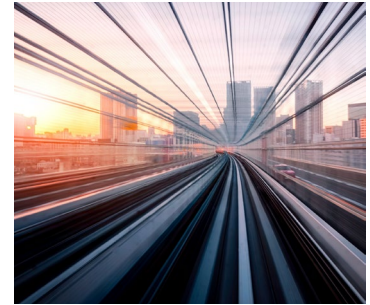




July 16, 2024

Global Asset Allocation Strategy Team

Addressing the needs of highly taxed investors with tax-efficient asset allocation

Introduction

The Wells Fargo Investment Institute (WFII) tax-efficient strategic asset-allocation process seeks to produce diversified portfolios that meet investors' long-term investment objectives on an after-tax basis. In our view, the wealth-management industry historically has oversimplified customizing advice for investors based on their tax sensitivity and tolerance for illiquidity. The tax-efficient guidance is the proposed solution for these specific challenges.

We believe the tax-efficient allocation guidance offers a consistent process to manage investment accounts, primarily for multigenerational, high-net-worth, and ultra-high-net-worth investors. Because investor needs and portfolio constraints vary, we believe manager selection and asset-allocation decisions are most effective when they are made as part of a collaborative dialogue between investors and their advisors. In building the after-tax capital market assumptions (CMAs)¹ and tax-efficient strategic asset allocations, underlying assets are selected in an effort to create a consistent investment philosophy and portfolio risk-management framework. This means that the after-tax CMAs and tax-efficient strategic allocations are developed without consideration for account size, portfolio-level constraints, or other unique circumstances. Taxes are assumed to be the highest marginal income-tax rate at the federal level and an average of the highest marginal income-tax rate at the state level. The after-tax CMA model is designed with the assumption that high-net-worth individuals would be able to optimize investments and planning with tax efficiencies in mind and can maintain a certain amount of long-term capital gains at the end of their investment time horizon. We offer two versions of portfolio allocations. One assumes that only liquid asset classes will be used, while the second allows for the inclusion of less liquid asset classes, such as Private Real Estate and Private Equity.

This white paper presents an overview of our approach to developing the after-tax CMAs and tax-efficient strategic asset allocations. It also provides guidance on transitioning existing portfolios to tax-efficient allocations.

Investment and Insurance Products: ➤ NOT FDIC Insured ➤ NO Bank Guarantee ➤ MAY Lose Value

1. For details on our capital market assumptions and revised strategic allocation preferences, please see "2024 Capital Market Assumptions: Methodology — The building-block approach" and "2024 Capital Market Assumptions: Strategic asset allocation recommendations," Wells Fargo Investment Institute, July 16, 2024.

Background review

In recent years, we have observed a growing interest among investors in establishing tax-efficient portfolios. This motivated us to develop a unique set of after-tax CMAs and tax-efficient strategic asset allocations. These portfolio allocations are designed for high-net-worth and ultra-high-net-worth individual investors with relatively high income-tax obligations.

When developing after-tax CMAs, WFII has taken into consideration federal, state, and capital-gains taxes that apply to the asset classes for which WFII creates CMAs. In developing the after-tax CMAs, WFII consulted academic literature that explored the challenge of creating tax-efficient asset-allocation advice, including a look at how the highly regarded Yale University (Yale) endowment fund might be managed if it were subject to taxes.

The Yale endowment

The Yale endowment has benefited from an infinite time horizon and unique access to some of the world's best active managers of private capital and absolute return strategies. The endowment also uses an active approach to security selection. Risk management seeks to manage the fund's liquidity, given its large allocation to illiquid private strategies, and to preserve the real value of the endowment over time.

It is our belief that ultra-high-net-worth and many high-net-worth individual investors have much in common with the world's most sophisticated institutional investors: multigenerational investment horizons, large portfolio sizes, and access to a universe of global investments in public and private markets. Yet, individual investors can *differ* from large institutions in two important ways. First, they often pay a high income-tax rate. For some investors, taxes can consume up to half of their before-tax return on high-yielding assets or on high-turnover strategies that generate short-term capital gains. Second, whether due to balance-sheet needs, lack of qualified purchaser status, preference for liquidity, or tax-filing simplicity, some investors are constrained to liquid asset classes, including the public equity and fixed-income markets.

For investors with high tax sensitivity and a need for liquidity, attempting to replicate an illiquid, highly active institutional strategy can result in lower after-tax returns and greater portfolio risk during periods of market stress. A case study by Aperio² makes this point by showing how the Yale endowment allocation strategy would change if Yale, like many individual investors, were subject to income taxes. The resulting after-tax optimized portfolio would look significantly different from the before-tax Yale endowment allocation mix.

As noted in the Aperio study, academic literature on after-tax asset allocation is limited, in part because “the complexity of tax law, its variation over time, and its wide range of effects on different portfolios present a challenge to even the most tax-aware adviser. These considerations complicate the task of identifying after-tax investment principles that are universally applicable.” Still, as the (Aperio) research notes, accounting for taxes in the estimation of expected return shows “profound differences between the before-tax and after-tax allocations.” Taxes can reduce the expected return of certain asset classes by 40% to 50%. In their paper, the authors describe a method for applying tax haircuts³ to expected before-tax returns, then re-optimizing a strategic asset allocation using before-tax volatility to study the effect on the optimized asset allocation.

2. Geddes, Goldberg, and Bianchi, “What Would Yale Do If It Were Taxable?” *Financial Analysts Journal*, Vol. 71, No. 4, 2015

3. A tax haircut is the downward adjustment made to expected return to take into account the impact of taxes.

Table 1. The effect on optimal asset allocation can be dramatic, as illustrated in the table below

Asset class for Yale endowment	Before-tax implied return (%)	After-tax implied return (%)	Tax haircut (%)	Before-tax weight (%)	After-tax active equity weight (%)	After-tax indexed equity weight (%)	After-tax tax-advantaged equity weight (%)
Absolute return	2.0	1.6	-0.4	17.8	0.0	0.0	8.0
Active equity	9.1	7.0	-2.1	15.7	0.0	0.0	0.0
Indexed equity	9.1	8.6	-0.5	0.0	0.0	45.1	0.0
Tax-advantaged equity	9.1	10.6	1.4	0.0	0.0	0.0	24.6
Bonds	1.6	0.9	-0.7	4.9	35.3	26.3	18.5
Natural resources	10.1	9.2	-0.9	7.9	13.5	0.8	6.6
Real estate	11.6	10.0	-1.6	20.2	14.4	9.6	3.0
Private equity	10.9	9.7	-1.2	32.0	36.8	18.3	39.3
Cash	1.5	0.8	-0.7	0.0	0.0	0.0	0.0

Source: Geddes, Goldberg, and Bianchi, “What Would Yale Do If It Were Taxable?” 2015, corrected January 2016. The After-Tax Active Equity Weight shows the weights of the Yale endowment asset allocation with the equity allocation available only through active strategies. The After-Tax Indexed Equity Weight shows Yale’s endowment asset allocation under the same assumption but with indexed equities as well. The After-Tax Tax-Advantaged Equity Weight shows the portfolio with access to the same indexed strategy but with inclusion of tax-advantaged equities as well.

The resulting optimized after-tax allocations shown in the columns on the right differ substantially in their composition from the before-tax allocations. For example, the weight in absolute return strategies is reduced from 18% to 0% in two of three scenarios that the Yale study examined. Bonds increase from 4.9% in a before-tax allocation to 35.3%, 26.3%, or 18.5% across the alternative scenarios studied in the paper. The study concludes that while the task of estimating tax haircuts is difficult across many types of assets and asset classes, it is critical to estimate this effect given the stark differences in before-tax and after-tax optimized asset allocations.

