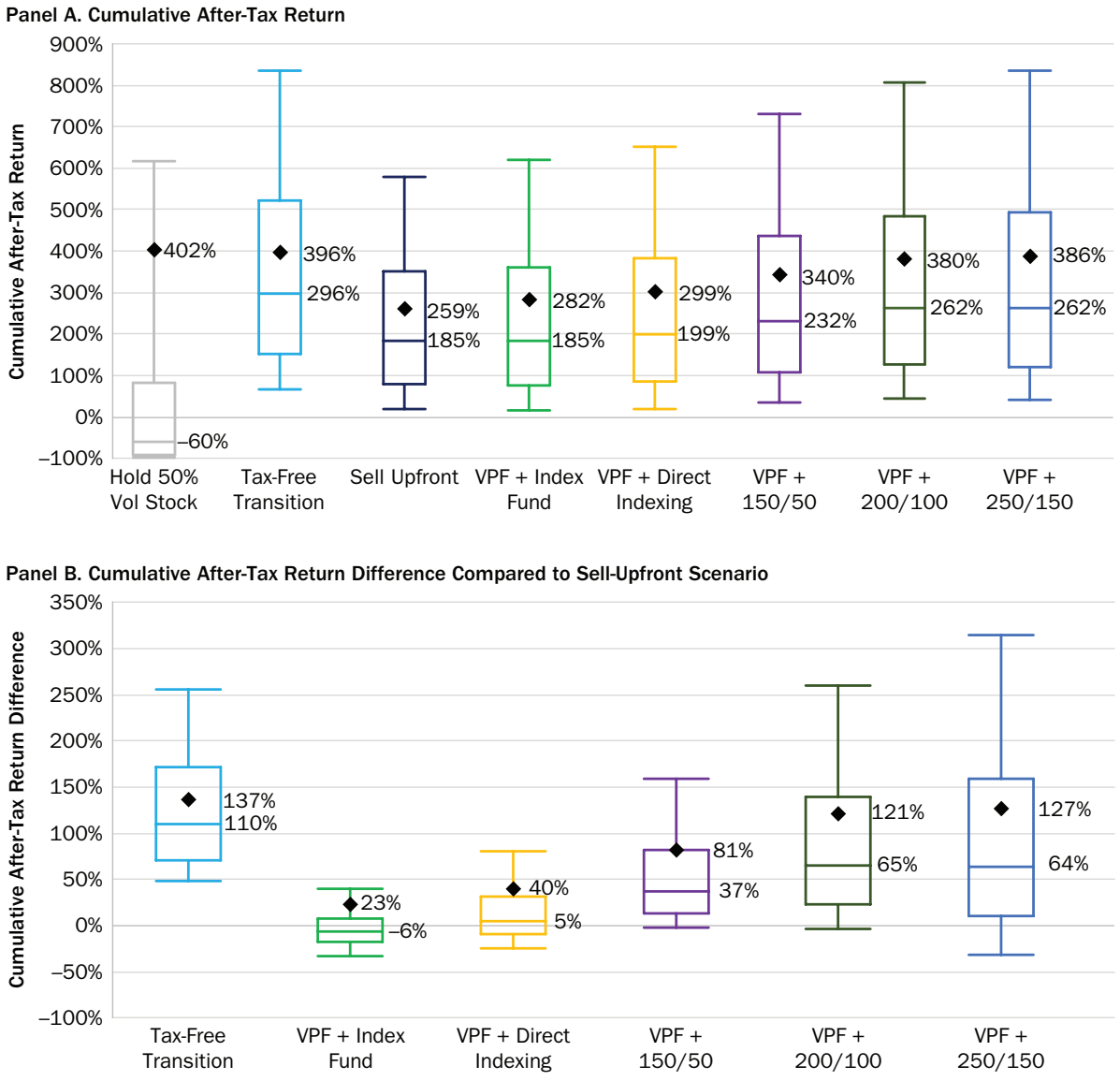
[16] In an analysis not reported here for the sake of brevity, we find that the financing cost of the VPF can be reduced by combining the VPF contract with a partial outright sale of the stock position. The optimal outright sale amount depends on the strategy in which the sale proceeds and the VPF prepayment are invested. For example, for the 250/150 strategy, if the sale occurs on the first business day of the year, the approach that maximizes after-tax wealth is selling around two-thirds of the stock position outright and entering into a VPF contract on the remaining one-third.

