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Locking in Progress: Rethinking Taft-Hartley Asset Allocations

The improved aggregate funded status of the U.S. multiemployer pension plan system since the financial crisis disguises a marked divergence in the fortunes of the best-funded plans and the worst-funded plans. For the worst-funded, structural weaknesses rather than investment returns are now determining long-term outcomes. Investment returns can and should be improved, but the ultimate solutions may need to come from legislators.

Better-funded plans can still realize a decisive benefit from optimizing their asset portfolios. A decade of high market returns have left us with stretched valuations across traditional asset classes. We believe it is a critical time to rethink asset allocations in an effort to both realize gains of recent years and enhance return profiles given the growth rate of liabilities.

In this paper, we focus on the potential benefits of adding alternative investments to a multiemployer pension plan. We show their potential to move the long-term funding needle meaningfully in the right direction—even with lower asset class return outlooks for the coming decade.

Executive Summary

- We add the following alternative investments as options for "red-zone", "yellow-zone" and "green-zone" U.S. multiemployer pension plans:
  - Private Equity
  - Hedge Funds
  - Private Real Estate
  - PutWrite
  - Real Assets
- We optimize portfolios with and without alternative investments (as defined above) across a range of asset volatilities and surplus volatilities, and show that adding alternatives improves the return profiles at each level of volatility.
- Using a long-term return assumption on assets of 6% as the liability discount rate, we find that adding alternatives to the asset portfolio of a "yellow-zone" plan that can tolerate a funded status volatility of 8% could double the probability of reaching 100% funded status within 15 years from 6% to 11%, relative to its pathway without alternative investments.
- A "green-zone" plan that can tolerate a funded status volatility of 10% could increase its probability of reaching 100% funded status within 15 years from 27% to 37%.
- Full results and methodology—including results obtained using a lower, FTSE Pension Curve-derived liability discount rate—are presented in appendices.

Note: Please note that asset class returns shown are hypothetical estimates that are for illustrative purposes only. Hypothetical return estimates are not intended to represent, and should not be construed to represent, predictions of future rates of return. Actual returns may vary significantly. Investing entails risks, including possible loss of principal. **Past performance is no guarantee of future results.**

Many institutional investors face a common set of challenges. They need to design investment portfolios that can generate excess returns with enough liquidity to cover their cash flows, while maintaining a risk profile that limits funded status volatility. Furthermore, they need to do this at a time when asset-market valuations are stretched and return outlooks have become lower.

U.S. multiemployer pension plans ("Taft-Hartley plans") face a particular challenge, however, because many are looking at investment options from a position of deep underfunding, declining active membership and negative cash flows.

Around 1,300 of these plans cover some 10 million members from 200,000 or so U.S. private sector employers. More than one-third of members are retired, and the system carries hundreds of billions of dollars of unfunded liabilities.[1]

A 2019 study by Milliman estimated that Taft-Hartley plans have an aggregate funding ratio of 74%, up from a low of 53% in the aftermath of the 2008–09 financial crisis.[2] That looks like solid progress, but unfortunately it obscures the reality that the worst-funded Taft-Hartley plans face.

The Pension Protection Act of 2006 established a color-zoning system to indicate the funded status of a multiemployer pension plan: healthy plans, whose liabilities are 80% funded or better, are in the green zone; endangered plans with 65–79% funding in yellow; and critical plans that are funded at less than 65% are in the red zone.

[1]Ladd Preppernau, et al., Milliman Multiemployer Pension Funding Study, Spring 2019.
[2]Please see the appendices for asset class assumptions. Milliman study used weighted average 7.26% discount rate.

This funded status color-zoning is closely correlated with two key plan characteristics: the ratio of active (contributing) members to inactive members and the level of net cash flows. While fewer than half of the members even of the average green-zone plan are active, this pales into insignificance next to the red-zone plans, where every active member is outnumbered two, three or even five times. Similarly, the more negative a plan's net cash flow is, the less well-funded it tends to be.

When a plan is in the red zone, it is likely that it has structural problems that no overhaul of an investment program would be able to fix. For example, when Milliman looked at this at the end of 2017, there were more than 100 plans that were less than 50% funded, on average, but that needed asset returns to top 14% per year just to cover net cash outflows.[3]

That is why, although the average Taft-Hartley plan has improved its funding from 53% to 74% since the financial crisis, the average red-zone plan has only climbed from 46% to 60%, and 123 "critical and declining" plans have seen their funded status worsen. Plans with relatively healthy demographics and cash flows have been able to recover off the back of a decade of strong asset returns. The others have been running to stand still since 2010.

To be clear, we do believe that red-zone plans can potentially improve their investment return profiles by implementing measures such as those outlined in this paper. However, as we discuss below, it is not realistic to depend on the investment portfolio for a decisive solution. That is why, for critical and endangered plans, legislators may need to step in with measures and proposals that include benefit suspensions and even long-term, low-interest government loans.

That said, green-zone and better-funded yellow-zone plans that have already greatly benefited from their investment program could continue to do so.

In our view, these plans are at an important turning point. We appear to be late into the current, historically long investment cycle. Valuations in equity markets are relatively high and yields in fixed income markets are close to historic lows, leaving us with low return outlooks across traditional asset classes.

We believe it is unrealistic to think the return prospects of the next decade can match those of the last. For multiemployer plans looking to realize some of the gains of recent years and maintain a return profile that has the potential to outpace the growth rate of liabilities without incurring excessive funded status volatility, we argue that multiemployer plans can benefit from adding alternative investments into their asset mix—particularly illiquid private markets investments.