Geddes, Goldberg, and Bianchi also comment on the potential impact of taxes on volatility, noting that “after-tax returns of tax-inefficient assets tend to have lower volatility than before-tax returns.” However, they note that “this question is difficult to answer because after-tax returns generally are not available for analysis.” Unlike the before-tax covariance matrix that can be estimated based on historical results, historical after-tax returns typically are not available for analysis. Geddes, Goldberg, and Bianchi use simplifying assumptions about the relationship between before-tax returns and tax haircuts to estimate an after-tax covariance matrix and then re-optimize portfolio weights (see Table 2).

Geddes, Goldberg, and Bianchi found that the portfolio allocation changed from the allocation derived using the before-tax covariance matrix; however, the changes were consistently in the direction of an increase in the allocation to risk assets (equities, private equity, and real estate) and reduced allocation to lower-volatility assets (bonds and absolute return) relative to the weights derived using a before-tax covariance matrix. For example, in Table 2, depending on the assumed correlation between the before-tax expected return and the tax haircut, the allocation to risky asset classes increased by up to 20% of the portfolio weight. Given the uncertainty of estimating an after-tax covariance matrix without observable historical after-tax inputs, the approach of optimizing a portfolio with after-tax expected returns and a before-tax covariance matrix captures the potential benefit of estimating after-tax returns while adhering to the principle of conservatism in terms of its impact on portfolio weight allocated to risk asset classes.

Table 2. Change in asset class allocation (weight) after using after-tax covariance matrix

Asset class for Yale endowment	Weight with before-tax covariance matrix	Change in weight using after-tax covariance matrix (p = 0.25)	Change in weight using after-tax covariance matrix (p = 0.50)	Change in weight using after-tax covariance matrix (p = 0.75)	Change in weight using after-tax covariance matrix (p = 1.00)
Absolute return	8.0%	-2.1%	-7.8%	-8.0%	-8.0%
Active equity	0.0%	0.0%	6.2%	14.2%	23.6%
Indexed equity	0.0%	0.0%	0.0%	0.0%	0.0%
Tax-advantaged equity	24.6%	-0.5%	1.3%	4.5%	8.5%
Bonds	18.5%	-0.4%	0.6%	-4.7%	-11.5%
Natural resources	6.6%	1.3%	0.6%	-1.3%	-3.5%
Real estate	3.0%	2.9%	5.9%	9.4%	13.7%
Private equity	39.3%	-1.2%	-6.8%	-14.1%	-22.7%
Cash	0.0%	0.0%	0.0%	0.0%	0.0%
Change in "equity like" asset-class weights	–	2.5%	7.2%	12.7%	19.6%
Change in "bond like" asset-class weights	–	-2.5%	-7.2%	-12.7%	-19.5%

Source: Geddes, Goldberg, and Bianchi, “What Would Yale Do If It Were Taxable?” 2015, corrected January 2016. The p value represents the correlation between before-tax return and the tax haircut increases; the correlation ranges between a low correlation where p = 0.25 to a perfect correlation where p = 1.00. This table is hypothetical and for illustrative purposes only. It is not intended to represent an actual investment.

The findings of Geddes, Goldberg, and Bianchi (2015) as well as Chopra and Ziemba (1993) suggest the prioritization of adjusting the before-tax CMAs mean after-tax returns to generate the after-tax CMAs. In their study, “The Effect of Errors in Means, Variances, and Covariances on Optimal Portfolio Choice,” Chopra and Ziemba find that for an investor with a moderate risk tolerance, “errors in means are about 11 times as important as errors in variances, a result similar to that of Kallberg and Ziemba (1984).”⁴ For higher risk tolerances, errors in means are even more important than errors in variances and covariances, while for lower risk tolerances, the relative impact among variables is closer.

Table 3. Average ratio of cash equivalent loss for errors in means, variances, and covariances

Risk tolerance	Errors in means versus variances	Errors in means versus covariances	Errors in variances versus covariances
25	3.20	5.38	1.67
50	10.98	22.50	2.05
75	21.40	56.80	2.68

Source: Chopra and Ziemba, “The Effect of Errors in Means, Variances, and Covariances on Optimal Portfolio Choice,” *Journal of Portfolio Management*, 1993. Risk tolerance indicates low (25), moderate (50), and high (75).

Historically, our CMAs have not taken into account the impact of taxes on estimated returns or risk. Given the importance of this work demonstrated by Geddes, Goldberg, and Bianchi (2015) and Chopra and Ziemba (1993), we are focused on providing improved estimates of after-tax returns for highly taxed investors.

4. Chopra and Ziemba, “The Effect of Errors in Means, Variances, and Covariances on Optimal Portfolio Choice,” *Journal of Portfolio Management*, 1993

In the next section, we discuss our conceptual framework in developing the after-tax CMAs.

After-tax CMAs

Estimating the effect of taxes on return requires many inputs and assumptions, but we view our approach as straightforward and the methodology as sound because tax rates are observable and calculations of taxes follow statutory guidance. Moreover, we use three key inputs required for calculating after-tax CMAs: before-tax CMA expected return, CMA expected standard deviation (a measure of volatility), and CMA expected yield. While we make certain qualitative and judgmental assumptions about asset-class-specific tax treatment through the process described in this paper, we view the tax-haircut calculation (the difference between before-tax and after-tax expected return) as repeatable and robust across asset classes, as demonstrated through performance testing and sensitivity analysis.

There are three primary data inputs used to calculate after-tax CMAs:

1. Federal and state income-tax rates for ordinary income, qualified dividends, and capital gains
2. WFII's before-tax CMAs, including expected return, yield, and standard deviation of asset classes
3. Asset-class data that is used either as direct model inputs or to form assumptions for model inputs regarding the taxation of each asset class's components of total return (ordinary income, qualified dividend income (QDI), long-term capital gains, and short-term capital gains)

The after-tax CMA creation involves two sets of calculations determined by the asset classes and the method used to calculate their tax haircuts:

- For fixed-income asset classes and cash, a simple arithmetic calculation is used to calculate the tax adjustment for the asset classes because the before-tax CMA geometric return is set equal to the income return (yield). This means there is no assumed growth component to the CMA total return of the asset class, so the tax adjustment is simply the before-tax CMA geometric return multiplied by the applicable income-tax rate. The tax treatment of these asset classes is fairly straightforward and determined by statutory guidance about the applicable tax rate for various fixed-income asset classes based on whether income is fully taxable or exempt from federal (and possibly state) income tax, as well as any QDI produced.
- Each of the remaining asset classes, including equities, real assets, and alternatives, have a CMA total return that is composed of growth and income. Therefore, the tax adjustment must be calculated over the holding period of the investment. The return component subject to income tax (for example, dividends) is taxed annually, while the capital-gains tax is calculated based on assumptions about the investor holding period and turnover within the strategy. The tax adjustment calculated on asset classes with a growth component is affected by the path of annual returns over a given holding period; therefore, the analysis is simulated over 15,000 return paths, and the average tax adjustment over those simulations is used.

