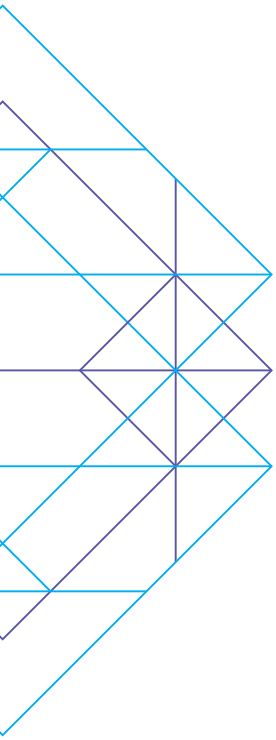
August 2017

Intelligent Risk Taking:
How to Secure Retirement in a Low Expected Return World[1]



Executive Summary

Retirement savers' ability to consume in retirement is a function of how much they save, how long they invest, and what those investments return over the lifecycle. In this chapter, we examine the rate of return needed to deliver a comfortable retirement based on current savings rates as well as intelligent ways to construct portfolios to achieve this rate of return. Based on reasonable long-term return assumptions, defined contribution portfolios as frequently constructed today are unlikely to achieve this required rate of return. By relaxing existing constraints and taking advantage of well-known and broadly accepted investment themes this required rate of return can be achieved with an exceptionally well-diversified portfolio, which may also lead to a more consistent portfolio across different economic environments.

Antti Ilmanen, Ph.D.
Principal
Portfolio Solutions Group

Matthew Rauseo
Vice President
Defined Contribution

1 The authors thank Jordan Brooks and Rodney Sullivan as well as the Pension Research Council Symposium participants in Philadelphia (May 4-5, 2017), for helpful comments, and Max Freccia for excellent research assistance. AQR Capital Management is a global investment management firm, which may or may not apply similar investment techniques or methods of analysis as described herein. The views expressed here are those of the authors and not necessarily those of AQR.

Article originally appeared in *How Persistent Low Returns Will Shape Saving and Retirement*. 2018. Editors, Olivia S. Mitchell, Robert Clark, and Raimond Maurer. Oxford University Press.

Contents

Introduction

Low market yields on stocks and bonds have historically led to depressed prospective returns for both asset classes. Today's low return environment makes it challenging for investors to meet their future liabilities. While this is true for all investors, from the most sophisticated institutions to individual investors saving for retirement, the impact of this low return environment on securing retirement is far less well understood.

In simplest terms, the liabilities of defined benefit (DB) pension plans can be thought of as what sponsors need to have on hand to meet the future retiree obligations. For decades, professional investors have been managing DB plan assets with an eye towards meeting future liabilities. By contrast, the same foresight has not always been used for employee-directed plans such as defined contribution (DC) plans.

The liability that DC investors should be concerned with is their post-retirement consumption. DC plans are financed over time by a combination of employee and employer contributions as well as real investment returns on those contributions. Nevertheless, a secure retirement is the sole responsibility of the employee, not the retirement plan sponsoring the program. In our previous study we have explored ways DC plans might become more like DB plans in addressing this challenge (Ilmanen, Kabiller, Siegel, and Sullivan, 2017).

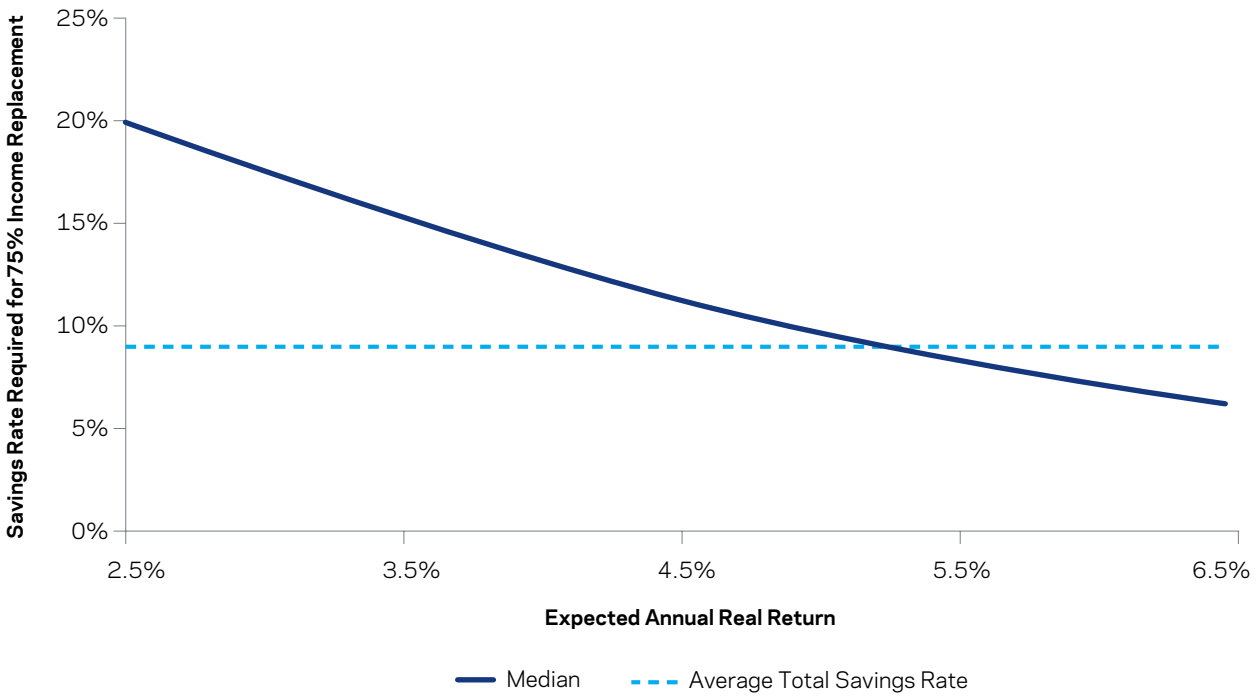
The economics of retirement saving are well-established. Post-retirement consumption is a function of three drivers: time, savings and real investment returns. Time represents the length of a participant's accumulation period, beginning when she starts saving for retirement and concluding when retirement begins. Time may also include the decumulation period of an uncertain length. (This chapter will not cover decumulation strategies, mortality pooling and related important topics.) Savings represents the periodic contributions made by both the participant and the plan sponsor. Savings can be expressed in dollars or in a rate (say, as a percentage of income). Finally, the driver we focus on here is the real investment return generated by the investor's portfolio. This return reflects both portfolio holdings and market outcomes.