ISOLATING THE EFFECT OF LOSSES REALIZED BY TAX-AWARE STRATEGIES

To isolate the effect of losses realized by tax-aware strategies from their pre-tax alpha, Exhibit 6 replicates Exhibit 1, this time assuming a net of fees and costs pre-tax information ratio of 0 for all tax-aware strategies. This includes the direct-indexing strategy, for which, in the base case presented in Exhibit 1, we assumed a –30 bps alpha due to fees and transaction costs.

EXHIBIT 6

Cumulative After-Tax Return Distribution under Alternative Scenarios and the Assumption of Zero Pre-Tax Alpha for All Tax-Aware Strategies



NOTES: The exhibit shows the distribution of 20-year cumulative after-tax returns (Panel A) and return differences (Panel B). A difference compared to the "Sell Upfront" scenario is computed for each simulation, and the distribution of differences across simulations is shown in Panel B. The box denotes the 25th, 50th, and 75th percentiles. The whiskers denote the 10th and 90th percentiles. The marker represents the mean cumulative return (Panel A) and return difference (Panel B).

As seen in Exhibit 6, the ability of tax-aware strategies to realize losses is highly beneficial. If the direct-indexing strategy could match the pre-tax return of the market index fund, a VPF combined with direct indexing would outperform both the "Sell Upfront" scenario and the "VPF + Index Fund" scenario. The difference between the "VPF + Index Fund" and "Sell Upfront" scenarios highlights the benefits of the VPF contract. The further difference between the "VPF + Direct Indexing" and "VPF + Index Fund" shows the potential value of investing the VPF prepayment in a tax-aware strategy.[17] Moreover, as evidenced in the last three boxes in Exhibit 6, Panel A, the ability of the long-short strategies to realize greater losses than direct indexing yields an additional increase in cumulative after-tax returns. Higher-leverage strategies—200/100 and 250/150—compare favorably with the theoretical tax-free transition.[18]

Exhibit 6, Panel B, compares combinations of VPF with various investments to the "Sell Upfront" scenario under the assumption of a 0 pre-tax information ratio. Investing VPF proceeds in the index fund generally does not outperform selling the stock upfront and investing the proceeds in the index fund. Using direct indexing instead of an index fund fares slightly better. However, the real value of gain deferral offered by the VPF is observed when the VPF is combined with long-short strategies.

Notably, the 200/100 strategy generally performs similarly to the 250/150 strategy in terms of mean and median cumulative after-tax returns, and even slightly better when considering the 25th and 10th percentiles. Exhibit 2 helps to understand this effect. There, we saw that the 200/100 strategy is sufficient to fully offset the settlement gain of the two-year VPF. Under the assumption of a 0 information ratio, the 250/150 strategy only increases volatility without providing additional tax or pre-tax benefits compared to the 200/100. Higher volatility leads to worse downside outcomes. Note, however, that, as shown in Exhibit 1, if factor strategies have a positive information ratio, as a large body of empirical literature has demonstrated, the 250/150 strategy provides the highest cumulative after-tax return, thanks to a combination of tax efficiency and high pre-tax return.

Before proceeding, we would like to highlight the difference in cumulative after-tax returns between Exhibits 6 and 1, which is driven by pre-tax returns. The magnitude of this difference underscores the importance of pre-tax performance. While a VPF enables tax-efficient portfolio repositioning, the long-run success of an investment program kickstarted with the help of a VPF relies on pre-tax returns just as much as it does on tax efficiency.