Once tax haircuts are calculated for all asset classes, they are subtracted from CMA geometric before-tax returns, which are multiperiod annualized estimates. These are converted to CMA arithmetic after-tax returns, which represent the average return for a single year. Finally, CMA after-tax yields are calculated for each asset class. Before-tax CMA geometric returns are used as the basis for tax-haircut adjustments because of the multiperiod nature of taxes. The after-tax yield for fixed-income asset classes is set equal to the after-tax geometric return. For asset classes with a growth component, the after-tax yield is calculated by applying the applicable dividend and ordinary income-tax rates to the before-tax yield.

In certain private asset classes, such as private real estate and master limited partnerships (MLPs), there is the potential for the before-tax yield to differ from taxable income due to the pass-through of business expenses, depreciation, and other liabilities that reduce the taxable income to investors in the early years of the investment, often to zero. In cases such as these, taxable income is set to zero while capital-gains rates are adjusted to reflect the fact that sheltered income ultimately decreases cost basis and increases the tax haircut on capital gains for these assets.

A. Fixed income and cash

1. Determine taxability: For fixed-income and cash asset classes, a determination of the taxability for federal and state tax purposes is made. Taxability drives the effective income-tax rate that is applied to before-tax income.
 - a. Some asset-class assumptions are derived using broad market indexes that contain securities with varying levels of taxability.
 - b. The blended tax rate is calculated as a weighted average of the allocation of the sub-asset classes and their corresponding tax rates.
 - c. Only one fixed-income asset class consistently produces income that is taxed as QDI: preferred stocks.
2. Tax haircut: Once the inputs and assumptions are built, the calculation of the fixed-income tax haircut is a simple arithmetic calculation using the methodology described above.

B. Equities, real assets, and alternative investments

1. Determining assumptions: In contrast with the cash and fixed-income before-tax CMAs, equities, real assets, and alternative asset classes have a total return that is composed of growth and/or income. Therefore, the tax adjustment must be calculated over the holding period of the investment. The return component subject to income tax (for example, dividends) is taxed annually, while the capital-gains tax is calculated based on assumptions of the investor holding period and turnover within the strategy. The following assumptions are made:
 - a. Taxable income: For most asset classes, the before-tax yield represents the amount of income that is subject to annual income tax. Private real estate, MLPs, and infrastructure benefit from a depreciation shield in which passed-through business expenses, including depreciation on assets, reduce taxable income from the before-tax yield assumption.
 - b. QDI: For equity asset classes, preferred stocks, and public real estate investment trusts (REITs), the QDI rate estimate is observed from the five-year average QDI rate provided by Blackrock for iShares exchange-traded funds (ETFs) that are investable proxies for the asset class.
 - c. Federal and state long-term/QDI rate: The sum of the federal long-term rate, state long-term rate, and the Medicare investment income surcharge is the “max long-term rate.”
 - d. Federal and state short-term/ordinary-income rate: The sum of the federal short-term rate, state short-term rate, and the Medicare investment income surcharge is the “max short-term rate.”

- e. Hedge fund long-term proportion: This represents the estimated mix of long-term and short-term capital gains/ordinary income for actively managed strategies with high turnover. The estimate is based on historical product analysis.
 - f. Holding period: For liquid asset classes with investment vehicles that can be owned indefinitely, the holding period is assumed to be 20 years. Alternative asset classes are assumed to have a 20-year holding period. Private real estate, infrastructure and MLPs, and private equity asset classes are assumed to have a holding period of 13 years.
 - g. Tax-loss harvesting eligible: Tax-loss harvesting can occur with liquid asset classes at the end of any annual period in which the carrying value of the asset is below cost. Liquid asset classes, including all equity asset classes, public REITs, commodity funds, and liquid alternatives, are accessible through liquid ETFs and mutual funds for which substitute products are readily available. Illiquid, private-placement asset classes are generally unable to tax-loss harvest.
 - h. Final sale: Private-placement investments are liquidated at the end of the investment period and any remaining unrealized gains or losses in the portfolio at that time are therefore realized. For assets like an S&P 500 ETF, we assume investors can hold indefinitely without a final sale.
 - i. Internal turnover: The internal turnover percent describes the turnover in the portfolio due to active management within an investment. Because fixed-income asset classes assume return is fully produced by income, no turnover percent is required.
 - j. External turnover: External turnover attempts to simulate the decision of a portfolio manager to sell a portion of an investment over time to keep its weight in the portfolio consistent with a starting level. Rebalancing is possible only for liquid asset classes, so for all private-placement assets, the external rebalancing percent is set to zero.
- 2. Management fee: In order to model the potential tax drag for asset classes in which higher fees typically are charged to gain access (hedge funds and private capital strategies, for example), manager fees need to be added to CMA expected returns to create a gross-of-fee calculation for illiquid asset classes. Taxes are applied to gross-of-fee returns for these asset classes.
 - 3. Tax haircut: Once the assumptions are determined, a Monte Carlo simulation is run to derive expected returns for these asset classes. The expected returns would reflect the potential tax impacts. The tax haircut then becomes the difference between the before-tax expected returns and the after-tax expected returns. (Monte Carlo is an analytical technique in which a large number of simulations are run using random quantities for uncertain variables and looking at the distribution of results to infer which values are most likely.)

Not all asset classes are equally affected by taxes. Chart 1 shows the sensitivity of each asset class analyzed. The bars are for illustrative purposes only to show the relative tax impact between various asset classes. They do not represent absolute values of the haircut and should not be used on a stand-alone basis. The smaller bars indicate the asset classes that tend to be more tax-efficient. The larger the bars are, such as in the alternatives asset class, the more tax-inefficient the assets tend to be.

Chart 1. Illustration of tax haircut for asset classes



Source: Wells Fargo Investment Institute, as of July 16, 2024. Global liquid alternatives are investment strategies such as mutual funds, exchange-traded funds, and closed-end funds that may provide daily liquidity.

As Chart 1 demonstrates, some assets are more attractive in our opinion on an after-tax basis compared with their before-tax expected returns. These characteristics feed into our optimization process to develop the tax-efficient strategic asset allocation described in the next section.

Tax-efficient asset-allocation approach

The tax-efficient strategic asset allocations are generated by optimizing portfolios using the after-tax CMAs as inputs. Various asset-class-level constraints and risk budgets are applied during the optimization process.

Separate optimizations are run for the liquid and illiquid allocations, as each uses different constraints. Tax-exempt cash and fixed-income asset classes are used instead of taxable cash and fixed-income asset classes for both liquid and illiquid allocations. The optimization output is used by the Asset Allocation team to provide directional guidance when determining changes to the tax-efficient strategic asset allocations.

In 2024, we made several changes to the tax-efficient allocations to maintain alignment with desired risk targets in accordance with the long-term strategic time horizon, which takes into account trends we expect to prevail over the long term, covering multiple market cycles. In the illiquid allocations, for the Growth & Income and Growth investment objectives, we reallocated from U.S. Small Cap Equities to Private Equity. We recommend increasing exposure to Private Equity to reflect our continued expectations for favorable, long-term risk-return dynamics in the asset class. In the liquid allocations, we reallocated from U.S. Small Cap Equities to U.S. Large Cap Equities in the Growth & Income and Growth investment objectives. The number of non-earning companies in the small-cap universe has continued to increase, making this segment of the U.S. equity market less attractive from a risk-return perspective. Even so, we believe the expected return for this asset class should outpace less risky areas of the market over long periods of time, so it remains an important asset class for strategic allocations.