Of course there is no single DC portfolio, as participants have the ability to construct their own given the investment options their plan sponsor makes available. That said, DC portfolio strategies have tended to become more similar since the Pension Protection Act of 2006, which allowed for automatic enrollment into qualified default investment alternatives (QDIA). These are typically a pre-constructed diversified portfolio, resulting in a step toward better design and more efficient investing in DC plans. While Target Date Funds have shortcomings (Dhillon, Ilmanen, and Liew, 2016), this chapter focuses on intelligent ways to take investment risk in an effort to improve a DC portfolio's real investment return. Ultimately, the goal is to meet participant's liability, which is his/her target for post-retirement income.

A Percent Saved is not a Percent Earned

Our examination of how capital market returns shape a DC investor's ability to consume in retirement is informed by previous research (Ilmanen, Rauseo, and Truax, 2016). There we showed that capital market returns have an outsized impact on saving accruals. **Figure 1** shows the amount of DC savings needed to generate a 75 percent income replacement ratio (as a fraction of the final salary),[2] which is our proxy for a comfortable retirement at the typical retirement age of 65. Results cover a range of capital market environments. As one would expect, higher capital market expectations translate to lower required savings rates; however, the trade-off is not one-for-one. The amount of additional savings required to offset a one-percentage-point reduction in capital market expectations varies depending on the initial return expectations. For example, a decrease in returns from 5.5 to 4.5 percent requires a savings increase of 3 percent, while a decrease from 4.5 to 3.5 percent requires 4 percent additional savings to meet the same income replacement goal of 75 percent.

Figure 1
Savings Rate Required for 75 Percent Income Replacement in a Range of Market Environments



Source: AQR and authors' calculations. This assumes investment in a stock/bond glidepath, which transitions from a 90/10 stock/bond mix to a 50/50 split at retirement over a 40 year working period. Average contribution and employer match statistics (total savings rate) is according to the Cerulli Retirement Markets Report 2015.

2 See Ilmanen-Rauseo-Truax (2016) for details. The most important auxiliary assumptions include 30 percent of the replacement ratio coming from savings outside the DC plan (say, from social security or home ownership), and real income growing by 2 percent p.a. over a 40-year working life (reflecting both per-capita economic growth and wage growth from increasing experience/seniority).

The key point here is not the nonlinearity, but the steep negative slope. Although these are estimates, the takeaway is that, in order to compensate for the prospectively low capital market returns, participants would have to save meaningfully more to achieve the same goal, all else equal. Based on today's typical 9 percent savings rate among DC savers, participants need to achieve a real return in excess of 5 percent annually on their investment portfolios to retire comfortably. Much of the DC literature in the past has happily assumed such return prospects because they were broadly consistent with past realized return experience. But looking ahead, such 'rearview mirror' expectations (which are more common when assessing prospects for stock markets than for bonds) ignore the fact that starting yields are much lower today. Moreover, both past stock and bond returns have been boosted by windfall gains in recent decades (and since 2009).

Additionally, low expected returns may have further consequence than reduced savings accruals. Chapter 7 "How Persistent Low Expected Returns Alter Optimal Life Cycle Saving, Investment, and Retirement Behavior" explores how lower future returns may lead to higher savings in non-retirement accounts and Social Security benefits being claimed later in people's life.

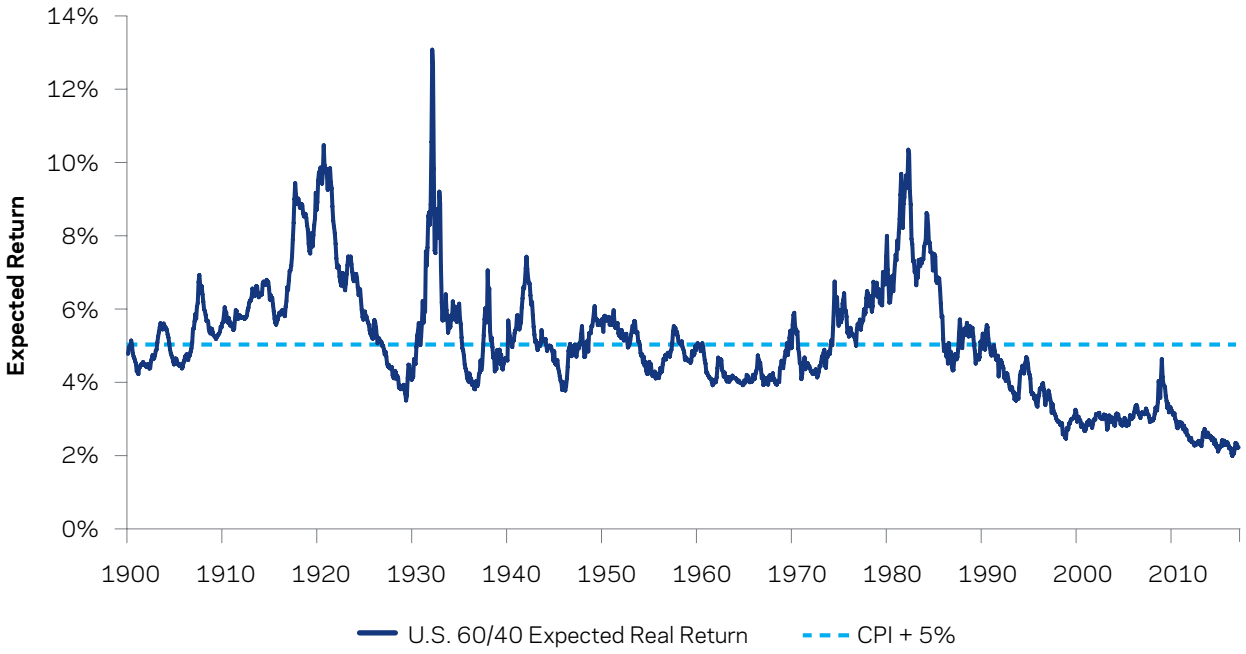
What Returns does the Future Hold?

