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USING DEFINED MATURITY BOND FUNDS AND QLACs TO BETTER MANAGE RETIREMENT RISKS

A Whitepaper for Franklin Templeton and MetLife by

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Abstract

Few defined contribution (DC) investment solutions exist that help retirees better envision how much they can plan to spend in retirement as well as provide a more efficient solution for turning a nest egg into a stream of income for retirement. In multiple simulations, we find that the combined use of a series of defined maturity bond funds that provide a payout in a specific year and a qualifying longevity annuity contract (QLAC) that provides guaranteed income starting later in life increases the likelihood that a participant will be able to fund a spending goal late in life. We also find that there is little tradeoff in terms of expected legacy to heirs from purchasing a $125,000 QLAC because late-life income from the annuity allows a retiree to draw less from their investments once payments commence, thereby potentially leaving more money to their heirs. Finally, our results don't fully capture the positive benefit from the QLAC because the retiree will maintain this lifetime income even in the scenarios when they deplete their investment assets.

Introduction

More employees are reaching traditional retirement age with a nest egg accumulated within a defined contribution (DC) savings plan. Unlike a traditional defined benefit (DB) pension, investment options offered to plan participants generally do not provide a pathway to spending in retirement. It is important that plan sponsors consider whether DC investments can help participants most efficiently turn their savings into retirement income.

Investment management practices that are more efficient in the accumulation period may be less appropriate and less efficient in the retirement income phase. Simply investing in a diversified portfolio of stocks and bonds does not help workers plan how they might withdraw assets in order to maintain a desired lifestyle in retirement, nor does it help to ensure that workers' savings will not be depleted prematurely. Additionally, this traditional asset allocation exposes participants to unnecessary sequencing of returns risk, which creates further uncertainty for participants trying to create and implement a sustainable retirement income plan. In the retirement phase, an ideal investment would focus on spending rather than growing assets.

In this article, we explain and test an investment solution – and an insurance solution – both of which were created to provide more efficient retirement spending. Defined maturity bond funds used to support spending early in retirement, combined with qualifying longevity annuity contracts (QLACs), allow plan sponsors to offer employees a DC plan option that is tailored to address a worker's post-retirement investment and income protection needs. We find that the combination of defined maturity bond funds, QLACs, and a conventional total-return diversified investment portfolio, is more effective at helping retirees meet spending goals and manage retirement risks than a conventional investments-only portfolio. By broadening the range of offerings within qualified retirement plans, plan sponsors can give plan participants better tools to help them achieve successful retirement outcomes.

A series of defined maturity bond funds that "payout" the investment principal at specific future dates can be a useful tool for participants. By holding bonds to maturity, an investor reduces the risk that they will need to sell shares of their bond fund at a loss to fund near-term spending, if interest rates rise. As long as a proper rule is used to extend the ladder of payout funds as retirement progresses, this may neutralize the sequence of returns risk for early retirement expenditures, allowing other investment assets to grow and support longer-term retirement expenses.

Deferred income annuities are insurance products generally backed by bonds held in an insurance company's general account. The concept of pooling allows an insurance company to transfer resources from retirees who need to fund fewer years of spending in retirement to retirees who live much longer than average life expectancy. Through longevity risk pooling, workers can set aside less of the bond portion of their retirement portfolio in order to fund the same expected income later in life. Deferred income annuities can also help reduce the fear and worry that many have about outliving their assets in retirement, as well as simplifying a retirement spending plan.

Although retirees are quite fond of the idea of lifetime income provided by Social Security and defined-benefit pensions, they have been hesitant to see a large lump-sum of assets leave their investment portfolio as a premium for lifetime income. Academics view the lack of income annuity use as a puzzle, since the higher and safer income offered by annuities can provide a powerful boost to retirement spending. Annuities that begin making payments later in life, also known as longevity annuities, give workers a higher future income per dollar invested in an annuity premium because the income commences later in life and can be spread among fewer living retirees for a shorter period of time. The ability to obtain this longevity protection at a lower cost may be appealing to plan participants because it allows them to avoid the risk that a long life and poor investment returns will severely impact their lifestyle in old age.

In 2014, The U.S. Department of the Treasury established a new rule permitting the use of QLACs within employer-sponsored DC plans. The purpose of the new QLAC rule is to encourage greater use of deferred income annuities by retirees to help them more effectively insure against the risk of outliving assets. MetLife was the first insurer to offer an institutional QLAC and, to the best of our knowledge, remains the only company offering this type of product for DC plan sponsors and their participants.