Table 4 and Table 5 compare the final tax-efficient allocations with before-tax liquid and before-tax illiquid allocations. Comparatively, the tax-efficient allocations have smaller allocations to the asset classes that are less tax-efficient across investment objectives. For example, alternative assets are generally less tax-efficient; thus, in a tax-sensitive portfolio, the recommended allocation is reduced and replaced using tax-exempt fixed income. Additionally, Emerging Market Fixed Income and Commodities are not included in the tax-efficient recommended allocations due to tax inefficiencies.

Table 4. Comparison between before-tax and tax-efficient liquid allocations

Asset class	Tax-efficient CI 2024 (%)	Conservative income 2024 (%)	Tax-efficient CI change (%)	Tax-efficient MI 2024 (%)	Moderate income 2024 (%)	Tax-efficient MI change (%)	Tax-efficient AI 2024 (%)	Aggressive income 2024 (%)	Tax-efficient AI change (%)
Cash Alternatives	3	2	1	3	2	1	2	2	—
U.S. Investment Grade Fixed Income	91	76	15	68	60	8	50	47	3
High Yield Fixed Income	0	3	-3	6	4	2	16	6	10
Developed Market ex-U.S. Fixed Income	0	0	—	0	0	—	0	0	—
Emerging Market Fixed Income	0	3	-3	0	5	-5	0	8	-8
Total Global Fixed Income	91	82	9	74	69	5	66	61	5
U.S. Large Cap Equities	6	12	-6	14	18	-4	17	21	-4
U.S. Mid Cap Equities	0	2	-2	5	5	—	7	7	—
U.S. Small Cap Equities	0	0	—	0	0	—	0	0	—
Developed Market ex-U.S. Equities	0	0	—	4	4	—	8	7	1
Emerging Market Equities	0	0	—	0	0	—	0	0	—
Total Global Equities	6	14	-8	23	27	-4	32	35	-3
Commodities	0	2	-2	0	2	-2	0	2	-2
Total Global Real Assets	0	2	-2	0	2	-2	0	2	-2
Total Portfolio	100	100	—	100	100	—	100	100	—

Asset class	Tax-efficient CGI 2024 (%)	Conservative growth & income 2024 (%)	Tax-efficient CGI change (%)	Tax-efficient MGI 2024 (%)	Moderate growth & income 2024 (%)	Tax-efficient MGI change (%)	Tax-efficient AGI 2024 (%)	Aggressive growth & income 2024 (%)	Tax-efficient AGI change (%)
Cash Alternatives	2	2	—	2	2	—	2	2	—
U.S. Investment Grade Fixed Income	45	39	6	35	30	5	25	20	5
High Yield Fixed Income	8	6	2	8	6	2	7	7	—
Developed Market ex-U.S. Fixed Income	0	0	—	0	0	—	0	0	—
Emerging Market Fixed Income	0	5	-5	0	5	-5	0	6	-6
Total Global Fixed Income	53	50	3	43	41	2	32	33	-1
U.S. Large Cap Equities	21	23	-2	26	27	-1	30	31	-1
U.S. Mid Cap Equities	10	8	2	12	10	2	14	12	2
U.S. Small Cap Equities	2	2	—	3	3	—	3	3	—
Developed Market ex-U.S. Equities	8	7	1	9	8	1	13	9	4
Emerging Market Equities	4	4	—	5	5	—	6	6	—
Total Global Equities	45	44	1	55	53	2	66	61	5
Commodities	0	4	-4	0	4	-4	0	4	-4
Total Global Real Assets	0	4	-4	0	4	-4	0	4	-4
Total Portfolio	100	100	—	100	100	—	100	100	—

Table 4. Comparison between before-tax and tax-efficient liquid allocations (continued)

Asset class	Tax-efficient CG 2024 (%)	Conservative growth 2024 (%)	Tax-efficient CG change (%)	Tax-efficient MG 2024 (%)	Moderate growth 2024 (%)	Tax-efficient MG change (%)	Tax-efficient AG 2024 (%)	Aggressive growth 2024 (%)	Tax-efficient AG change (%)
Cash Alternatives	2	2	—	2	2	—	2	2	—
U.S. Investment Grade Fixed Income	18	16	2	11	8	3	5	0	5
High Yield Fixed Income	4	3	1	3	3	—	0	0	—
Developed Market ex-U.S. Fixed Income	0	0	—	0	0	—	0	0	—
Emerging Market Fixed Income	0	0	—	0	0	—	0	0	—
Total Global Fixed Income	22	19	3	14	11	3	5	0	5
U.S. Large Cap Equities	34	33	1	36	35	1	33	37	-4
U.S. Mid Cap Equities	15	13	2	16	14	2	18	16	2
U.S. Small Cap Equities	5	5	—	6	6	—	8	7	1
Developed Market ex-U.S. Equities	14	14	—	13	15	-2	18	18	—
Emerging Market Equities	8	9	-1	13	12	1	16	15	1
Total Global Equities	76	74	2	84	82	2	93	93	—
Commodities	0	5	-5	0	5	-5	0	5	-5
Total Global Real Assets	0	5	-5	0	5	-5	0	5	-5
Total Portfolio	100	100	—	100	100	—	100	100	—

Source: Wells Fargo Investment Institute, as of July 16, 2024. CI = conservative income. MI = moderate income. AI = aggressive income. CGI = conservative growth and income. MGI = moderate growth and income. AGI = aggressive growth and income. CG = conservative growth. MG = moderate growth. AG = aggressive growth. Liquid allocations may include fixed income, equities, and real assets. Tax-efficient allocations use tax-exempt cash and fixed income, and before-tax allocations use taxable cash and fixed income.

Table 5. Comparison between before-tax and tax-efficient illiquid allocations

Asset class	Tax-efficient CI 2024 (%)	Conservative income 2024 (%)	Tax-efficient CI change (%)	Tax-efficient MI 2024 (%)	Moderate income 2024 (%)	Tax-efficient MI change (%)	Tax-efficient AI 2024 (%)	Aggressive income 2024 (%)	Tax-efficient AI change (%)
Cash Alternatives	2	2	—	2	2	—	2	2	—
U.S. Investment Grade Fixed Income	80	63	17	58	48	10	43	35	8
High Yield Fixed Income	0	2	-2	7	2	5	14	4	10
Developed Market ex-U.S. Fixed Income	0	0	—	0	0	—	0	0	—
Emerging Market Fixed Income	0	3	-3	0	5	-5	0	8	-8
Total Global Fixed Income	80	68	12	65	55	10	57	47	10
U.S. Large Cap Equities	6	8	-2	16	12	4	19	15	4
U.S. Mid Cap Equities	0	0	—	5	4	1	6	6	—
U.S. Small Cap Equities	0	0	—	0	0	—	0	0	—
Developed Market ex-U.S. Equities	0	0	—	0	4	-4	5	4	1
Emerging Market Equities	0	0	—	0	0	—	0	0	—
Total Global Equities	6	8	-2	21	20	1	30	25	5
Private Real Estate	7	5	2	7	6	1	7	7	—
Commodities	0	2	-2	0	2	-2	0	2	-2
Total Global Real Assets	7	7	—	7	8	-1	7	9	-2
Global Hedge Funds	5	11	-6	5	11	-6	4	11	-7
Private Equity	0	0	—	0	0	—	0	0	—
Private Debt	0	4	-4	0	4	-4	0	6	-6
Total Alternative Investments	5	15	-10	5	15	-10	4	17	-13
Total Portfolio	100	100	—	100	100	—	100	100	—