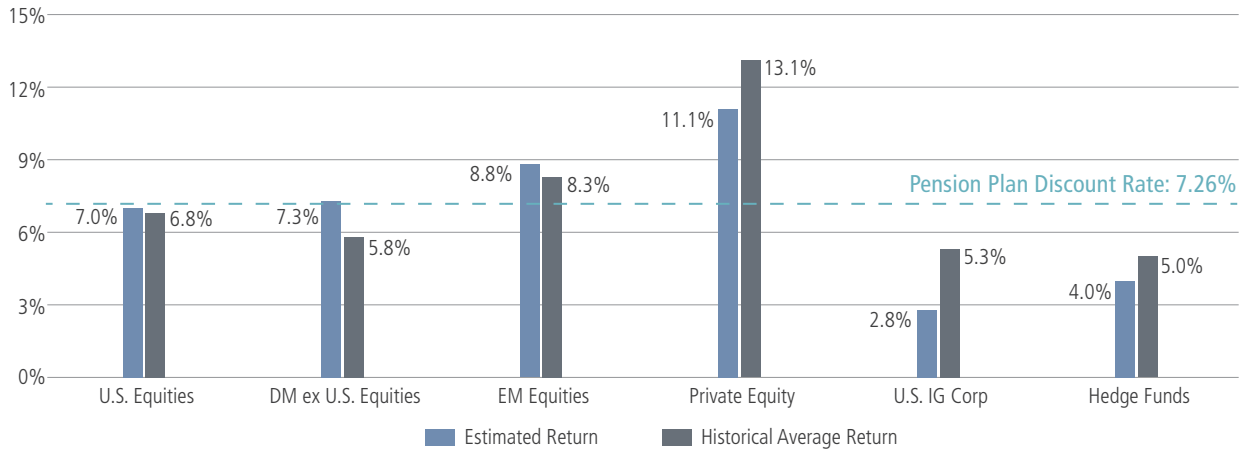
Here we show that alternative investments have the potential to help better-funded plans continue to close their funding deficits at a faster rate than plans that allocate only to traditional assets.

Traditional Portfolios Face a World With Lower Return Outlooks

On average, according to Milliman, multiemployer pension plan actuaries are using a 7.26% return target/discount rate on plan assets. As figure 1 shows, based on our long-term (20+ years) capital market return estimates, it appears their return targets may be difficult to achieve without allocating a high proportion to equities, and thereby taking on incremental risk.

[3]Kevin Campe, et al., Milliman Multiemployer Pension Funding Study, Spring 2018.

FIGURE 1. AVERAGE HISTORICAL RETURN VS. NB LONG-TERM (20+ YEARS) CAPITAL MARKET ASSUMPTION



Source: Neuberger Berman long-term (20+ years) capital market assumptions. Annualized historical returns are calculated using indices indicated in the appendix. **IMPORTANT:** Performance and risk projections/estimates are hypothetical in nature and for illustrative and discussion purposes only. Projections are based on Neuberger Berman's long-term (20+ years) capital market assumptions. Projections do not reflect actual investment results and are not guarantees of future results. Actual results will vary, perhaps to a significant degree. Estimated returns do not reflect the alpha of any investment manager or investment strategy/vehicle within an asset class. Information is not intended to be representative of any investment product or strategy and does not reflect the fees and expenses associated with managing a portfolio. Note, net returns will be lower. Investing entails risks, including possible loss of principal. Indexes are unmanaged and are not available for direct investment. **Past performance is no guarantee of future results.** See Additional Disclosures at the end of this presentation for additional information regarding ISG Capital Market Assumptions and methodologies.

While we view target returns of 7.26% as unrealistic without taking on increased risk, we believe a target rate of return of around 6% is possible by diversifying sources of risk. In particular, we believe there is the potential for significant benefits from assuming more liquidity risk in the form of private equity and credit investments.

Illiquid investments may not be suitable for all Taft-Hartley plans and carry unique risks. Private equity investments can have a 10-year lifecycle, with committed capital being called throughout the first five years and most distributions of cash coming later. In evaluating whether to add illiquid assets and how much to allocate, we believe an important factor to consider is how well their cash-flow profiles map onto the plan's current liabilities, as well as how the demographics of the plan will change over time as the number of active, contributing members decreases and the number of retired beneficiaries grows. Another factor to consider is a "worst-case scenario" of negative market returns combined with deteriorating net-negative cash flows.

Even considering these adverse cash-flow situations, we believe many plans could benefit from an asset allocation that includes private market investments.

Adding Alternatives Can Move the Funding Needle

To show the potential benefits of adding alternatives, we optimized two sets of portfolios: one with alternatives and one without alternatives. For the portfolio with alternatives, we have the following investment options:

- Private Equity (capped at 20% of assets)
- Hedge Funds (capped at 10% of assets)
- Private Real Estate (capped at 15% of assets)
- PutWrite (capped at 12% of assets)
- Real Assets (capped at 5% of assets)

We then create a series of sample portfolios with increased allocations to alternative investments, and use our hypothetical return estimates (Appendix III), volatility and correlation estimates to show the potential marginal return for each additional percentage point of asset volatility (figure 2).

FIGURE 2. HYPOTHETICAL ESTIMATED RETURNS FOR A GIVEN LEVEL OF ASSET VOLATILITY

Asset allocations and hypothetical gross return estimates of optimal portfolios with and without alternatives

	Without Alts	With Alts	Without Alts	With Alts	Without Alts	With Alts	Without Alts	With Alts
Asset Volatility	**6% Vol**		**7% Vol**		**8% Vol**		**9% Vol**	
Fixed Income	**58%**	**43%**	**51%**	**37%**	**41%**	**37%**	**32%**	**32%**
Public Equity	**42%**	**14%**	**49%**	**16%**	**59%**	**20%**	**68%**	**30%**
Private Equity	0%	14%	0%	16%	0%	20%	0%	20%
Real Estate	0%	12%	0%	11%	0%	10%	0%	5%
Other Alts (Hedge Funds, PutWrite, Real Assets)	0%	18%	0%	19%	0%	12%	0%	13%
Estimated Return	**4.67%**	**5.23%**	**5.18%**	**5.81%**	**5.68%**	**6.33%**	**6.07%**	**6.72%**
Return Potential with Alts	**+0.56%**		**+0.63%**		**+0.65%**		**+0.65%**	

Source: Neuberger Berman. For illustrative purposes only. See Appendix I for model methodology. **IMPORTANT:** Performance and risk projections/estimates are hypothetical in nature and for illustrative and discussion purposes only. Projections are based on Neuberger Berman's long-term (20+ years) capital market assumptions. Projections do not reflect actual investment results and are not guarantees of future results. Actual results will vary, perhaps to a significant degree. Estimated returns do not reflect the alpha of any investment manager or investment strategy/vehicle within an asset class. Information is not intended to be representative of any investment product or strategy and does not reflect the fees and expenses associated with managing a portfolio. Note, net returns will be lower. Investing entails risks, including possible loss of principal. See Additional Disclosures at the end of this presentation for additional information regarding NB capital market assumptions and methodologies. See Appendix III for asset assumptions.

As well as looking at the marginal return potential for an increase in asset-portfolio volatility, we can make our calculations more Taft-Hartley-specific by considering how changes to the portfolio could affect the volatility of a plan's funded status (figure 3). This means that we assess the impact that different portfolio mixes have on the relationship between both plan assets and plan liabilities. Funded status volatility is a measure of how much one can anticipate a plan's funded status to swing up and down in response to portfolio performance. The higher the level of funded status volatility, the more likely it is that the funded status of the plan could go lower (or higher) than the level at which it started.