THE EFFECT OF LIQUIDATION

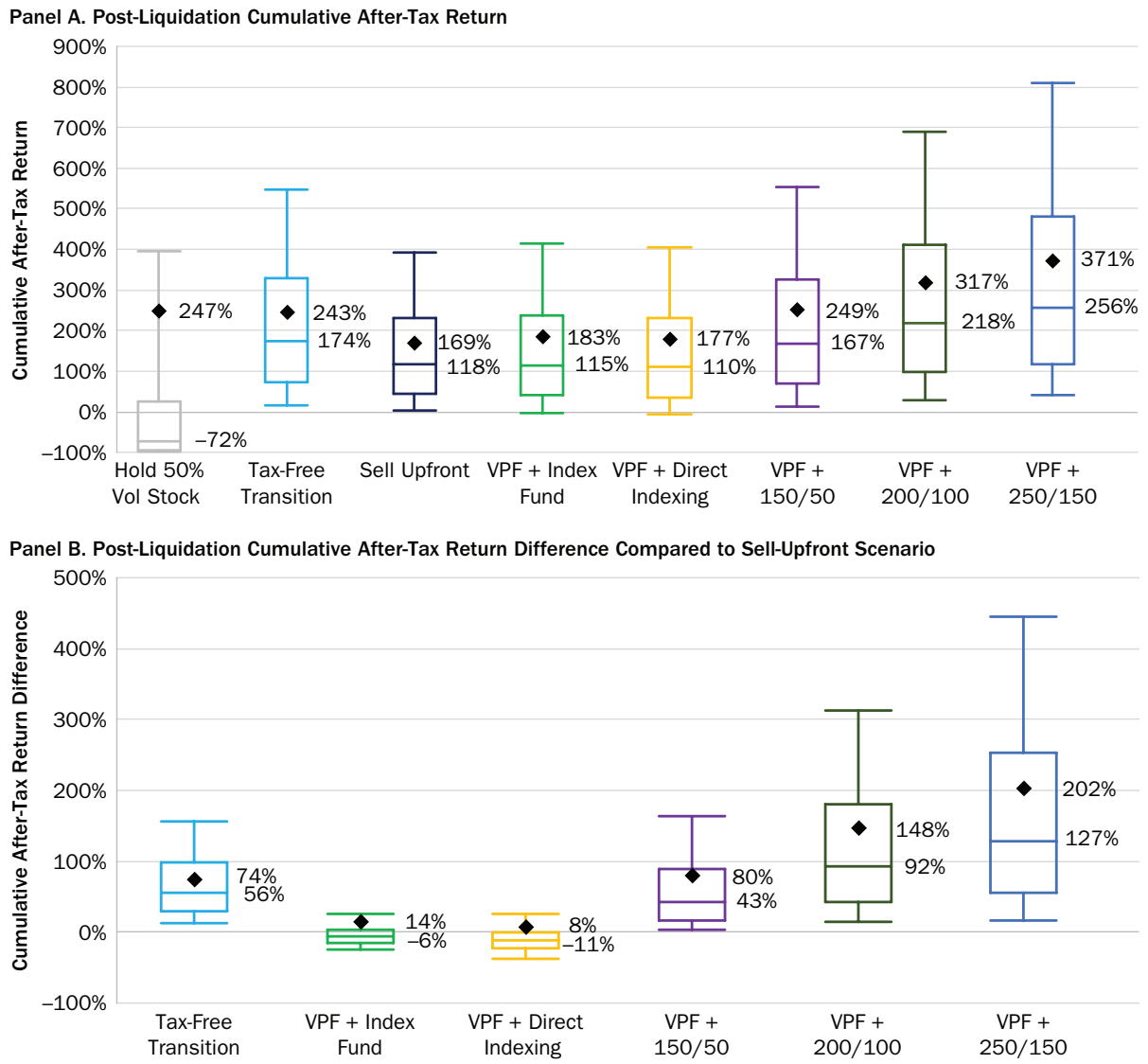
Over long investment horizons, tax-efficient investments—such as buying and holding a stock or a market index fund—tend to accumulate substantial built-in gains. Tax-aware strategies tend to accrue even larger built-in gains. Although a tax-sensitive

[17] As we have seen in Exhibit 1, the problem with the direct-indexing strategy is that in the long run, its costs, which are typically higher than those of a market index fund, may outweigh the tax benefits it provides upon settlement of the VPF.

[18] In an analysis not included here for the sake of brevity, we find that when the net of fees and costs pre-tax information ratio of tax-aware long-short factor strategies is less than −0.2 during the entire 20-year investment period, simply selling the stock upfront and investing the proceeds in a market index fund produces better after-tax wealth outcomes. One could also argue that the concentrated stock itself might have alpha. However, we find that for the median wealth of a concentrated stock investment to match the median wealth achieved with tax-aware long-short strategies, the stock's alpha needs to be between 10% and 15% over the entire 20-year investment period. While not impossible, this level of alpha is highly improbable: depending on the estimation method used, a single stock alpha of this magnitude corresponds to only a few top percentiles of historical stock returns in the Russell 3000 universe.