Asset class	Tax-efficient CGI 2024 (%)	Conservative growth & income 2024 (%)	Tax-efficient CGI change (%)	Tax-efficient MGI 2024 (%)	Moderate growth & income 2024 (%)	Tax-efficient MGI change (%)	Tax-efficient AGI 2024 (%)	Aggressive growth & income 2024 (%)	Tax-efficient AGI change (%)
Cash Alternatives	2	2	—	1	2	-1	1	2	-1
U.S. Investment Grade Fixed Income	38	29	9	30	19	11	23	12	11
High Yield Fixed Income	7	4	3	5	4	1	6	3	3
Developed Market ex-U.S. Fixed Income	0	0	—	0	0	—	0	0	—
Emerging Market Fixed Income	0	3	-3	0	4	-4	0	6	-6
Total Global Fixed Income	45	36	9	35	27	8	29	21	8
U.S. Large Cap Equities	19	18	1	22	20	2	25	24	1
U.S. Mid Cap Equities	6	6	—	7	8	-1	9	8	1
U.S. Small Cap Equities	2	0	2	2	0	2	2	2	—
Developed Market ex-U.S. Equities	7	5	2	9	6	3	10	7	3
Emerging Market Equities	0	3	-3	2	4	-2	3	5	-2
Total Global Equities	34	32	2	42	38	4	49	46	3
Private Real Estate	7	5	2	7	6	1	7	6	1
Commodities	0	4	-4	0	4	-4	0	4	-4
Total Global Real Assets	7	9	-2	7	10	-3	7	10	-3
Global Hedge Funds	4	10	-6	4	10	-6	0	7	-7
Private Equity	8	8	—	11	10	1	14	11	3
Private Debt	0	3	-3	0	3	-3	0	3	-3
Total Alternative Investments	12	21	-9	15	23	-8	14	21	-7
Total Portfolio	100	100	—	100	100	—	100	100	—

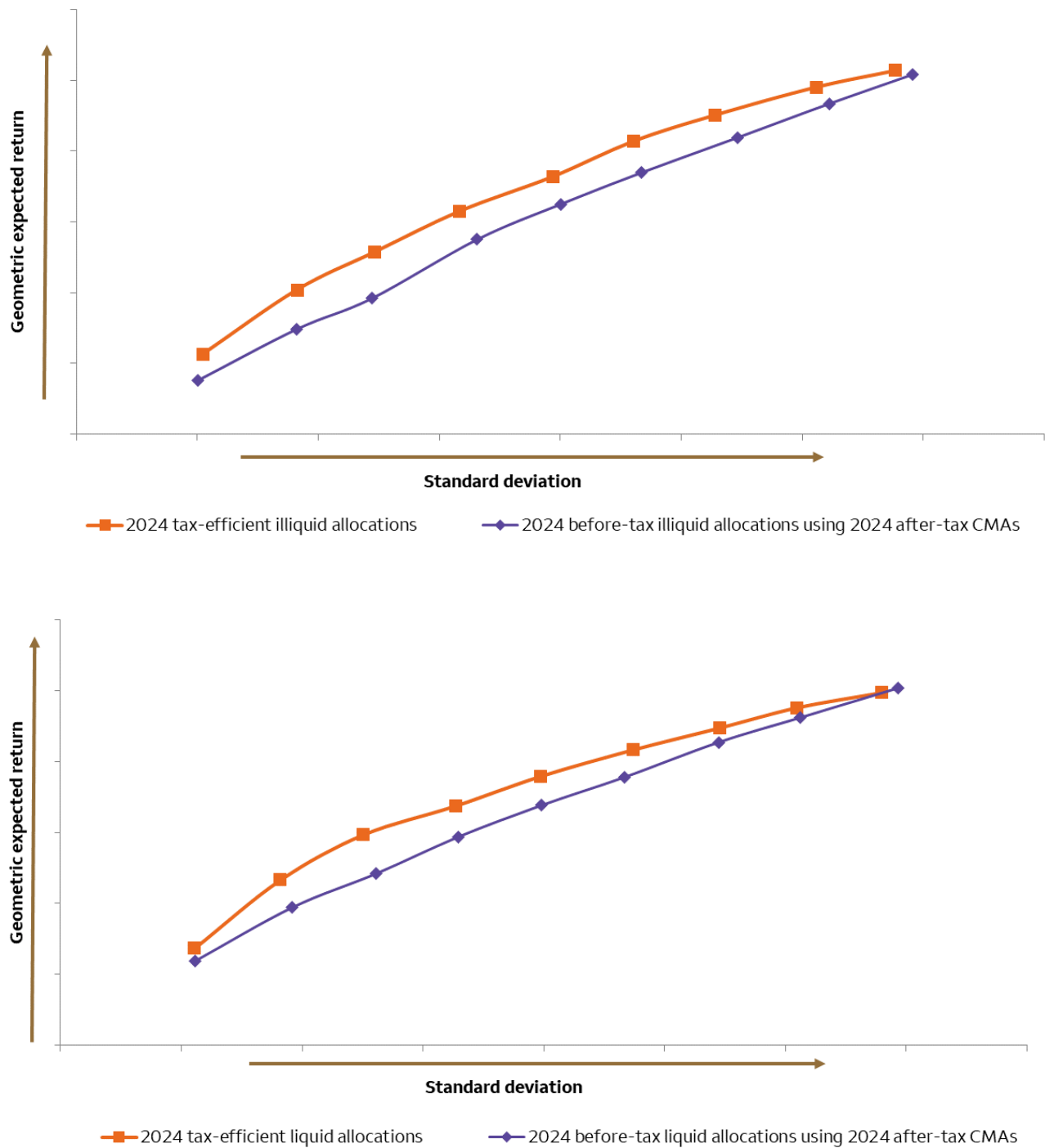
Table 5. Comparison between before-tax and tax-efficient illiquid allocations (continued)

Asset class	Tax-efficient CG 2024 (%)	Conservative growth 2024 (%)	Tax-efficient CG change (%)	Tax-efficient MG 2024 (%)	Moderate growth 2024 (%)	Tax-efficient MG change (%)	Tax-efficient AG 2024 (%)	Aggressive growth 2024 (%)	Tax-efficient AG change (%)
Cash Alternatives	1	1	—	1	1	—	1	1	—
U.S. Investment Grade Fixed Income	14	7	7	4	2	2	0	0	—
High Yield Fixed Income	6	3	3	5	2	3	0	0	—
Developed Market ex-U.S. Fixed Income	0	0	—	0	0	—	0	0	—
Emerging Market Fixed Income	0	0	—	0	0	—	0	0	—
Total Global Fixed Income	20	10	10	9	4	5	0	0	—
U.S. Large Cap Equities	28	26	2	32	26	6	33	24	9
U.S. Mid Cap Equities	11	9	2	11	13	-2	13	15	-2
U.S. Small Cap Equities	3	3	—	4	4	—	4	6	-2
Developed Market ex-U.S. Equities	11	12	-1	12	14	-2	12	17	-5
Emerging Market Equities	4	6	-2	8	9	-1	13	12	1
Total Global Equities	57	56	1	67	66	1	75	74	1
Private Real Estate	7	5	2	7	5	2	7	2	5
Commodities	0	5	-5	0	5	-5	0	5	-5
Total Global Real Assets	7	10	-3	7	10	-3	7	7	—
Global Hedge Funds	0	7	-7	0	2	-2	0	0	—
Private Equity	15	13	2	16	14	2	17	18	-1
Private Debt	0	3	-3	0	3	-3	0	0	—
Total Alternative Investments	15	23	-8	16	19	-3	17	18	-1
Total Portfolio	100	100	—	100	100	—	100	100	—

Source: Wells Fargo Investment Institute, as of July 16, 2024. CI = conservative income. MI = moderate income. AI = aggressive income. CGI = conservative growth and income. MGI = moderate growth and income. AGI = aggressive growth and income. CG = conservative growth. MG = moderate growth. AG = aggressive growth. Illiquid allocations may include fixed income, equities, real assets, and alternative investments. Tax-efficient allocations use tax-exempt cash and fixed income, and before-tax allocations use taxable cash and fixed income. **Alternative investments, such as hedge funds, private capital, and private real estate funds, are not appropriate for all investors.** They are speculative and involve a high degree of risk that is appropriate only for those investors who have the financial sophistication and expertise to evaluate the merits and risks of an investment in a fund and for which the fund does not represent a complete investment program.