FIGURE 3. HYPOTHETICAL ESTIMATED RETURNS FOR A GIVEN LEVEL OF FUNDED STATUS VOLATILITY

Asset allocations and hypothetical gross return estimates of optimal portfolios with and without alternatives

Red-zone (<65% funded)

	Without Alts	With Alts	Without Alts	With Alts	Without Alts	With Alts	Without Alts	With Alts
Funded Status Volatility	**7% Vol**		**8% Vol**		**9% Vol**		**10% Vol**	
Core Fixed Income	**67%**	**67%**	**59%**	**61%**	**52%**	**51%**	**44%**	**39%**
Public Equity	**33%**	**13%**	**41%**	**17%**	**48%**	**20%**	**56%**	**20%**
Private Equity	0%	13%	0%	17%	0%	20%	0%	20%
Real Estate	0%	2%	0%	0%	0%	4%	0%	13%
Other Alts (Hedge Funds, PutWrite, Real Assets)	0%	5%	0%	5%	0%	5%	0%	8%
Estimated Return	**4.84%**	**5.32%**	**5.12%**	**5.70%**	**5.39%**	**6.06%**	**5.66%**	**6.37%**
Return Potential with Alts	**+0.48%**		**+0.58%**		**+0.67%**		**+0.71%**	

Yellow-zone (65–79% funded)

	Without Alts	With Alts	Without Alts	With Alts	Without Alts	With Alts	Without Alts	With Alts
Funded Status Volatility	**7% Vol**		**8% Vol**		**9% Vol**		**10% Vol**	
Core Fixed Income	**59%**	**60%**	**52%**	**48%**	**44%**	**39%**	**37%**	**37%**
Public Equity	**41%**	**17%**	**48%**	**20%**	**56%**	**20%**	**63%**	**30%**
Private Equity	0%	17%	0%	20%	0%	20%	0%	20%
Real Estate	0%	0%	0%	7%	0%	11%	0%	2%
Other Alts (Hedge Funds, PutWrite, Real Assets)	0%	5%	0%	5%	0%	10%	0%	12%
Estimated Return	**5.13%**	**5.73%**	**5.39%**	**6.08%**	**5.66%**	**6.39%**	**5.92%**	**6.63%**
Return Potential with Alts	**+0.60%**		**+0.69%**		**+0.73%**		**+0.71%**	

Green-zone (>80% funded)

	Without Alts	With Alts	Without Alts	With Alts	Without Alts	With Alts	Without Alts	With Alts
Funded Status Volatility	**7% Vol**		**8% Vol**		**9% Vol**		**10% Vol**	
Core Fixed Income	**52%**	**52%**	**44%**	**38%**	**37%**	**37%**	**32%**	**32%**
Public Equity	**48%**	**20%**	**56%**	**20%**	**63%**	**28%**	**68%**	**33%**
Private Equity	0%	20%	0%	20%	0%	20%	0%	20%
Real Estate	0%	3%	0%	12%	0%	3%	0%	1%
Other Alts (Hedge Funds, PutWrite, Real Assets)	0%	5%	0%	10%	0%	12%	0%	13%
Estimated Return	**5.38%**	**6.02%**	**5.65%**	**6.34%**	**5.91%**	**6.60%**	**6.11%**	**6.82%**
Return Potential with Alts	**+0.64%**		**+0.69%**		**+0.69%**		**+0.71%**	

Source: Neuberger Berman. For illustrative purposes only. See Appendix I for model methodology. **IMPORTANT:** Performance and risk projections/estimates are hypothetical in nature and for illustrative and discussion purposes only. Projections are based on Neuberger Berman's long-term (20+ years) capital market assumptions. Projections do not reflect actual investment results and are not guarantees of future results. Actual results will vary, perhaps to a significant degree. Estimated returns do not reflect the alpha of any investment manager or investment strategy/vehicle within an asset class. Information is not intended to be representative of any investment product or strategy and does not reflect the fees and expenses associated with managing a portfolio. Note, net returns will be lower. Investing entails risks, including possible loss of principal. See Additional Disclosures at the end of this presentation for additional information regarding NB's Capital Market Assumptions and methodologies. See Appendix I for model methodology.

The true difference in potential impact becomes clearer still when we consider the effect of asset allocation changes on a plan's probability of attaining 100% funded status over 10 and 15 years. We analyze this difference by stochastically projecting 10,000 different return scenarios using a Monte Carlo simulation framework. In figure 4, we show the full results for a green-zone plan that allows funded status volatility of 8%, and those hypothetical results for yellow- and green-zone plans that allow funded status volatilities of 8% and 10%.

What we see is that a yellow-zone plan that can tolerate funded status volatility of 8% has the potential to double the probability of reaching 100% funded status within 15 years from 6% to 11%, for example. A green-zone fund that can tolerate increasing its funded status volatility to 10% has the potential to increase the probability of reaching 100% funded status from 27% to 37%.

FIGURE 4. THE IMPACT OF ALTERNATIVE INVESTMENTS ON FUNDED STATUS OVER TIME
Hypothetical estimated gross returns and funded status impact of optimal portfolios with and without alternatives

Yellow-zone (65–79% funded)

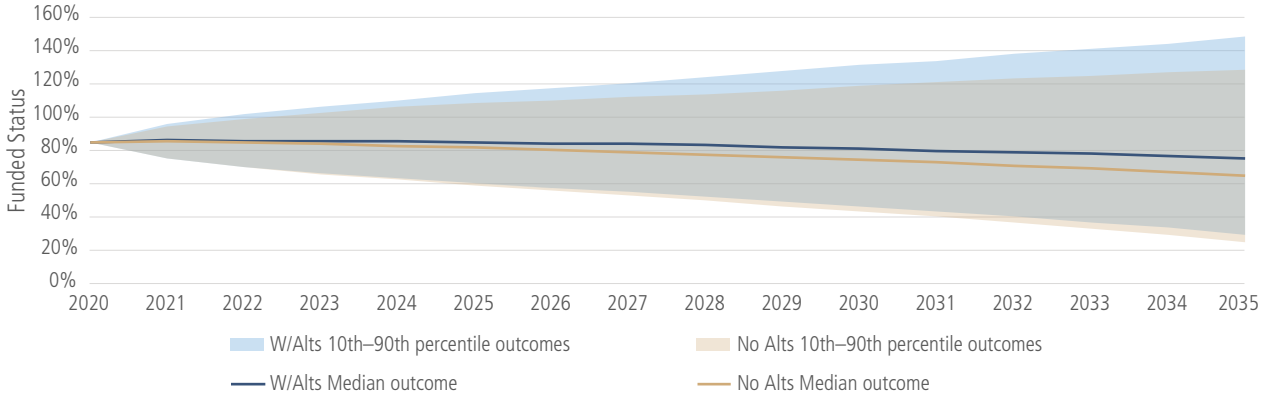
	Without Alts	With Alts	Without Alts	With Alts
Funded Status Volatility	**8% Vol**		**10% Vol**	
Estimated Return	5.39%	**6.08%**	5.92%	**6.63%**
Probability of 100% Funding in 10 years	5%	**9%**	9%	**13%**
Probability of 100% Funding in 15 years	6%	**11%**	11%	**16%**