Predicting future market returns is notoriously difficult, and even the most reliable forecasting methods have limited predictive power (Zhou 2010). Therefore, a healthy dose of skepticism should be present when considering return forecasts over a 40 or 60 year period. That said, we believe that at current market yields and valuations, it is unlikely that DC portfolios will achieve a real return close to what was experienced in the past and is needed for participants saving 9 percent annually over the course of their careers to generate adequate consumption in retirement, especially when investing in traditional DC portfolios.

Figure 2 shows the prospective real yield on a US 60/40 stock and bond portfolio going back through time. We believe this is a reasonable proxy for long-term real returns. This estimate of the real equity return is a simple average of the Shiller earnings yield (which uses smoothed 10-year earnings) and an estimate based on a basic dividend discount model (the sum of dividend yield and 1.5 percent to account for the trend real rate of growth of dividends per share, assuming no change in valuations). The real bond yield is the 10-year Treasury yield adjusted for expected inflation (based on economist consensus forecasts in recent decades and based on statistical estimates before survey data is available). During much of the 20th century, expected as well as realized long-term real returns for a 60/40 portfolio frequently exceeded the 5 percent return required for today's savings environment. But today's

Figure 2

Expected Return of U.S. 60/40 Stock/Bond Portfolio, January 1900 – March 2017



Source: AQR, authors' calculations, Bloomberg, Robert Shiller's web site, Kozicki-Tinsley (2006), Federal Reserve Bank of Philadelphia, Blue Chip Economic Indicators, Consensus Economics, Morningstar. Prior to 1926, stocks are represented by a reconstruction of the S&P 500 available on Robert Shiller's web site which uses dividends and earnings data from Cowles and associates, interpolated from annual data. After that, stocks are the S&P 500. Bonds are represented by long-dated 10 year Treasuries.

expected real returns fall short of the 5 percent bogey, and they are among the lowest seen in history (at 2.2 percent in figure 2).

While we believe that such current yield measures have limited ability to predict near-term returns, they may be reasonable anchors for realized future returns over the next decade. Extrapolating our view for the next decade to accommodate an entire savings and retirement window, we anticipate that future returns will be closer to 3.5 percent for a global 60/40 stock and bond portfolio. This multi-decade expectation assumes some increase in starting yields beyond the next decade. Even for the first decade, our expected returns could be somewhat higher than shown in figure 2 because non-US stocks have higher yields than US stocks, and global fixed income should include credit spreads on non-government bonds as well as so-called rolldown gains.

Savings, Time, and Returns

For DC investors to achieve a comfortable retirement in a world with around 3.5 percent expected real return, they need to be saving at least 15 percent[3] rather than the 9 percent participants are currently saving on average.[4] If post-retirement consumption is the objective, either savings rates need to be raised, the length of time participants contribute and earn investment returns must be lengthened, or investment returns must be increased. We next briefly summarize how the inputs related to each have changed in recent years, to improve participants' potential for income in retirement.

Time

Retirement plan sponsors have recently sought to lengthen the accumulation phase through automatic enrollment, which allows employers to automatically place new employees in a retirement plan. As a result, the percentage of plans adopting auto enrollment increased from 10 percent in 2006 to 41 percent in 2015 (Vanguard, 2016). For participants who start active retirement saving late in life, other strategies may be needed, including making most of their social security benefits, for more details see Chapter 4 "Investing for Retirement in a Low Returns Environment: Making the Right Decision to Make the Money Last."

Savings

Retirement plan sponsors have also begun taking advantage of findings from behavioral finance (Wurtzel, 2015) that help encourage participants increase savings. Despite these efforts, however, participant savings rates have not improved much. Indeed, savings rates inclusive of the matching contribution fell from 10 percent to 9 percent since 2011 (Vanguard, 2016) also see Chapter 3 "Getting More From Less: Three Levers for a Low Return World."

Investment returns

There has also been some limited innovation related to Target Date Funds. From a broad asset allocation perspective, the asset class allocation along the glide path has been largely unchanged. Slight increases in equity exposure have been seen for mid-career investors, but young savers and near-retirees have not changed their asset allocation much. Few enhancements have been added to date to the investment strategies in Target Date Funds, such as alternative asset classes or strategies adopted by institutional pension plans and endowments (Morningstar, 2017). Thus, it seems that investment returns is one area ripe for innovation.

3 We say at least 15 percent since this coincides with the median required savings rate. The mathematics of median indicates that 50 percent of the time the 15 percent savings rate will provide sufficient retirement income. Savers who want to self-insure against worse market outcomes than the base case in a low expected return world may need to save closer to 20 percent of their income. Thus, it is arguably better to think of 15 percent as a floor than as a target.

4 This is an estimate that depends on assumptions used. In Ilmanen et al. (2016), we found that the broad conclusions were robust using a simple 60/40 portfolio or a more complex portfolio evolving along the typical Target Date Fund glidepaths used by the largest providers, as well as a reasonable range of auxiliary assumptions. Blanchett et al. (2017) explore the impact of expected return levels – as well as other parameters – on required savings rates and find comparable central estimates to ours.

Examining the DC Investors Tool Box

Investors have a broad range of tools available to harvest returns, with the most-recognized being the traditional asset classes of stocks and bonds. Stocks can harvest the equity risk premium, and bonds capture the term and credit premium. These traditional asset classes have long dominated DC investors' asset allocations in traditional ways. Fund menus include market cap-weighted, benchmark-centric strategies, that are either passively managed or utilize discretionary active managers. They are most frequently funded by cash rather than taking advantage of more capital efficient techniques like leverage. These traditional ways also limit holdings exclusively to long positions, rather than taking advantage of the ability to express negative views on securities by selling them short. Importantly, this no-shorting constraint rules out the ability to utilize market-neutral strategies designed to generate absolute returns without exposure to general equity and fixed income markets.