Chart 2 demonstrates the results of incorporating tax impacts into the strategic asset allocation for the various investment objectives. For both the liquid and illiquid portfolios, the tax-efficient frontier is above the before-tax efficient frontier. Because both frontiers are based on the after-tax CMAs, Chart 2 shows that by taking taxes into consideration, we improve the tax efficiency of the portfolios across investment objectives.

Chart 2. Illustration comparing tax-efficient and before-tax efficient frontiers



Implementation: Transition to tax-efficient models

Implementation of the tax-efficient allocations is a holistic process that incorporates tax awareness at every step of our portfolio-construction process. WFII’s Global Investment Strategy (GIS) team develops the tax-efficient strategic asset-allocation recommendations. The Global Manager Research (GMR) team assesses and ranks investment products according to their overall tax efficiency. This work comes together as the Global Portfolio Management (GPM) team uses the recommended tax-efficient allocations and products to develop tax-efficient portfolio models used by the Wells Fargo businesses.

In this section, we provide an overview of the GPM portfolio-construction approach to show how tax considerations are incorporated into the process of building portfolios.

GPM takes an enhanced core-satellite approach in building out the basic portfolio structure to align with the risk and return objectives according to our strategic asset-allocation recommendations. Starting from a core portfolio, enhancements are made to focus on effective ways to differentiate products and strategies that can be optimally blended and coordinated. As Chart 3 shows, GPM makes adjustments for tax impact as a standard part of its portfolio-construction process, leveraging certain tax-efficient fund recommendations from GMR.

Chart 3. Portfolio adjustments and enhancements



Source: “Wealth Investment Portfolios: Portfolio Construction,” Wells Fargo Investment Institute.

Conclusion

The enhancements to WFII’s strategic asset-allocation process have produced meaningful changes, as illustrated by the tax-efficient strategic allocations. By maintaining a persistent focus on the management of risk, taxes, and fees, we believe these newly created allocations can improve investment outcomes for highly taxed investors.

Risk considerations

Wells Fargo and its affiliates are not legal or tax advisors. Be sure to consult your own legal or tax advisor before taking any action that may involve tax consequences. Tax laws or regulations are subject to change at any time and can have a substantial impact on individual situations.

Forecasts, estimates, and projections are not guaranteed and are based on certain assumptions and views of market and economic conditions which are subject to change.

Asset allocation is an investment method used to help manage risk. It does not guarantee investment returns or eliminate the risk of loss. All investing involves risks, including the possible loss of principal. There can be no assurance that any investment strategy will be successful. Investments fluctuate with changes in market and economic conditions and in different environments due to numerous factors, some of which may be unpredictable. Each asset class has its own risk and return characteristics. The level of risk associated with a particular investment or asset class generally correlates with the level of return the investment or asset class might achieve. The risks associated with the representative asset classes discussed in this report include:

Alternative investments: Alternative investments, such as hedge funds, private capital, and private real estate funds, are speculative and entail significant risks that can include losses due to leveraging or other speculative investment practices, lack of liquidity, volatility of returns, restrictions on transferring interests in a fund, potential lack of diversification, absence and/or delay of information regarding valuations and pricing, complex tax structures and delays in tax reporting, less regulation, and higher fees than mutual funds. Hedge fund, private capital, and private real estate fund investing involves other material risks, including capital loss and the loss of the entire amount invested. They are intended for qualified, financially sophisticated investors who can bear the risks associated with these investments. Hedge fund strategies, such as equity hedge, event driven, macro, and relative value may expose investors to risks such as short selling, leverage, counterparty, liquidity, volatility, the use of derivative instruments, and other significant risks.

Cash alternatives: Each type of cash alternatives, such as bank certificates of deposits, Treasury bills, and ultrashort bond mutual funds, has advantages and disadvantages. They typically offer lower rates of return than longer-term equity or fixed-income securities and may not keep pace with inflation over extended periods of time. While government securities are backed by the full faith and credit of the federal government as to payment of principal and interest if held to maturity and are considered free from credit risk, they are subject to interest rate risk.

Commodities: Exposure to the commodities markets may subject an investment to greater share price volatility than an investment in traditional equity or debt securities. The commodities markets are considered speculative, carry substantial risks, and have experienced periods of extreme volatility. Commodities may be affected by changes in overall market movements, commodity index volatility, changes in interest rates, or other factors affecting a particular industry or commodity.

Equities: Stock markets, especially foreign markets, are volatile. Stock values may fluctuate in response to general economic and market conditions, the prospects of individual companies and industry sectors. Foreign investing has additional risks, including those associated with currency fluctuation, political and economic instability, and different accounting standards. These risks are heightened in emerging markets. Mid- and small-cap stocks are generally more volatile, are subject to greater risks, and are less liquid than large-company stocks. Dividends are not guaranteed and are subject to change or elimination. Growth stocks may be more volatile than other stocks and there is no guarantee growth will be realized. Preferred stocks are subject to issuer-specific and market risks. They are generally subordinated to bonds or other debt instruments in an issuer's capital structure, subjecting them to a greater risk of nonpayment than more senior securities.

Exchange-traded funds (ETFs): Exchange-traded funds are subject to risks similar to those of stocks. Investment returns may fluctuate and are subject to market volatility, so that an investor's shares, when redeemed, or sold, may be worth more or less than their original cost. ETFs seek investment results that, before expenses, generally correspond to the price and yield of a particular index. There is no assurance that the price and yield performance of the index can be fully matched.

Fixed income: Investments in fixed-income securities are subject to interest rate, credit/default, call, liquidity, inflation, and other risks. Bond prices fluctuate inversely to changes in interest rates. Therefore, a general rise in interest rates can result in a decline in the bond's price. Credit risk is the risk that an issuer will default on payments of interest and/or principal. This risk is heightened in lower-rated bonds. If sold prior to maturity, fixed-income securities are subject to market risk. All fixed-income investments may be worth less than their original cost upon redemption or maturity. Inflation-linked fixed-income securities are subject to interest rate risk, especially when real interest rates rise. Municipal bonds offer interest payments exempt from federal taxes and, potentially, state and local income taxes. These bonds are subject to interest rate and credit/default risk and, potentially, the alternative minimum tax (AMT). Quality varies widely depending on the specific issuer.

Infrastructure: Investments in infrastructure companies expose an investment to potentially adverse economic, regulatory, political and other changes affecting such companies. Infrastructure companies may also be subject to various other risks, including, governmental regulations, high interest costs associated with capital construction programs, costs associated with compliance and changes in environmental regulation, economic slowdown and surplus capacity, competition from other providers of services and other factors.