Green-zone (>80% funded)

	Without Alts	With Alts	Without Alts	With Alts
Funded Status Volatility	**8% Vol**		**10% Vol**	
Estimated Return	5.65%	**6.34%**	6.11%	**6.82%**
Probability of 100% Funding in 10 years	22%	**29%**	27%	**34%**
Probability of 100% Funding in 15 years	22%	**31%**	27%	**37%**

Source: Neuberger Berman. For illustrative purposes only. See Appendix I for model methodology. **IMPORTANT:** Performance and risk projections/estimates are hypothetical in nature and for illustrative and discussion purposes only. Projections are based on Neuberger Berman's long-term (20+ years) capital market assumptions. Projections do not reflect actual investment results and are not guarantees of future results. Actual results will vary, perhaps to a significant degree. Estimated returns do not reflect the alpha of any investment manager or investment strategy/vehicle within an asset class. Information is not intended to be representative of any investment product or strategy and does not reflect the fees and expenses associated with managing a portfolio. Net returns will be lower. Investing entails risks, including possible loss of principal. See Additional Disclosures at the end of this presentation for additional information regarding Neuberger Berman's capital market assumptions and methodologies.

Flightpath for green-zone plan with 8% funded status volatility, with and without alternatives



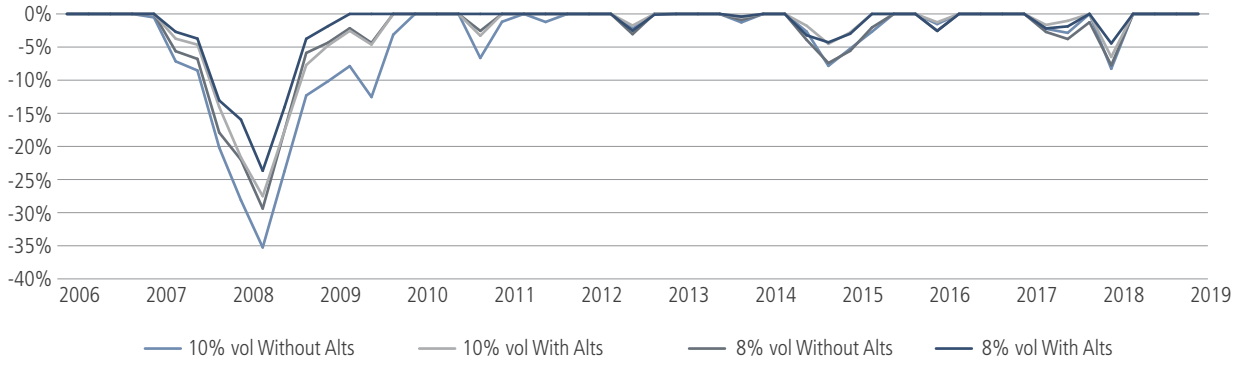
Source: Neuberger Berman. **IMPORTANT:** Performance and risk projections/estimates are hypothetical in nature and for illustrative and discussion purposes only. Projections are based on Neuberger Berman's long-term (20+ years) capital market assumptions. Projections do not reflect actual investment results and are not guarantees of future results. Actual results will vary, perhaps to a significant degree. Estimated returns do not reflect the alpha of any investment manager or investment strategy/vehicle within an asset class. Information is not intended to be representative of any investment product or strategy and does not reflect the fees and expenses associated with managing a portfolio. Net returns will be lower. Investing entails risks, including possible loss of principal. Time to 100% was calculated deterministically by projecting the portfolios' estimated returns. Probability of 100% funded status in 10/15 years was calculated by means of stochastic Monte Carlo simulations. The liability discount rate applied is an estimated return on assets of 6%. See Appendix I for model methodology. See Appendix II for full results from red-, yellow- and green-zone plans at 7%, 8%, 9% and 10% funded status volatility, using discount rates derived both from an estimated return on assets and from the FTSE Pension Curve.

We recognize that some multiemployer pension plans are also concerned with how their portfolio value can be affected in more extreme downside ("left-tail") scenarios. For that reason, in figure 5 we show historical % drawdowns of the model portfolios in the financial crisis.

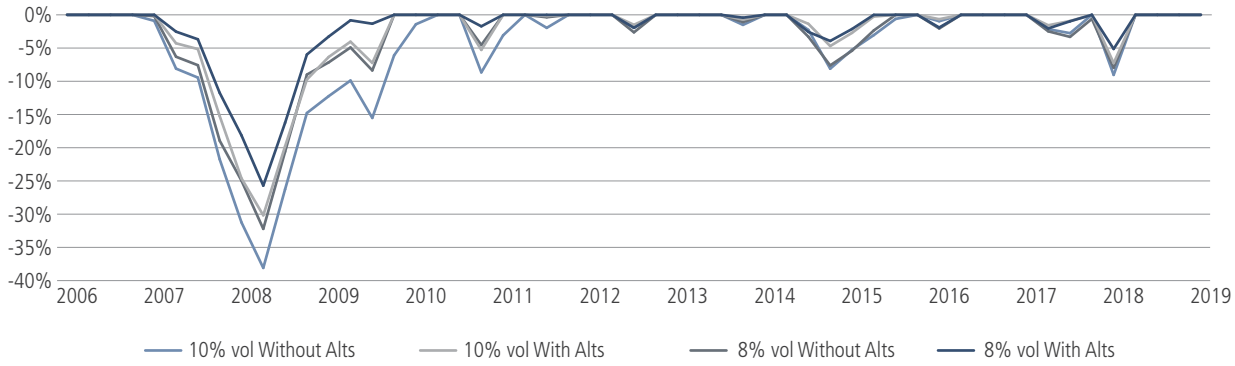
We can see that adding alternatives would have lowered drawdowns during the financial crisis.