EXHIBIT 7

Post-Liquidation Cumulative After-Tax Return Distribution under Alternative Scenarios



NOTES: The exhibit shows the distribution of 20-year post-liquidation cumulative after-tax returns (Panel A) and return differences (Panel B). A difference compared to the "Sell Upfront" scenario is computed for each simulation, and the distribution of differences across simulations is shown in Panel B. The box denotes the 25th, 50th, and 75th percentiles. The whiskers denote the 10th and 90th percentiles. The marker represents the mean cumulative return (Panel A) and return difference (Panel B).

investor is unlikely to liquidate an appreciated portfolio all at once,[19] modeling a full liquidation at the end of the 20-year investment horizon allows us to estimate post-liquidation cumulative returns under the most conservative scenario.

Exhibit 7 shows the *post-liquidation* 20-year cumulative after-tax returns. The results mirror the *pre-liquidation* 20-year cumulative returns in Exhibit 1. Utilizing a

[19] See, for example, Sialm and Sosner (2018): "There are several reasons to relax this assumption (Poterba 1999). Capital gains taxes can be completely avoided if the investor holds the positions until death, when the cost basis of the shares in the portfolio is stepped up to their market value, or if the investor donates the shares to a qualified charity. In addition, the investor can time the liquidation and realize gains in periods when statutory rates are low or the investor's income slides into a lower marginal tax bracket."

VPF in conjunction with a market index fund yields better after-tax wealth outcomes than simply selling the stock and buying a market index fund, at least in terms of mean return and the 75th and 90th return percentiles. Investing a VPF prepayment in the direct-indexing strategy continues to perform worse than investing it in a market index fund.

As further observed in Exhibit 7, investing a VPF prepayment in the tax-aware long-short factor strategies is highly value-additive compared to all other options. Panel A shows that in comparison to investing the prepayment in a market index fund, the 150/50 strategy increases the median post-liquidation cumulative return by approximately 50%, from 115% to 167%, closely matching the distribution of cumulative return under the theoretical tax-free transition. The 200/100 strategy further increases the median post-liquidation cumulative return by an additional 50% to 218%. Finally, the 250/150 strategy increases the median post-liquidation cumulative return by another 40% to 256%, which is about 80% higher than the theoretical tax-free transition median return of 174%.

The differences from "Sell Upfront" shown in Exhibit 7, Panel B, reinforce the conclusions derived from Panel A. Compared to "Sell Upfront," the value added by the VPF is quite limited if the VPF proceeds are invested in an index fund or a direct-indexing strategy. In contrast, investing VPF proceeds in tax-aware long-short strategies significantly boosts cumulative after-tax wealth, even when accounting for liquidation.

CONCLUSION

Combining VPFs with tax-aware strategies can help low-basis concentrated stock investors diversify their stock holdings and enhance after-tax wealth accumulation. However, the choice of tax-aware strategy for investing the VPF prepayment significantly impacts after-tax wealth outcomes. For example, while a direct-indexing strategy can offset some VPF settlement gains, its effectiveness is limited. We find that a cost of 30 bps resulting from fees and transaction costs is sufficient to tip the balance in favor of investing the VPF prepayment in a market index fund rather than in a direct-indexing strategy.

Tax-aware long-short factor strategies have two potential advantages over direct indexing. First, a tax-aware long-short factor strategy seeks to outperform the market index on a pre-tax basis, after costs and fees. Therefore, if such a strategy achieves its stated objective, it will generate a potentially significant pre-tax profit. Second, tax-aware long-short factor strategies realize significantly higher net losses than direct indexing, allowing the investor to offset a substantially larger fraction of the VPF settlement gain. This propensity of tax-aware long-short factor strategies to realize significant tax losses is shown in Liberman et al. (2023) and further analyzed in Krasner and Sosner (2024). We show that investing the VPF prepayment in tax-aware long-short factor strategies creates wealth outcomes superior to other investment options, such as a market index fund or direct indexing. Our findings thus support the assertion made at the beginning of the article: a VPF should be viewed as only the first step in a wealth-planning journey.

In summary, low-basis stock investors can effectively diversify their concentrated portfolios by combining three innovations in the financial industry: VPF contracts, tax-aware equity portfolio management, and long-short factor investing. While each of these innovations individually can benefit a taxable investor pursuing wealth growth and preservation, their value is truly maximized when they are combined under the umbrella of a cohesive investment plan.