Master limited partnerships (MLPs): MLPs involve certain risks that differ from an investment in the securities of a corporation. MLPs may be sensitive to price changes in oil, natural gas, etc.; regulatory risk; and rising interest rates. A change in the current tax laws regarding MLPs could result in the MLP being treated as a corporation for federal income tax purposes, which would reduce the amount of cash flows distributed by the MLP. Other risks include the volatility associated with the use of leverage, volatility of the commodities markets, market risks, supply and demand, natural and man-made catastrophes, competition, liquidity, market price discount from net asset value, and other material risks.

Real estate: Investments in real estate securities have certain risks, including the possible illiquidity of the underlying properties, credit risk, interest rate fluctuations, and the impact of varied economic conditions. Other risks associated with investing in listed REITs include the use of leverage, unexpected reductions in common dividends, increases in property taxes, and the impact to listed REITs from new property development.

Timberland: Timberland investments are subject to acts of nature such as fire, tornados, hurricanes, forest insects, invasive species, and diseases, in addition to the risks associated with short-term price volatility, interest rate fluctuations, and lack of liquidity.

Absolute return: Bloomberg 9-12 Month Treasury Index

Domestic equity: Wilshire 5000 Total Market Index

Fixed income: Bloomberg 1-3 Year Treasury Index

Foreign equity: Blend of MSCI EAFE Investable Market Index, MSCI Emerging Markets Investable Market Index, MSCI China A-Share Investable Market Index

Leveraged buyouts: Blend of Russell 2000 Index, MSCI ACWI ex USA Small Cap Index

Natural resources: Blend of Custom Timber REIT Basket, S&P Commodity Producers Oil & Gas Exploration & Production Index, Euromoney Global Mining Index

Real estate: MSCI US REIT Index

Venture capital: Blend of Russell 2000 Technology Index, MSCI China Small Cap Index, MSCI India Small Cap Index

Definitions

The below representative indexes are used to construct the CMA correlation matrix and are used when asset class and strategic asset allocation index-based performance is reported. CMAs are not expectations of performance of representative indexes. An index is unmanaged and not available for direct investment.

Cash Alternatives (Taxable/Tax Exempt): Bloomberg U.S. Treasury Bills (1-3 Month) Index is representative of money markets.

U.S. Short Term Taxable Fixed Income: Bloomberg U.S. Aggregate 1-3 Year Bond Index is the one- to three-year component of the Bloomberg U.S. Aggregate Bond Index, which represents fixed-income securities that are SEC-registered, taxable, dollar denominated, and investment grade.

U.S. Intermediate Term Taxable Fixed Income: Bloomberg U.S. Aggregate 5-7 Year Bond Index is composed of the Bloomberg U.S. Government/Credit Index and the Bloomberg U.S. Mortgage-Backed Securities Index and includes Treasury issues, agency issues, corporate bond issues, and mortgage-backed securities with maturities of five to seven years.

U.S. Long Term Taxable Fixed Income: Bloomberg U.S. Aggregate 10+ Year Bond Index is composed of the Bloomberg U.S. Government/Credit Index and the Bloomberg U.S. Mortgage-Backed Securities Index and includes Treasury issues, agency issues, corporate bond issues, and mortgage-backed securities with maturities of 10 years or more.

U.S. Investment Grade Taxable Fixed Income: Bloomberg U.S. Aggregate Bond Index is a broad-based measure of the investment-grade, U.S. -dollar-denominated, fixed-rate taxable bond market.

U.S. Short Term Tax Exempt Fixed Income: Bloomberg U.S. Municipal Bond 3 Year (2-4) Index represents municipal bonds with a minimum credit rating of at least Baa, an outstanding par value of at least \$3 million and a remaining maturity of two to four years.

U.S. Intermediate Term Tax Exempt Fixed Income: Bloomberg U.S. Municipal Bond Intermediate (5-10) Index represents municipal bonds with a minimum credit rating of at least Baa, an outstanding par value of at least \$3 million and a remaining maturity of five to ten years.

U.S. Long Term Tax Exempt Fixed Income: Bloomberg U.S. Municipal Bond 15 Year (12-17) Index represents municipal bonds with a minimum credit rating of at least Baa, an outstanding par value of at least \$3 million and a remaining maturity of 12 to 17 years.

U.S. Investment Grade Tax Exempt Fixed Income: Bloomberg U.S. Municipal Index represents municipal bonds with a minimum credit rating of at least Baa, an outstanding par value of at least \$3 million, and a remaining maturity of at least one year. The index excludes taxable municipal bonds, bonds with floating rates, derivatives, and certificates of participation.

High Yield Taxable Fixed Income: Bloomberg U.S. Corporate High-Yield Index covers the universe of fixed-rate, non-investment-grade debt.

High Yield Tax Exempt Fixed Income: Bloomberg U.S. Municipal High Yield Index measures the non-investment-grade and nonrated U.S. -dollar-denominated, fixed-rate, tax-exempt bond market within the 50 United States and four other qualifying regions (Washington, D.C.; Puerto Rico; Guam; and the Virgin Islands).

Developed Market ex-U.S. Fixed Income: J.P. Morgan GBI Global ex-U.S. Index (Unhedged) in USD is an unmanaged index market representative of the total return performance in U.S. dollars on an unhedged basis of major non-U.S. bond markets.

Emerging Market Fixed Income: J.P. Morgan Emerging Markets Bond Index (EMBI Global) currently covers more than 60 emerging market countries. Included in the EMBI Global are U.S.-dollar-denominated Brady bonds, Eurobonds, traded loans, and local market debt instruments issued by sovereign and quasi-sovereign entities.

Inflation Linked Fixed Income: Bloomberg Global Inflation Linked Index measures the investment-grade, government inflation-linked debt from 12 different developed market countries.

Preferred Stock: The ICE BofA Fixed Rate Preferred Securities Index tracks the performance of fixed rate U.S.-dollar-denominated preferred securities issued in the U.S. domestic market.

U.S. Large Cap Equities: S&P 500 Index is a market-capitalization-weighted index calculated on a total return basis with dividends reinvested. The index includes 500 widely held U.S. market industrial, utility, transportation, and financial companies.

U.S. Mid Cap Equities: Russell Midcap Index measures the performance of the mid-cap segment of the U.S. equity universe.

U.S. Small Cap Equities: Russell 2000 Index measures the performance of the 2,000 smallest companies in the Russell 3000® Index, which represents approximately 8% of the total market capitalization of the Russell 3000 Index.

Developed Market ex-U.S. Equities: MSCI EAFE Index is a free-float-adjusted market-capitalization-weighted index that is designed to measure the equity market performance of 21 developed markets, excluding the U.S. and Canada.

Emerging Market Equities: MSCI Emerging Markets Index is a free-float-adjusted market-capitalization-weighted index that is designed to measure equity market performance of 23 emerging markets.

Private Real Estate: NCREIF Property Index is a quarterly time series composite total rate of return measure of investment performance of a very large pool of individual commercial real estate properties acquired in the private market for investment purposes only.

Master Limited Partnerships: Alerian MLP Index is a composite of the 50 most prominent energy master limited partnerships (MLPs) that provides investors with an unbiased, comprehensive benchmark for this emerging asset class. The index, which is calculated using a float-adjusted, capitalization-weighted methodology, is disseminated real-time on a price-return basis and on a total-return basis.

Commodities: Bloomberg Commodity Index is composed of 23 exchange-traded futures on physical commodities weighted to account for economic significance and market liquidity.