FIGURE 5. THE IMPACT OF ALTERNATIVE INVESTMENTS ON HISTORICAL MAXIMUM DRAWDOWN

Yellow-zone plan historical maximum drawdown (reflects asset allocations with and without alternatives as shown in figure 3)



Green-zone plan historical maximum drawdown (reflects asset allocations with and without alternatives as shown in figure 3)



For illustrative purposes only. Asset class historical returns are represented indexes as set forth in Appendix I. Indexes are unmanaged and are not available for direct investment. Investing entails risks, including possible loss of principal. **Past performance is no guarantee of future results.**

Our assumptions and parameters are set out in detail in Appendix I below. The decision that is most important to note here is the discount rate/estimated return we have used to calculate the present value of plan liabilities. While multiemployer pension plans are required to report liabilities discounted with a bond yield-derived rate, they can also use an actuary's target return on assets, and they tend to use this rate for their own strategic planning. For that reason, we use the hypothetical estimated return on assets here. As we have seen, the weighted average of all multiemployer plans' target return on assets is currently 7.26%. These targets often include an assumption that plan investments can outperform market indices. We regard this rate as optimistic; using our own long-term (20+ year) capital market assumptions to the asset mixes we examine here, we arrive at an average hypothetical estimated portfolio

return of around 5.5–6.5%. We therefore use 6% as the liability discount rate/hypothetical estimated return. We also note that U.S. legislators have been considering a cap on the discount rate that multiemployer plans can use, and that Milliman has estimated that the level of such a cap would currently be "in the neighborhood of 6%."[4]

The choice of discount rate has a meaningful impact on the probability of reaching 100% funding over time, which we show in figure 4. Hypothetical simulations that use a higher discount rate result in a lower present value for liabilities and therefore a better-looking funded status outlook. However, that discount rate, along with net cash flows, defines the hurdle that asset returns need to clear in order to close a gap in funded status—a higher rate therefore makes it more difficult to improve upon the relatively high starting-point for funded status. In addition, we note that generally speaking the higher the discount rate, the further out the portfolio is on the risk/return spectrum and therefore the higher the downside risk to the portfolio in bear markets.

We believe the lower discount rate (based on the FTSE curve) is more reasonable. In Appendix II we show our full results for the average red-, yellow- and green-zone plans, allowing for 7%, 8%, 9% and 10% funded status volatility, using discount rates derived both from an estimated return on assets of 6% and from the FTSE Pension Curve. All of the results show that adding alternative investments can have a positive impact on the path toward 100% funded status.

Using the higher discount rate, we see a lesser impact because, as we mentioned above, the plans start out with a better-funded status outlook. The impact for red-zone plans is negligible; that is because when all plans are given a better funded status to start out with, the ones that end up in the red zone are mostly in a critical and declining condition that will ultimately require structural intervention.

Using the lower discount rate, we obviously see a bigger impact, including for red-zone plans. That is because when all plans are given a worse funded status to start out with, the population of plans in the red zone becomes much larger—many would not be considered critical and declining, and are still in a position to benefit decisively from higher asset returns.

Conclusion: Alternatives Have the Potential to Improve Long-Term Outcomes

The improved aggregate funded status of the U.S. multiemployer pension plan system since the financial crisis disguises a marked divergence in the fortunes of the best-funded plans and the worst-funded plans. Because the best-funded plans also tend to have a higher proportion of younger, active, contributing members and more positive cash flow, they are the ones that have continued to invest during the past decade of high market returns. The worst-funded plans, by contrast, have been constrained by more deeply negative cash flows and were therefore unable to benefit as much from higher returns.

We show that plans have the potential to improve their asset returns and their flightpath to 100% funded status by making changes to their asset mix. Furthermore, we maintain that all but the worst-funded plans with the deepest net negative cash flows have the potential to make a decisive difference to their flightpaths back toward full funding.

In our view, the high asset market returns of the past decade are not likely to repeat over the next decade. Valuations are historically high in fixed income markets and arguably stretched in many equity markets, suggesting that it is time to rethink return outlooks and the portfolio mix.

We believe that alternative investments, including illiquid private markets investments, should figure in that rethink. They have the potential to move the needle meaningfully in the right direction—even with lower return outlooks for the coming decade.

[4]Ladd Preppernau, et al., Milliman Multiemployer Pension Funding Study, Spring 2019.

Appendix I

Model Methodology

Constructing liability cash flows

- We approximate Taft-Hartley plan cash flows by weighting active, deferred and retiree Projected Benefit Obligation (PBO) cash flows from a sample pension plan
- According to the most recent Pension Benefit Guaranty Corporation (PBGC) reported data, 10.6 million insured participants are distributed as actives (36.1%), deferreds (28.4%) and retirees (35.5%)

Contributions and distributions for each year

- According to the funding rules for multiemployer DB pension plans (26 U.S. Code section 431), minimum required contributions should cover the normal cost of the plan for the plan year and the amortization of unfunded past service liability
- We assume all unfunded service liability has already been fully amortized, and we model each year's contribution as the normal cost

Incorporating new participants

- We assume the minimum required contribution will cover the distributions for new participants

Optimizing portfolios with and without alternatives

- Our optimization process aims to estimate the potential return difference between portfolios with and without the alternative investments listed in the article
- We optimize by minimizing two different volatility targets:
  - Asset volatility: volatility of modeled asset classes including diversification
  - Funded status volatility: volatility of assets minus liabilities, where liabilities are represented by a liability replicating portfolio of key rate durations
- Optimization parameters:
  - Estimated return is defined as market yield-to-worst adjusted for estimated default cost for fixed income; and long-term (20+ years) estimated return for equities and alternative investments
  - Private equity is capped at 20%; PutWrite is capped at 12%; private real estate is capped at 15%; hedge funds are capped at 10%; real assets are capped at 5%
- Indices used:
  - Core Fixed Income: Bloomberg Barclays U.S. Treasury 3M, 1-5, 5-10, 10-20 & 20-30 Years Indices; U.S. Corporate Credit A & Above 1-5, 5-10, 10-20, 20+ Years and BBB 1-5, 5-10, 10-20, 20+ Years Indices
  - Opportunistic Fixed Income: Bloomberg Barclays U.S. High Yield Index
  - Public Equity: S&P 500 Index; MSCI World ex U.S. Index
  - PutWrite: CBOE S&P 500 PutWrite Index
  - Private Equity: Cambridge Associates LLC Global Private Equity Index
  - Real Estate: NCREIF Open End Diversified Core Equity (ODCE) Index
  - Hedge Funds: HFRI Global Hedge Fund Index
  - Real Assets: S&P Real Assets Index