Such traditional investments implemented in traditional ways generate several benefits. Their efficacy as return drivers has been understood for decades, so they are the most conventional way to harvest risk premia. They are also relatively liquid and in this modern age of index funds, they can be accessed at very low cost to the investor. Indeed, cap-weighted indices are the only strategies that can be held by everyone at the same time.[5] Additionally, stock and bond returns are often only loosely correlated, providing solid building blocks for a portfolio.

Yet this approach also has several disadvantages. One is that when combined in any typical equity-centric portfolios the resulting asset allocation is undiversified. Superficially this may not seem true when viewed through the lens of how the capital is allocated. But viewed through a risk allocation lens a 50/50 capital split between stocks and bonds loads most of the portfolio risk in equities. This is because equities usually have three times more volatility than bonds. So what may appear to be diversified may, in fact, imply extreme risk concentration and occasionally sharp drawdowns. Bad times like 2008 can, in turn, lead retirement savers to capitulate near the market bottom. Better risk diversification allows for higher risk-adjusted returns (Sharpe ratios) and can reduce the likelihood of ill-timed capitulations. The benefits of a higher Sharpe ratio portfolio can be realized either through the same expected return and lower corresponding portfolio volatility, higher expected return and the same corresponding portfolio volatility, or some mixture of the two.

In the current low expected return environment for stocks and bonds, in which a 5 percent real return would require holding a highly risky all-equity portfolio, it arguably makes more sense to take Sharpe ratio improvements in the form of higher expected returns, while maintaining the same aggregate portfolio risk. In other words, the question is how investors might take risks more intelligently and efficiently when seeking to earn the 5 percent annual real return that they need for a comfortable retirement at current savings rates.

5 Other strategies – including those suggested below – can help only a subset of investors. The fact that a market cap-weighted stock/bond portfolio does not offer 5 percent real return today means that if subjective expectations remain anchored at such high levels, most investors will be disappointed in the future. And it is hardly clear that DC savers as a group will be in the subset earning above-market returns through more risky or more intelligent choices.

Incorporating Intelligent Investing

We challenge the traditional approach to DC investing so as to improve expected return by:

1. Examining ways to allocate to traditional assets classes beyond market cap-weighted exposure;
2. More fully realizing the benefits of diversification by incorporating leverage; and
3. Increasing the opportunity set by allowing for the shorting of unattractive securities (e.g. allowing for market-neutral strategies).

To do so, we consider three additional types of investment strategies for inclusion in a DC investor's asset allocation.

Long-only style-tilted strategies

Sometimes referred to as "smart beta," this approach is based on well-known and generally accepted styles that have been shown in and out of sample to outperform market cap-weighted portfolios. An integrated strategy which overweights securities based on the attributes or styles that research has been shown to deliver positive excess return over time. In addition to positive excess return, these classic style exposures are backed by strong economic reasoning and out of sample evidence. For equities, those styles are value, momentum, and defensive. For fixed income, we also include carry. It may be reasonable to expect lower excess returns in the future from these tilts than historical evidence suggests. Specifically we assume that global style-tilted equities provide one percent incremental net return relative to cap-weighted global equities, while global style-tilted fixed income can outpace issuance-weighted global fixed income by about 0.75 percent net (Frazzini, Israel, Moskowitz, and Novy-Marx, 2013; AQR, 2016).

Risk parity strategies

Risk-based diversification seeks to generate both higher and more consistent returns across potential economic environments compared to a traditional portfolio. A risk parity approach allocates equal risk weight to each of the underlying asset classes, which for a DC portfolio can include global stocks, global bonds, and inflation-sensitive assets (both commodities and inflation linked bonds). Risk parity is based on the observation that the risk-adjusted returns of traditional asset classes are more similar than they are different, so investing in each asset class is beneficial because these offer complementary performance in different economic environments. Risk parity portfolios hold a better combination of market exposures by including greater nominal exposure to low-risk asset classes and then moderately levering the portfolio to the desired risk level. Acknowledging the low expected return environment, we assume that a risk parity portfolio with 10 percent volatility will earn 4.6 percent annual real return net of fees over the long run, and the gross leverage utilized will be 2.25, on average (Hurst, Johnson, and Ooi, 2010).

Alternative Risk Premia

The alternative risk premium approaches a cousin to long-only styles. As before, it seeks to capture exposure to the classic styles discussed above. But instead of holding a long-only portfolio where the style exposure is blended with traditional market beta, it involves a long/short portfolio applied in a more balanced way, across a diversified set of asset classes including stocks, bonds, equity indexes, and currencies. The advantage of capturing long/short style exposures is that the resulting portfolio can be engineered to be market-neutral, with each independent style and asset class combination having low correlation to the others. These low correlations provide an exceptional diversification benefit that has been shown in and out of sample to deliver consistent long-term performance unrelated to traditional stocks and bonds. The styles utilized are value, momentum, carry, defensive, and trend. A diversified portfolio of market-neutral style premia can be especially resilient across a range of macroeconomic environments. In contrast, long-only portfolios (such as 60/40) tend to perform well amidst strong growth and low inflation, but they underperform in times of weak growth and high inflation (Ilmanen, Maloney, and Ross, 2014). It is again reasonable to expect somewhat lower future returns than historical evidence suggests, we assume that a portfolio of integrated long/short styles applied across the above set of asset classes with 9 percent volatility will generate 6.2 percent real return net of fees per year and utilize gross leverage of 5.75, on average (Asness, Ilmanen, Israel, Moskowitz, 2015; Moskowitz, Ooi, and Pedersen, 2012).

About Leverage

US DC plan sponsors have typically been leverage averse.[6] Nevertheless, other institutional investors have embraced moderate use of leverage as a valuable portfolio management tool to improve portfolio performance by increasing returns and/or by improving diversification and reducing risk concentration. That said, the use of leverage comes with risks that must be considered. Leverage magnifies exposures, and transaction costs can be high when bid-ask spreads are wide. Additionally, if an investor has inadequate cash reserves amidst falling asset prices, collateral requirements may force the investor to unwind the positions at inopportune times. Derivatives, which are often the type of security utilized to gain leveraged exposure, introduce risks of their own, specifically counterparty risk. This is the risk that the counterparty on the other side of the trades' credit deteriorates, or they cannot make good on their obligations; the use of exchange-traded futures can mitigate this risk.