Hedge Funds – Relative Value: HFRI Relative Value (Total) Index strategy is predicated on realization of a valuation discrepancy in the relationship between multiple securities. Managers employ a variety of fundamental and quantitative techniques to establish investment theses, and security types range broadly across equity, fixed income, derivative, or other security types. Fixed-income strategies are typically quantitatively driven to measure the existing relationship between instruments and, in some cases, identify attractive positions in which the risk-adjusted spread between these instruments represents an attractive opportunity for the investment manager. Relative Value (RV) positions may be involved in corporate transactions also, but as opposed to Event Driven (ED) exposures, the investment thesis is predicated on realization of a pricing discrepancy between related securities as opposed to the outcome of the corporate transaction.

Hedge Funds – Macro: HFRI Macro (Total) Index encompasses a broad range of strategies predicated on movements in underlying economic variables and the impact these have on equity, fixed-income, hard-currency, and commodity markets. Managers employ a variety of techniques, both discretionary and systematic analysis, combinations of top-down and bottom-up theses, quantitative and fundamental approaches, and long- and short-term holding periods. Although some strategies employ RV techniques, Macro strategies are distinct from RV strategies in that the primary investment thesis is predicated on predicted or future movements in the underlying instruments rather than on realization of a valuation discrepancy between securities. In a similar way, while both Macro and Equity Hedge managers may hold equity securities, the overriding investment thesis is predicated on the impact movements in underlying macroeconomic variables may have on security prices as opposed to Equity Hedge (EH), in which the fundamental characteristics on the company are the most significant are integral to investment thesis.

Hedge Funds – Event Driven: HFRI Event Driven (Total) Index maintains positions in companies currently or prospectively involved in corporate transactions of a wide variety, including mergers, restructurings, financial distress, tender offers, shareholder buybacks, debt exchanges, security issuance, or other capital structure adjustments. Security types can range from most senior in the capital structure to most junior or subordinated and frequently involve additional derivative securities. Exposure includes a combination of sensitivities to equity markets, credit markets, and idiosyncratic, company-specific developments. Investment theses are typically predicated on fundamental (as opposed to quantitative) characteristics with the realization of the thesis predicated on a specific development exogenous to the existing capital structure.

Hedge Funds – Equity Hedge: HFRI Equity Hedge (Total) Index. Equity Hedge (EH): Investment Managers who maintain positions both long and short in primarily equity and equity derivative securities. A wide variety of investment processes can be employed to arrive at an investment decision, including both quantitative and fundamental techniques; strategies can be broadly diversified or narrowly focused on specific sectors and can range broadly in terms of levels of net exposure, leverage employed, holding period, concentrations of market capitalizations, and valuation ranges of typical portfolios. EH managers would typically maintain at least 50% exposure to, and may in some cases be entirely invested in, equities, both long and short.

Global Hedge Funds: HFRI Fund Weighted Composite Index is a global, equal-weighted index of over 2,000 single-manager funds that report to HFR Database. Constituent funds report monthly net-of-all-fees performance in U.S. dollars and have a minimum of \$50 million under management or a 12-month track record of active performance. The HFRI Fund Weighted Composite Index does not include funds of hedge funds.

Global Liquid Alternatives: Wilshire Liquid Alternative Index measures the collective performance of the five Wilshire Liquid Alternative strategies that make up the Wilshire Liquid Alternative Universe. The Wilshire Liquid Alternative Index is designed to provide a broad measure of the liquid alternative market by combining the

performance of the Wilshire Liquid Alternative Equity Hedge Index, Wilshire Liquid Alternative Global Macro Index, Wilshire Liquid Alternative Relative Value Index, Wilshire Liquid Alternative Multi-Strategy Index, and the Wilshire Liquid Alternative Event Driven Index.

Private Equity: The Burgiss Private Equity Index is based on the pool of private equity funds sourced by Burgiss and is asset weighted. The index is calculated using cash flow and valuation histories of the underlying funds within Burgiss manager universe. The underlying funds are classified by Burgiss private capital classification system and the cash flow data is sourced from institutional investors around the world.

Private Debt: Burgiss Private Debt Index is a pooled quarterly time-weighted rate-of-return series based on data compiled by the Burgiss Group, LLC (Burgiss) from over 800 private debt funds (generalist, senior, mezzanine, and distressed debt), including fully liquidated partnerships, formed after 1986. The return series is net of fees, expenses, and carried interest. The benchmark is issued on a quarterly basis approximately 80 calendar days after quarter end. Index returns do not represent fund performance.

Bloomberg 9-12 Month Treasury Index measures the performance of the U.S. Treasury bills, notes, and bonds nine months to one year to maturity.

Wilshire 5000 Total Market Index is a market-capitalization-weighted index that seeks to represent the broad U.S. equity market.

Bloomberg 1-3 Year Treasury Index measures the performance of the U.S. Treasury bills, notes, and bonds with one year to three years to maturity.

MSCI EAFE Investable Market Index is an equity index that captures large-, mid-, and small-cap representation across developed market countries around the world, excluding the U.S. and Canada. With 3,210 constituents, the index is comprehensive, covering approximately 99% of the free-float-adjusted market capitalization in each country.

MSCI Emerging Markets Investable Market Index captures large-, mid-, and small-cap representation across 26 emerging market countries. With 2,942 constituents, the index covers approximately 99% of the free-float-adjusted market capitalization in each country.

MSCI China A-Share Investable Market Index captures large-, mid-, and small-cap representation across China A-shares. The index aims to reflect the opportunity set of China share classes listed in Hong Kong, Shanghai, and Shenzhen. It is based on the concept of the integrated MSCI China equity universe with China A-shares included.

MSCI ACWI ex USA Small Cap Index captures small-cap representation across 22 of 23 developed market countries (excluding the U.S.) and 26 emerging market countries. With 4,046 constituents, the index covers approximately 14% of the global equity opportunity set outside the U.S.

Custom Timber REIT Basket is Yale's proprietary custom benchmark.

S&P Commodity Producers Oil & Gas Exploration & Production Index includes the largest publicly traded companies involved in the exploration and production of oil and gas around the world.

Euromoney Global Mining Index measures the returns of companies in the metal and mineral extraction industries.

MSCI US REIT Index is a free-float-adjusted market-capitalization-weighted index that is composed of equity real estate investment trusts (REITs).

Russell 2000 Technology Index is a market-capitalization-weighted index of companies in the Russell 2000 Index that serve the electronics and computer technology industries or that manufacture products based on the latest applied science.

MSCI China Small Cap Index is designed to measure the performance of the small-cap segment of the China market.

MSCI India Small Cap Index is designed to measure the performance of the small-cap segment of the India market.

Note: HFRI Indices have limitations (some of which are typical of other widely used indices). These limitations include survivorship bias (the returns of the indices may not be representative of all the hedge funds in the universe because of the tendency of lower performing funds to leave the index); heterogeneity (not all hedge funds are alike or comparable to one another, and the index may not accurately reflect the performance of a described style); and limited data (many hedge funds do not report to indices, and, therefore, the index may omit funds, the inclusion of which might significantly affect the performance shown). The HFRI Indices are based on information self-reported by hedge fund managers that decide on their own, at any time, whether or not they want to provide, or continue to provide, information to HFR Asset Management, L.L.C. Results for funds that go out of business are included in the index until the date that they cease operations. Therefore, these indices may not be complete or accurate representations of the hedge fund universe, and may be biased in several ways. Returns of the underlying hedge funds are net of fees and are denominated in USD.

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