Simulating Funded Status

- We simulate the portfolios from the funded status volatility optimization using a proprietary Monte Carlo Simulation tool that captures:
  - Correlations between assets and liabilities
  - Non-normality in asset classes
  - PBGC premiums
- At each time step of our simulation, we add service cost cash flows to the liabilities, and add the contribution (equal to the present value of discounted additional cash flows) to the assets
- At each time step of our simulation, we calculated 10,000 different return scenarios for the portfolio and ranked the results. The median result is represented by the 50th percentile line. The 90th percentile line shows the results of the best 10% funded statuses in that year. Results this positive or better occurred in about 1,000 of the 10,000 trials. Conversely, the 10th percentile line shows the results of about the worst 1,000 of the 10,000 trials generated. Neither of these should be read as a "best case" or "worst case" scenario, as returns can and do occur outside of this range

Sensitivity of Modeled Funded Status to Market Rates and Contributions

- We have used an estimated return on assets of 6% as our discount rate to calculate contributions in the main exhibits and text; we have included results obtained using a discount rate derived from the FTSE Pension Curve at December 31, 2019 in Appendix II; in reality, contributions calculated with the yield curve from a different day, or using different actuarial estimates of estimated returns, or multiemployer plan funding assumptions rather than discounted additional cash flows, could differ from those in our model
- The formula that multiemployer pension plans use to determine legally required contributions can understate most plans' real service costs; when we move from assuming that contributions cover 100% of plan service costs to assuming they cover only 75% of those costs, a red-zone plan with alternatives and funded status volatility of 7% goes from taking 35 years to reach 100% funding to never achieving 100% funding at all; a green-zone plan with alternatives and funded status volatility of 10% goes from taking seven years to reach 100% funding to taking nine years; this sensitivity adjustment does not make a substantial difference to the relative improvement in outcome achieved by adding alternatives to the asset portfolio

Estimating Time to Reach 100% Funded Status

- We show this value for all plans when we use the discount rate derived from the FTSE Pension Curve; we assume that each portfolio earns its estimated return deterministically, and measure how long it takes for the plan to reach 100% funded status

Estimating Probability of Reaching 100% Funded Status After 10 Years and 15 Years

- These probabilities were calculated by means of a stochastic Monte Carlo simulation

Appendix II

Full Results for Optimizations Against Funded Status Volatility

RESULTS USING THE 6% DISCOUNT RATE (BASED ON EROA)

Red-zone (<65% funded)

	Without Alts	With Alts	Without Alts	With Alts
Funded Status Volatility	**8% Vol**		**10% Vol**	
Estimated Return	5.12%	**5.70%**	5.66%	**6.37%**
Probability of 100% funded in 10 years	1%	**1%**	2%	**4%**
Probability of 100% funded in 15 years	1%	**3%**	3%	**6%**

Yellow-zone (65–79% funded)

	Without Alts	With Alts	Without Alts	With Alts
Funded Status Volatility	**8% Vol**		**10% Vol**	
Estimated Return	5.39%	**6.08%**	5.92%	**6.63%**
Probability of 100% Funding in 10 years	5%	**9%**	9%	**13%**
Probability of 100% Funding in 15 years	6%	**11%**	11%	**16%**

Green-zone (>80% funded)

	Without Alts	With Alts	Without Alts	With Alts
Funded Status Volatility	**8% Vol**		**10% Vol**	
Estimated Return	5.65%	**6.34%**	6.11%	**6.82%**
Probability of 100% funded in 10 years	22%	**29%**	27%	**34%**
Probability of 100% funded in 15 years	22%	**31%**	27%	**37%**

Source: Neuberger Berman. For illustrative purposes only. Probability of 100% Funding in 10/15 Years was calculated by means of stochastic Monte Carlo simulations. See Appendix I for model methodology. **IMPORTANT:** Performance and risk projections/estimates are hypothetical in nature and for illustrative and discussion purposes only. Projections are based on Neuberger Berman's long-term (20+ years) capital market assumptions. Projections do not reflect actual investment results and are not guarantees of future results. Actual results will vary, perhaps to a significant degree. Estimated returns do not reflect the alpha of any investment manager or investment strategy/vehicle within an asset class. Information is not intended to be representative of any investment product or strategy and does not reflect the fees and expenses associated with managing a portfolio. Net returns will be lower. Investing entails risks, including possible loss of principal.

RESULTS USING THE DISCOUNT RATE DERIVED FROM THE FTSE PENSION CURVE AT DECEMBER 31, 2019

Red-zone (<65% funded)

	Without Alts	With Alts	Without Alts	With Alts
Funded Status Volatility	**8% Vol**		**10% Vol**	
Estimated Return	5.12%	**5.70%**	5.66%	**6.37%**
Probability of 100% Funding in 10 years	4%	**7%**	11%	**18%**
Probability of 100% Funding in 15 years	10%	**18%**	22%	**31%**

Yellow-zone (65%–79% funded)

	Without Alts	With Alts	Without Alts	With Alts
Funded Status Volatility	**8% Vol**		**10% Vol**	
Estimated Return	5.39%	**6.08%**	5.92%	**6.63%**
Probability of 100% Funding in 10 years	20%	**29%**	30%	**38%**
Probability of 100% Funding in 15 years	32%	**43%**	41%	**52%**

Green-zone (>80% funded)

	Without Alts	With Alts	Without Alts	With Alts
Funded Status Volatility	**8% Vol**		**10% Vol**	
Estimated Return	5.65%	**6.34%**	6.11%	**6.82%**
Probability of 100% Funding in 10 years	52%	**59%**	55%	**62%**
Probability of 100% Funding in 15 years	61%	**68%**	63%	**70%**

Source: Neuberger Berman. For illustrative purposes only. Probability of 100% Funding in 10/15 Years was calculated by means of stochastic Monte Carlo simulations. See Appendix I for model methodology. **IMPORTANT:** Performance and risk projections/estimates are hypothetical in nature and for illustrative and discussion purposes only. Projections are based on Neuberger Berman's long-term (20+ years) capital market assumptions. Projections do not reflect actual investment results and are not guarantees of future results. Actual results will vary, perhaps to a significant degree. Estimated returns do not reflect the alpha of any investment manager or investment strategy/vehicle within an asset class. Information is not intended to be representative of any investment product or strategy and does not reflect the fees and expenses associated with managing a portfolio. Net returns will be lower. Investing entails risks, including possible loss of principal.