These risks can be kept manageable by holding sufficient un-invested cash and sound risk management practices in levered strategies, and by applying leverage only on part of the overall portfolio. While these risks are real, prudent use of leverage through commonly traded derivatives can help investors achieve a more efficient risk diversification. Given that many investors tend to desire little or no leverage, we will only consider portfolios with limited embedded (that is, asset manager use of) leverage — gross holdings comprising less than twice the portfolio's unlevered assets — and recognize that even this may be difficult for many investors to pursue given leverage constraints (Asness, Kabiller, and Mendelson, 2010).

6 While DC plan sponsors have been averse to leverage, it is rarely a binding constraint. For example, many DC plans use mutual funds as the underlying investment vehicle, and regulations do allow mutual funds to utilize leverage even though many do not. Some of the best-known fixed income mutual funds have long advocated and taken advantage of leverage as a portfolio management tool.

Analysis of Stepwise Portfolio Improvements

To illustrate these concepts we assume that the baseline DC portfolio has a global 60/40 stock and bond allocation. While this is a simplification, we note that most DC plan sponsors utilize a Target Date Fund as a Qualified Default Investment Alternative, and Target Date Funds are the fastest growing investment option within DC plans. Target Date Funds are typically multi-asset class portfolios diversified between stocks and bonds, with large allocations to stocks in the early years of one's working life and gradually rising fixed income allocations later in life. While the exact composition of these funds varies by provider, a dollar-weighted average of the asset mix is generally close to a 60/40 portfolio.[7]

It should be noted that all of the enhancements we consider can also be incorporated into a Target Date Fund with similar benefits to the investor. In fact, a global 60/40 portfolio is generally very similar to a 2025 vintage Target Date Fund, since that vintage's asset allocation holds roughly 61 percent equity and 39 percent fixed income (Morningstar, 2017). Our goal is show how the three types of investment strategies described above can help participants improve their outlook for adequate consumption in retirement, while targeting the same aggregate portfolio volatility as the baseline DC portfolio. First we show how adding long-only style tilts to a cap-weighted portfolio improves the portfolio's expected real return. Second we examine how further additions of risk parity and alternative risk premia improve the portfolio's expected real return. In each case, we will constrain the amount of leverage utilized in an attempt to account for DC plan sponsors' inability or unwillingness to incorporate leverage. Finally, we solve for a portfolio that minimizes leverage while achieving a 5 percent expected rate of real return, is consistent with what a DC plan participant needs to earn over a life cycle to achieve a comfortable retirement while saving "only" 9 percent of salary income. We believe a 3.4 percent expected real return is a reasonable approximation of what may be earned over multiple decades if a DC portfolio is invested in market cap-weighted equity index funds and issuance-weighted fixed income index funds. The assumptions used for all portfolio combinations can be found in **Table 1**. These stylized assumptions represent plausible estimates for a well-executed strategy in each context.

7 For example, assuming a salary growth of 2 percent, a savings rate of 9 percent, and a glidepath that gradually de-risks from 90 percent equities to 50 percent equities over 40 years, a real return assumption of 5 percent for stocks and 1 percent for bonds results in a dollar-weighted equity allocation of 62 percent, on average.

Table 1
Asset Classes and Investment Strategies Assumptions

	Net Real Return (%)	Expected Volatility (%)	Net Sharpe Ratio	Fees (%)
Global Equity	4.95	15.0	0.33	0.05
Global Fixed Income	0.95	5.0	0.19	0.05
Global Style-Tilted Equity	5.95	15.0	0.40	0.35
Global Style-Tilted Fixed Income	1.70	5.0	0.34	0.25
Risk Parity	4.60	10.0	0.46	0.40
Alternative Risk Premia	6.20	9.0	0.69	1.10

Notes: Expected Sharpe ratio assumes zero real rate for cash, thus is the ratio of expected real return (net of fees) to expected volatility.

Source: AQR. Expected real return assumptions are based on yield-based estimates for equities and bonds and for alternative risk premia and style tilts a combination of discounted hypothetical performance and judgment. For cash, we assume a 0% real return, reflecting the current low-yield environment with some expectation of normalization. Volatilities are based on hypothetical and proxy index performance, rounded. Global Equity is based on the MSCI World Index (cap-weighted); Global Fixed Income is based on the Barclays Global Aggregate Index (hedged); Global Style-Tilted Equity is based on the MSCI World Index (style-tilted); Global Style-Tilted Fixed Income is based on the Barclays Global Aggregate Index (hedged, style-tilted); Risk Parity is based on a global risk parity strategy comprised of equity, interest rate and inflation risk; Alternative Risk Premia is based on a hypothetical multi-asset long/short style strategy.

In the event a plan sponsor believes it can identify active managers who have the skill to generate alpha, the 3.4 percent real return can be augmented. Nevertheless, alpha is often elusive, expensive, and derived from an idiosyncratic investment process whose merits are hard to identify in advance. Each of our three proposed solutions represents ways to potentially generate additional return, so they are "alpha" to the investor as long as they are underrepresented exposures within their portfolios; yet they are not idiosyncratic return sources. Rather, they are backed by scientific evidence identifying each of these premia as persistent and systematic sources of return that we believe can be harvested over the long term.

To demonstrate the possible performance impact for investors from the three proposed solutions, we first add long-only style-tilted strategies to replace the market cap-weighted equity index funds and issuance-weighted fixed income index funds. This maintains the same 60/40 allocation between stocks and bonds, resulting in estimated portfolio volatility of 9.4 percent and expected real return of 4.3 percent. In this portfolio, while maintaining the no-leverage and no-shorting constraints, we have enhanced annual returns by 0.9 percent net of fees. These results appear in **Table 2**, Portfolio 1.