APPENDIX

THE PERILS OF HOLDING A CONCENTRATED STOCK

Exhibit A1 shows the distribution of cumulative returns over a 20-year investment horizon. The first four boxes show the results for a concentrated stock with volatility ranging from 60% to 30%. The last box shows a theoretical tax-free transition to a market index fund with volatility of 15%.[20]

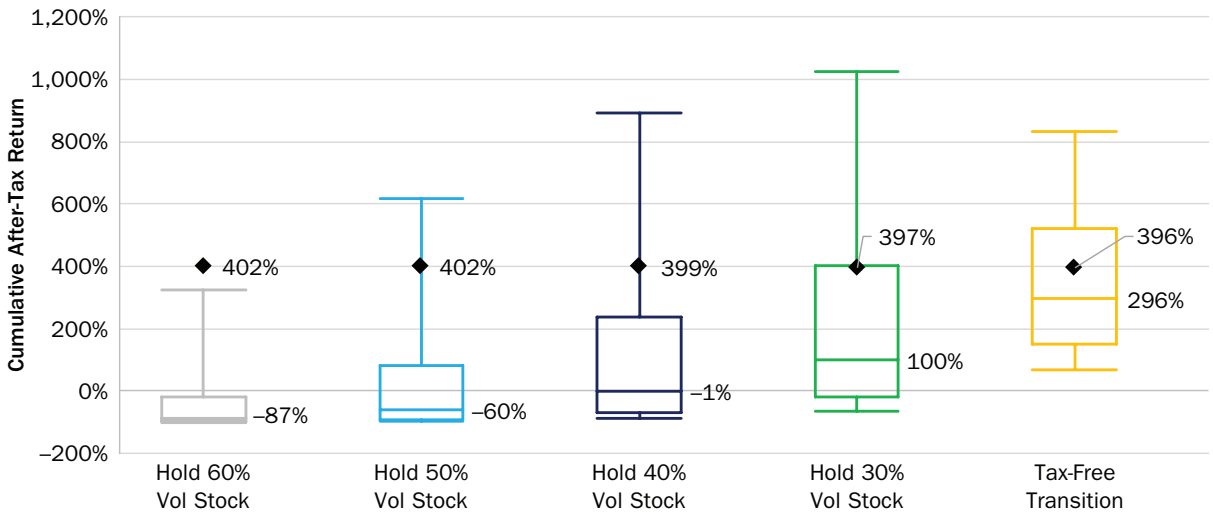
The effects of volatility are striking. For the stock with 60% volatility, the median outcome over a 20-year horizon is an almost 90% loss of wealth. The investor is expected to experience a loss with a probability exceeding 75%. The mean outcome lies completely outside of the 10th to 90th percentile range. This result is consistent with the findings in Sosner (2022): As stock volatility increases, the probability of achieving the mean outcome converges to zero.[21]

The mass of the 20-year cumulative return distribution shifts upward as the volatility of the concentrated stock decreases. When the volatility is 40%, the median outcome corresponds to just retaining the original value of the stock at the inception of the 20-year period. Even when the stock volatility is reduced to 30%, there is a greater than 25% chance that the stock will lose value over the 20-year horizon.

If, at the inception of the 20-year period, the investor could wave a magic wand and transform the stock into a market index fund without any liquidation tax, the investor's cumulative 20-year return distribution would look like it does in the right-most box in Exhibit A1. The mass of the cumulative return distribution sits well above zero, with the cumulative return exceeding 70% with 90% probability.

EXHIBIT A1

Cumulative After-Tax Return Distribution for a Concentrated Stock and a Theoretical Tax-Free Transition to a Market Index Fund



NOTES: The exhibit shows the distribution of 20-year cumulative after-tax returns. The box denotes the 25th, 50th, and 75th percentiles. The whiskers denote the 10th and 90th percentiles. The marker represents the mean cumulative return.

[20] Under our assumptions that neither the stock nor the market index fund pays dividends and that no taxable liquidations occur, after-tax returns are identical to pre-tax returns in all the scenarios depicted in Exhibit A1.

[21] The theoretical mean return is identical across all five investments depicted in Exhibit A1 and is equal to 395%, which is calculated as $e^{8\%\times 20}-1$. Simulation noise results in small deviations from this theoretical value.

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