Appendix III

Asset Class Assumptions

NEUBERGER BERMAN LONG-TERM (20+ YEARS) CAPITAL MARKET ASSUMPTIONS

Asset Class	Index Rating	Hypothetical Estimated Return	OAS (bps)	OASD	OAD	Ann. Vol
Cash & Short Term - USD	AAA	1.54%	0	0.0	0.3	0.3%
Treasuries 1-5 yrs	AAA	1.63%	0	0.0	2.7	1.5%
Treasuries 5-10 yrs	AAA	1.91%	0	0.0	6.4	4.4%
Treasuries 10-20 yrs	AAA	2.40%	0	0.0	12.6	7.4%
Treasuries 20-30 yrs	AAA	3.12%	0	0.0	18.6	12.0%
US Corp A/above 1-5 yrs	A1/A2	1.95%	37	2.6	2.6	1.8%
US Corp A/above 5-10 yrs	A1/A2	2.47%	64	6.3	6.3	4.1%
US Corp A/above 10-20 yrs	A1/A2	3.23%	102	11.5	11.6	6.4%
US Corp A/above 20+ yrs	A1/A2	3.60%	97	16.2	16.7	8.6%
US Corp BBB 1-5 yrs	BAA1/BAA2	2.22%	73	2.7	2.7	1.9%
US Corp BBB 5-10 yrs	BAA1/BAA2	2.86%	110	6.2	6.1	4.1%
US Corp BBB 10-20 yrs	BAA1/BAA2	3.83%	173	10.6	10.7	6.1%
US Corp BBB 20+ yrs	BAA1/BAA2	4.23%	170	15.1	15.5	8.6%
US HY	B1/B2	3.77%	336	3.1	3.1	5.6%
US Equity	NA	6.96%	NA	NA	NA	12.5%
Global Equity ex US	NA	7.60%	NA	NA	NA	13.1%
PutWrite	NA	6.76%	NA	NA	NA	8.4%
Private Equity	NA	11.11%	NA	NA	NA	17.1%
Real Estate	NA	5.50%	NA	NA	NA	8.9%
Hedge Funds	NA	3.96%	NA	NA	NA	4.5%
Real Assets	NA	7.45%	NA	NA	NA	7.7%

Estimated gross returns and estimated volatility (risk) shown are hypothetical and are for illustrative and discussion purposes only. They are not intended to represent, and should not be construed to represent, predictions of future rates of return or volatility. Actual returns and volatility may vary significantly. Unlike actual investment performance, hypothetical model results do not represent actual trading and accordingly they may not reflect the impact that material economic and market factors might have had on decision making if assets were actually managed during the relevant period. Net returns will be lower. Investing entails risks, including possible loss of principal. Indexes are unmanaged and are not available for direct investment. **Past performance is no guarantee of future results.**

CORRELATION MATRIX

	Cash & Short Term - USD	Treasuries 1-5 yrs	Treasuries 5-10 yrs	Treasuries 10-20 yrs	Treasuries 20-30 yrs	US Corp A/above 1-5 yrs	US Corp A/above 5-10 yrs	US Corp A/above 10-20 yrs	US Corp A/above 20+ yrs	US Corp BBB 1-5 yrs	US Corp BBB 5-10 yrs	US Corp BBB 10-20 yrs	US Corp BBB 20+ yrs	US HY	US Equity	Global Equity ex US	PutWrite	Private Equity	Real Estate	Hedge Funds	Real Assets
Cash & Short Term - USD	1.00																				
Treasuries 1-5 yrs	0.28	1.00																			
Treasuries 5-10 yrs	0.17	0.94	1.00																		
Treasuries 10-20 yrs	0.15	0.87	0.97	1.00																	
Treasuries 20-30 yrs	0.12	0.79	0.92	0.98	1.00																
US Corp A/above 1-5 yrs	0.19	0.71	0.67	0.60	0.53	1.00															
US Corp A/above 5-10 yrs	0.15	0.74	0.78	0.75	0.70	0.93	1.00														
US Corp A/above 10-20 yrs	0.13	0.67	0.76	0.79	0.79	0.80	0.93	1.00													
US Corp A/above 20+ yrs	0.13	0.66	0.76	0.81	0.83	0.76	0.90	0.99	1.00												
US Corp BBB 1-5 yrs	0.16	0.55	0.52	0.46	0.39	0.89	0.84	0.75	0.69	1.00											
US Corp BBB 5-10 yrs	0.15	0.60	0.63	0.60	0.55	0.87	0.93	0.89	0.85	0.94	1.00										
US Corp BBB 10-20 yrs	0.13	0.52	0.58	0.59	0.58	0.77	0.87	0.93	0.90	0.84	0.95	1.00									
US Corp BBB 20+ yrs	0.12	0.51	0.57	0.61	0.62	0.75	0.86	0.95	0.94	0.79	0.91	0.98	1.00								
US HY	-0.03	-0.13	-0.14	-0.16	-0.18	0.42	0.38	0.33	0.28	0.62	0.59	0.56	0.53	1.00							
US Equity	-0.02	-0.33	-0.34	-0.35	-0.34	0.09	0.10	0.08	0.05	0.24	0.25	0.29	0.28	0.72	1.00						
Global Equity ex US	-0.04	-0.23	-0.27	-0.30	-0.31	0.24	0.21	0.17	0.13	0.38	0.37	0.39	0.38	0.78	0.85	1.00					
PutWrite	-0.09	-0.34	-0.32	-0.31	-0.31	0.05	0.07	0.07	0.04	0.21	0.23	0.25	0.24	0.66	0.90	0.76	1.00				
Private Equity	-0.03	-0.32	-0.33	-0.34	-0.34	0.15	0.14	0.12	0.09	0.30	0.31	0.34	0.33	0.78	0.97	0.94	0.88	1.00			
Real Estate	0.06	0.18	0.24	0.25	0.25	0.43	0.50	0.47	0.47	0.48	0.54	0.52	0.52	0.57	0.55	0.46	0.53	0.54	1.00		
Hedge Funds	0.01	-0.33	-0.33	-0.31	-0.30	0.12	0.07	0.04	0.01	0.28	0.23	0.22	0.20	0.68	0.69	0.68	0.56	0.72	0.47	1.00	
Real Assets	0.04	0.05	0.05	0.02	0.00	0.47	0.48	0.43	0.40	0.60	0.62	0.60	0.60	0.84	0.74	0.84	0.67	0.80	0.74	0.65	1.00