Table 2
Summary Statistics of Stepwise Portfolio Improvements

	DC Portfolio	Portfolio 1 Add Style-Tilts	Portfolio 2 Add Risk Parity	Portfolio 3 Add Alternative Risk Premia	Portfolio 4 5% Real Return
Global Equity	60%	-	-	-	-
Global Fixed Income	40%	-	-	-	-
Global Style-Tilted Equity	-	60%	51%	55%	52%
Global Style-Tilted Fixed Income	-	40%	29%	26%	17%
Risk Parity	-	-	20%	11%	19%
Alternative Risk Premia	-	-	-	8%	12%
Total	**100%**	**100%**	**100%**	**100%**	**100%**
Expected Volatility	9.4%	9.4%	9.4%	9.4%	9.4%
Expected Real Return	3.4%	4.3%	4.4%	4.7%	5.0%
Expected Sharpe Ratio	0.36	0.45	0.47	0.50	0.53
Estimated Gross Leverage	1.00	1.00	1.25	1.50	1.82

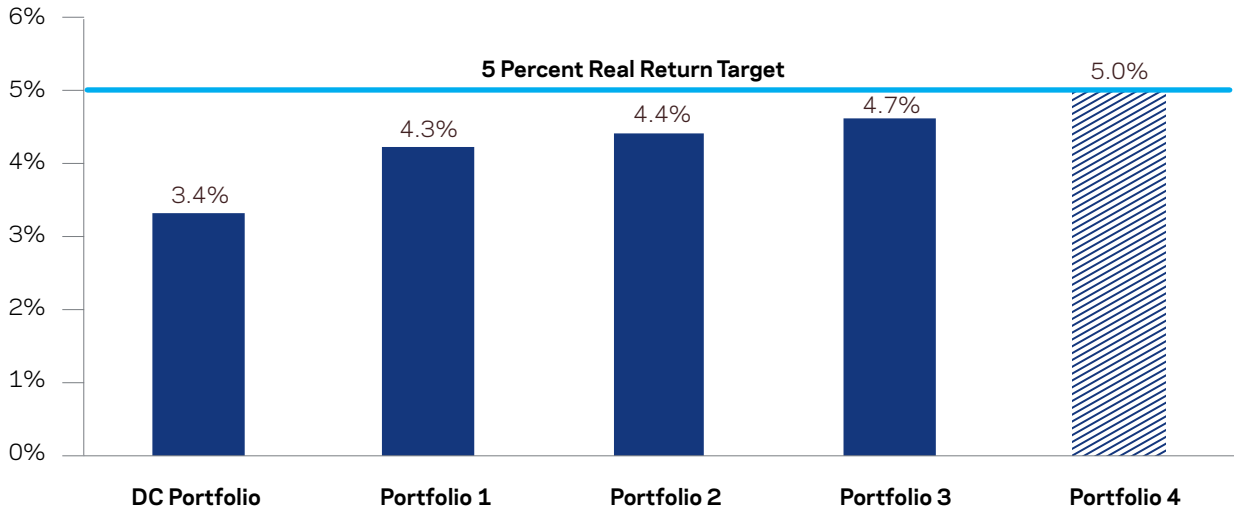
Notes: Expected Sharpe ratio assumes zero real rate for cash, thus is the ratio of expected real return (net of fees) to expected volatility.
Source: AQR.

Next, for Portfolio 2, we relax the no-leverage constraint and allow Risk Parity to be included within the solution. To do this, we run an optimization to maximize expected real return while maintaining the same 9.4 percent expected portfolio volatility and constraining gross leverage to 1.25. Under these conditions, a 51 percent allocation to style-tilted equities, a 29 percent allocation to style-tilted fixed income, and a 20 percent allocation to risk parity improves expected annual real returns to 4.4 percent net of fees. (The optimal allocation for risk parity would be higher, were it not for the leverage constraint.)

For Portfolio 3, we further relax the leverage constraint and also allow for short sales. In addition to risk parity, the alternative risk premia approach is also allowed. To do this, we again run an optimization to maximize expected real returns while maintaining the same 9.4 percent expected portfolio volatility. Portfolio leverage is constrained to 1.5 gross instead of 1.25. The constrained optimal portfolio includes 55 percent style-tilted equities, 26 percent style-tilted fixed income, 11 percent risk parity, and 8 percent alternative risk premia. It generates an expected 4.7 percent annual real return net of fees.

This illustrates in a stepwise fashion how participants may generate incremental return as they seek to finance their future retirement consumption. But constraining the gross leverage to 1.5 of unlevered long assets still produces a return shortfall for those seeking 5 percent real return. The expected returns for our three modified proposals are illustrated in **Figure 3**.[8]