Estimated correlations shown are hypothetical and are for illustrative and discussion purposes only. They are not intended to represent, and should not be construed to represent, predictions of future rates of return or volatility. Actual returns and volatility may vary significantly. Unlike actual investment performance, hypothetical model results do not represent actual trading and accordingly they may not reflect the impact that material economic and market factors might have had on decision making if assets were actually managed during the relevant period. Investing entails risks, including possible loss of principal. Indexes are unmanaged and are not available for direct investment. **Past performance is no guarantee of future results.**

Asset Class	Benchmark	Definition of Benchmark
Core Fixed Income	Bloomberg Barclays Capital U.S. Corporate	The U.S. Corporate Index measures the investment grade, fixed-rate, taxable corporate bond market. It includes USD-denominated securities publicly issued by U.S. and non-U.S. industrial, utility and financial issuers that meet specified maturity, liquidity and quality requirements. Securities in the index roll up to the U.S. Credit and U.S. Aggregate Indices. The U.S. Corporate Index was launched on January 1, 1973.
Core Fixed Income	Bloomberg Barclays U.S. Treasury	The Bloomberg Barclays U.S. Treasury Index measures U.S. dollar-denominated, fixed-rate, nominal debt issued by the U.S. Treasury. Treasury bills are excluded by the maturity constraint, but are part of a separate Short Treasury Index. STRIPS are excluded from the index because their inclusion would result in double-counting. The U.S. Treasury Index is a component of the U.S. Aggregate, U.S. Universal, Global Aggregate and Global Treasury Indices. The U.S. Treasury Index was launched on January 1, 1973.
Opportunistic Fixed Income	Bloomberg Barclays Capital U.S. Corporate High-Yield Bond	The U.S. Corporate High-Yield Bond Index covers the USD-denominated, non-investment grade, fixed-rate, taxable corporate bond market. Securities are classified as high-yield if the middle rating of Moody's Fitch, and S&P is Ba1/BB+/BB+ or below. The index excludes Emerging Markets debt. The index was created in 1986, with index history backfilled to January 1, 1983. The U.S. Corporate High-Yield Index is part of the U.S. Universal and Global High-Yield Indices.
Public Equity	S&P 500 Index	The S&P 500 Index is a capitalization weighted index comprised of 500 stocks chosen for market size, liquidity and industry group representation. The S&P 500 Index is constructed to represent a broad range of industry segments in the U.S. economy. The S&P 500 Index focuses on the large-cap segment of the market with over 80% coverage of US equities. Criteria for inclusion include financial stability (minimize turnover in the index), screening of common shares to eliminate closely held companies, and trading activity indicative of ample liquidity and efficient share pricing. Companies in merger, acquisition, leveraged buyouts, bankruptcy (Chapter 11 filing or any shareholder approval of recapitalization which changes a company's debt-to-equity ratio), restructuring or lack of representation in their representative industry groups are eliminated from the index.
Public Equity	MSCI ACWI ex U.S.	The MSCI All Country World ex. U.S (Net) Index is a free float-adjusted market capitalization weighted index that is designed to measure the equity market performance of developed and emerging markets, excluding the United States. The MSCI ACWI ex.US consists of 46 country indices comprising of 22 developed and 26 emerging market country indices. The developed market country indices included are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland and the United Kingdom. The emerging market country indices included are: Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Greece, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Qatar, Russia, Saudi Arabia, South Africa, Taiwan, Thailand, Turkey and United Arab Emirates. Net total return indexes reinvest dividends after the deduction of withholding taxes, using (for international indexes) a tax rate applicable to non-resident institutional investors who do not benefit from double taxation treaties.
PutWrite	CBOE S&P 500 PutWrite Index	The CBOE S&P 500 PutWrite Index measures the performance of a hypothetical portfolio that sells S&P 500 index (SPX) put options against collateralized cash reserves held in a money market account. The put strategy is designed to sell a sequence of one-month, at the money, S&P 500 Index puts and invest cash at one and three month Treasury Bill rates. The number of puts sold varies from month to month, but is limited so that the amount held in Treasury Bills can finance the maximum possible loss from final settlement of the SPX puts.
Private Equity	Cambridge Associates LLC Global Private Equity Index	The Global Private Equity row definition should be: Cambridge Associates Global Private Equity Index: Based on data compiled from 2,450 private equity funds, including fully liquidated partnerships, formed between 1993 and 2016. Internal rates of returns are net of fees, expenses and carried interest. CA research shows that most funds take at least six years to settle into their final quartile ranking, and previous to this settling they typically rank in two to three other quartiles; therefore fund or benchmark performance metrics from more recent vintage years may be less meaningful. Benchmarks with "—" have an insufficient number of funds in the vintage year sample to produce a meaningful return.
Real Estate	NCREIF Open End Diversified Core Equity (ODCE) Index	The NFI-ODCE (NCREIF Fund Index - Open-End Diversified Core Equity) is a fund-level capitalization weighted, time-weighted return index and includes property investments at ownership share, cash balances and leverage (i.e., returns reflect the fund's actual asset ownership positions and financing strategy).
Hedge Funds	HFRI Fund of Funds Composite Index	Fund of Funds invest with multiple managers through funds or managed accounts. The strategy designs a diversified portfolio of managers with the objective of significantly lowering the risk (volatility) of investing with an individual manager. The Fund of Funds manager has discretion in choosing which strategies to invest in for the portfolio. A manager may allocate funds to numerous managers within a single strategy, or with numerous managers in multiple strategies. The minimum investment in a Fund of Funds may be lower than an investment in an individual hedge fund or managed account. The investor has the advantage of diversification among managers and styles with significantly less capital than investing with separate managers. PLEASE NOTE: The HFRI Fund of Funds Index is not included in the HFRI Fund Weighted Composite Index.
Real Assets	S&P Real Assets Index	S&P DJI defines real assets through exposure to liquid real estate, infrastructure, natural resources, and inflation-linked bonds. The S&P Real Assets Index is the first of its kind to blend the capital structure of stocks, bonds, and futures to capture diversification, inflation protection, growth and income benefits—all in one place.

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