Figure 3
Expected Real Returns Versus Return Target



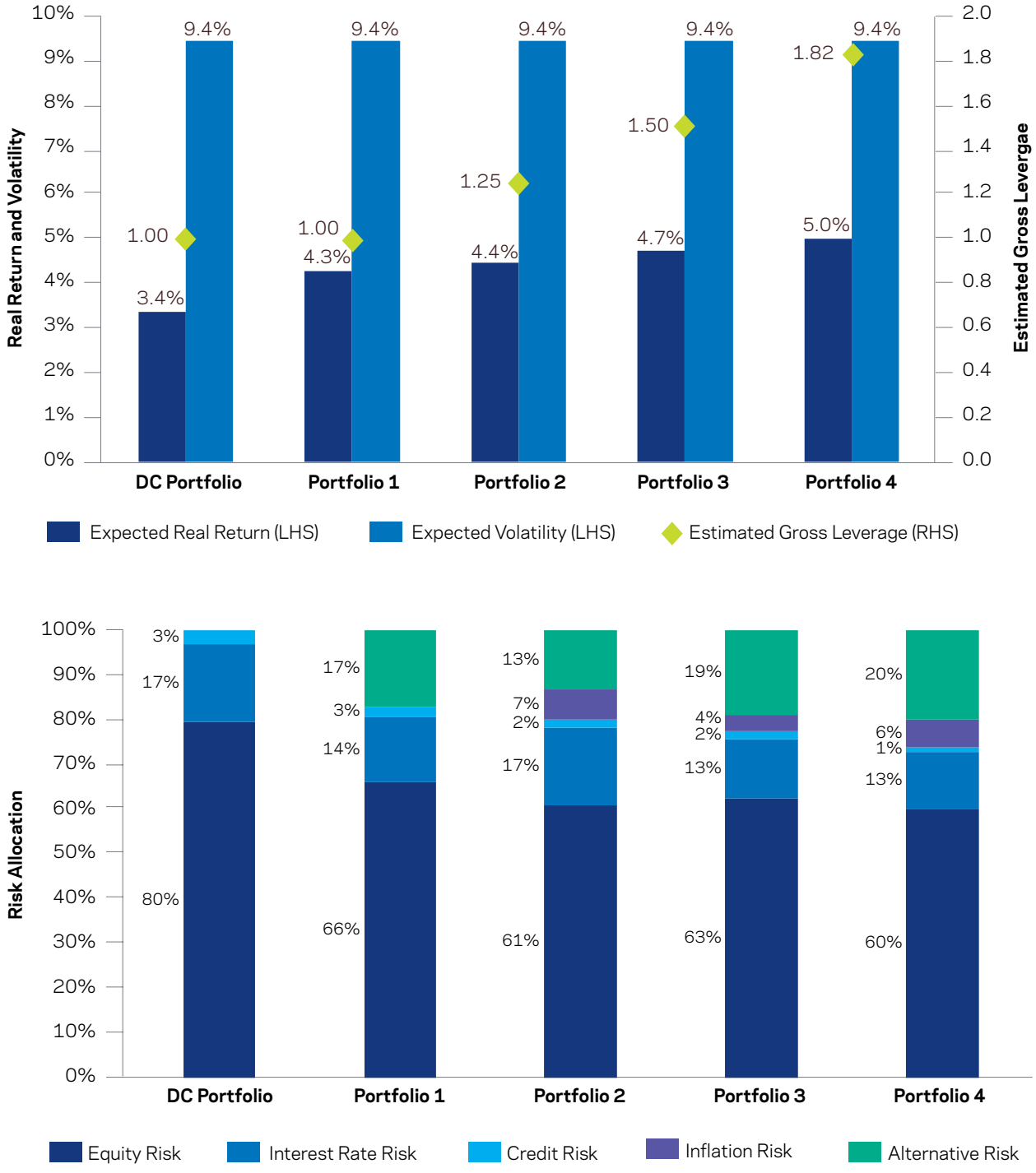
Source: AQR and authors' calculations.

Therefore, we propose a fourth portfolio that takes a different approach. Rather than optimize returns while constraining leverage, the optimizer is asked to minimize the use of leverage while solving for a 5 percent expected real return target based on return assumptions. Results in **Figure 4** show a portfolio that generates an expected 5 percent real return (by construction), while still staying below embedded gross leverage of 2 (at 1.82). The final asset allocation is 52 percent style-tilted equities, 17 percent style-tilted fixed income, 19 percent risk parity, and 12 percent alternative risk premia. While this portfolio may at first seem materially more risky than the initial portfolio, it is important to keep in mind that the expected portfolio volatility is unchanged, since maintaining the same expected portfolio volatility is a condition of the optimization. A benefit of this approach is that, while portfolio volatility is the same throughout, the sources of that volatility are different and more diversified.

8 Even a 5 percent solution does not quite get us to 9 percent savings rate being sufficient, though it is close. In reality, some further increases in savings or reduced expectations of retirement security will be needed. (Also recall from our discussion of Figure 2 that for the next decade we expect baseline DC portfolio real returns below 3 percent, not 3.5 percent, so the prospect of any portfolio reaching 5 percent real return over this period is lower.)

Figure 4

Expected Return and Risk of Different Portfolios (top panel) and Their Portfolio Risk Allocation (bottom panel)



Source: AQR and authors' calculations.

The top panel of Figure 4 shows that better diversification across strategies results in a higher return for the same level of portfolio volatility as long as leverage is allowed to convert higher risk-adjusted returns into higher raw returns. The bottom panel decomposes portfolio risk by showing the shares of key risk sources for total portfolio volatility (that is, summing up their volatilities and then computing volatility shares, ignoring correlations). In the traditional 60/40 portfolio, equity risk dominates with 80 percent risk share (and higher if we calculate risk contributions including correlations), while equity share of risk falls to 60-66 percent in all other portfolios. Equity risk is replaced by 'alternative risk' from long-only style tilts and long/short alternative risk premia as well as by 'inflation risk' mainly from commodities (in risk parity).

The lesser risk concentration as we move from left to right in Figure 4 improves the portfolio's risk-adjusted return (Sharpe ratio), which we convert to higher expected return through some use of leverage instead of smoothing the ride by lowering portfolio volatility. Even at the same portfolio volatility, the ride may be mildly smoother since higher expected returns should cushion drawdowns, and more balanced risk sources often imply more balanced outcomes across different macroeconomic environments. But the main tradeoff is between the concentrated risk exposure in the conventional equity-dominated portfolio, and the more diversified exposure to many return sources in an approach that involves embedded leverage and shorting to give a bigger role for market-neutral strategies. Any unconstrained mean-variance optimizer will favor portfolios with higher Sharpe ratios and thus the latter choice, even if, in practice, leverage or conventionality constraints keep many investors away from the efficient frontier. Investors who do not tolerate any embedded leverage may still consider Portfolio 1 which provides exposure to historically-rewarded systematic tilts, but does not improve risk diversification as much.

Here we leave aside the question of the shape of the glidepath in our proposal: that is, we do not examine how investors should use the diversifying return sources (alternative risk premia and risk parity, with their embedded leverage) over their life cycles. One possibility would be to combine a typical Target Date Fund structure, where the allocations typically shift from stocks to bonds as the saver ages (in this case using style tilted stocks and bonds), with a constant allocation to risk parity and alternative risk premia strategies. Better risk diversification could be especially important when retirement is approaching and the savings pot is large. In fact, one could propose increasing allocations to risk parity and alternative risk premia with age, but the flipside of better risk diversification is greater use of embedded leverage. While we believe that tools like leverage and shorting are intelligent ways to improve retirement portfolio risk-adjusted returns, whether to use them at all and whether to use them more at a later age must depend on investors' beliefs, preferences, and constraints. In practice, investor sophistication and familiarity with the pros and cons of leverage matter.

Other Paths to a 5 Percent Solution

To augment returns today, many DC plans elect more traditional sources of alpha, most frequently in the form of traditional, discretionary stock pickers who select securities they judgmentally believe will outperform a selected benchmark. Systematic managers seek to achieve the same goal by applying publicly-known factors (style tilts and alternative risk premia), more proprietary alpha signals, or some combination of the two. Though we are not impartial observers on this topic, the systematic approach has attracted increasing institutional investor interest, reflecting some disappointment in the performance and relatively higher fees of traditional active management.

For investors willing to relax the leverage and shorting constraints but in a more limited way than required in full market-neutral strategies, relaxed constraint strategies like 130/30 may be an attractive approach. These allow active managers more flexibility to implement their views by taking larger positions in attractive securities and short selling securities that are unattractive, while maintaining a market beta of one. An additional element that may make these types of strategies appealing to DC portfolios is that they are most frequently benchmarked to the same, or largely similar, indices already being used for DC portfolios. Taking even more conventional risk is another possibility. Given our assumptions, the traditional way to achieve 5 percent real return with passive indices would require an all-equity portfolio throughout the lifecycle: a permanently high and flat glidepath in Target Date Fund jargon. But a meaningful equity market drawdown could then trigger even more ill-timed capitulations than seen in 2008 when investors near retirement held close to 50/50 portfolios.

An additional source of return worth investigating by DC plan sponsors is the illiquidity premium, which is often accessed by institutional investors through private equity investments. Private equity returns mainly reflect a combination of equity premia and illiquidity premia (and hopefully some manager alpha), so they may help boost the returns of a DC portfolio. Yet, unlike risk parity and alternative risk premia strategies, there is limited diversification benefit, especially when returns are adjusted for smoothing. Further, the need for daily pricing and daily liquidity makes implementation challenging within a DC plan.

Who Should Do This?

A logical final question to address is: which investors may be interested in these proposed approaches, acknowledging that they do not have unlimited capacity? It is safe to say that, while these strategies are transparent and well documented they are not easily understood by the layperson. These strategies are probably most appropriate for institutional DC plans with experience in underwriting complex investments, access and skill to identify the most competent managers, and scale to negotiate appropriate terms including fees.

Conclusion

In a world of low expected returns and inadequate savings, generating sufficient post-retirement income is difficult. DC plan sponsors have taken steps in recent years to boost saving levels, yet saving rates have remained stubbornly stable. And with greater longevity and lower expected market returns, it is unlikely that these changes will be sufficient to fund a secure retirement. Accordingly, it is logical to look for ways to enhance portfolio return.

By taking advantage of decades of experience and theory it appears that expected returns can be boosted to cover participants' post-retirement needs. Doing so may not require increasing total portfolio risk but it does require taking more intelligent risk and relaxing self-imposed constraints. Thus we have shown that the prudent use of leverage, derivatives, and shorting can lead to portfolios that may deliver the required rate of 5 percent real return, without increasing the expected volatility of the portfolio. Further, this portfolio is more diversified across various systematic return sources, which may lead to more consistent performance across different economic environments and therefore better enable the investor to weather tough times.

References

AQR Capital Management (2016). 'Alternative Thinking: Style Investing in Fixed Income,' AQR White Paper. Greenwich, CT: AQR.

Asness C., D. Kabiller, and M. Mendelson (2010). 'Using Derivatives and Leverage to Improve Portfolio Performance,' Investors Archive, *Institutional Investor.* May 13: http://www.institutionalinvestor.com/Article/2486929/Investors-Archive/Using-Derivatives-and-Leverage-To-Improve-Portfolio-Performance.html#.WYtB9-mQyUk

Asness C., A. Ilmanen, R. Israel, and T. Moskowitz (2015). 'Investing with Style,' *Journal of Investment Management*, (13)1: 27-63.

Blanchett, D., M. Finke, and W. Pfau (2017). 'Low Returns and Optimal Retirement Savings,' in R. Clark, R. Maurer, and O. S. Mitchell (eds), *How Persistent Low Returns Will Shape Saving and Retirement*. Oxford, UK: Oxford University Press, pp. xxx-xxx.

Dhillon J., A. Ilmanen, and J. Liew (2016). 'Balancing on the Life Cycle: Target Date Funds Need Better Diversification,' *Journal of Portfolio Management*. 42(4): 12-27.

Frazzini A., R. Israel, T. Moskowitz, and R. Novy-Marx (2013). 'A New Core Equity Paradigm,' AQR Capital Management White Paper. Greenwich, CT: AQR Capital Management.

Hurst B., B. Johnson, and Y. Ooi (2010). 'Understanding Risk Parity.' AQR Capital Management White Paper. Greenwich, CT: AQR Capital Management.

Ilmanen A., D. Kabiller, L. Siegel, and R. Sullivan (2017). 'Defined Contribution Retirement Plans Should Look and Feel More Like Defined Benefit Plans,' *Journal of Portfolio Management*, 43(2): 61-76.

Ilmanen, A., T. Maloney, and A. Ross (2014). 'Exploring Macroeconomic Sensitivities.' *Journal of Portfolio Management*, 40(3): 87-99.

Ilmanen A., M. Rauseo, and L. Truax (2016). 'How Much Should DC Savers Worry about Expected Returns?' *Journal of Retirement*, 4(2): 44-53.

Morningstar (2017). 2017 *Target Date Landscape*. Chicago, IL: Morningstar. https://corporate1.morningstar.com/ResearchLibrary/article/803362/2017-target-date-fund-landscape/

Moskowitz T., Y. Ooi, and L. Pedersen (2012). 'Time Series Momentum,' *Journal of Financial Economics*, 104(2): 228-250.

Vanguard (2016). *How America Saves 2016, Vanguard 2015 Defined Contribution Plan Data*. Malvern, PA: Vanguard. https://pressroom.vanguard.com/nonindexed/HAS2016_Final.pdf

Wurtzel M. (2015). 'From Academia to Plan Design.' *Pensions and Investments*, October 19: http://www.pionline.com/article/20151019/PRINT/151019912/from-academia-to-plan-design.

Zhou, G. (2010). 'How Much Stock Return Predictably Can We Expect from an Asset Pricing Model?' *Economic Letters*, 108(2010), 184-186.

Notes

Notes

Notes

www.aqr.com

AQR Capital Management, LLC Two Greenwich Plaza, Greenwich, CT 06830 **P** +1.203.742.3600 **F** +1.203.742.3100