Before the QLAC rule, a worker could purchase a deferred income annuity that began providing income later in life (for example at age 80 or 85) within an IRA, but would need to pay shadow required minimum distributions (RMDs) from the annuity that begin at age 70½. Although this was technically a fair method of taxation, few were interested in a financial product that provides future income but is taxed in the present. The QLAC rule exempts certain deferred income annuity purchases up to $125,000 (or up to 25 percent of the account balance) from RMDs. Instead of fair taxation, the QLAC rule provides a tax subsidy that further increases the efficiency of annuitizing income later in life.

Defined Maturity Bond Funds as a Time Segmentation Strategy

A systematic withdrawal strategy uses a rule to take distributions from an investment portfolio. Spending may come from both the income generated by the portfolio and the spenddown of principal. The conventional asset mix includes stocks, bonds, and cash. The bond portion of a retirement portfolio is typically held in a bond mutual fund that seeks to maintain a constant duration, usually in line with the fund's stated benchmark. The longer the bond fund duration, the greater price sensitivity to changes in interest rates.

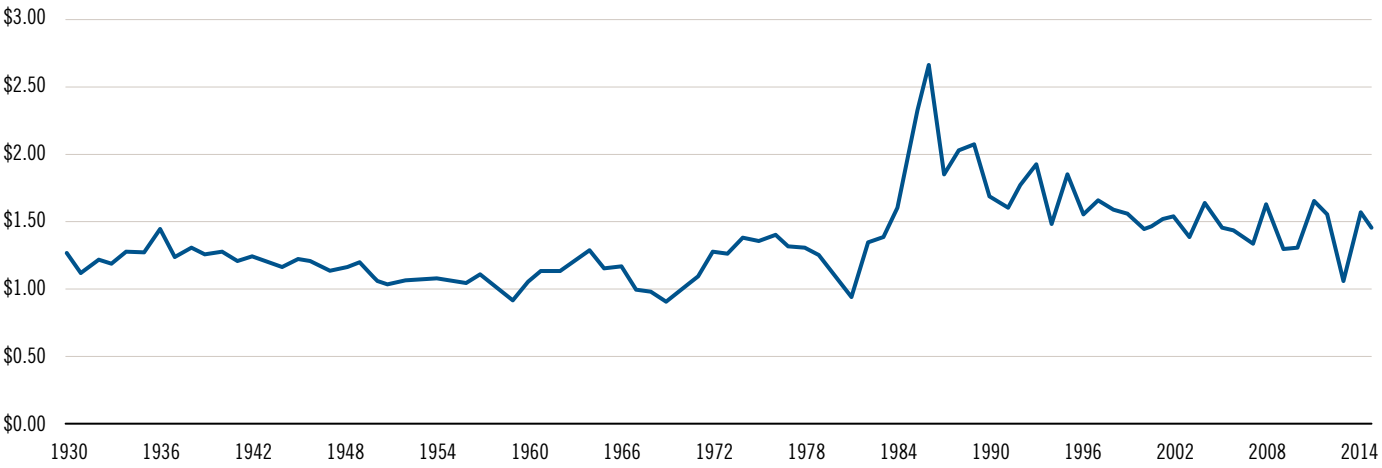
Traditionally, the purpose of bond funds within a total returns portfolio is to reduce the overall volatility of the portfolio. But bond funds are still volatile and subject to capital losses if interest rates rise. Constant duration bond mutual funds still fluctuate in value, except to a lesser degree than stocks. Though these bond funds provide flexibility and some upside growth potential they are more complex for retirees to understand in terms of their role in asset allocation, they are less precise in their ability to fund retirement expenses, and they leave a retiree exposed to interest rate risk.

Retirement can be viewed as a series of future time periods, for example 1-5 years, 6-10 years, 11-20 years, and so on. Time segmentation differs from systematic withdrawals in that fixed-income assets may be held to maturity to better match projected assets needed to support upcoming retiree expenses over the short- and medium-term. A growth portfolio with more volatile assets that has a higher expected return may be held to cover expenses in the more distant future. At its core, time segmentation simply involves investing differently for retirement spending goals falling at different points in retirement. Fixed income assets with greater security are generally reserved for earlier retirement expenses, and higher volatility investments with greater growth potential are employed to support later retirement expenses.

Although bond investments provide less risk than equities, most bond investments do not necessarily provide an adequate amount of retirement income certainty. An investor at age 60 may invest in a bond fund for spending in retirement at age 65. If they place $50,000 in the fund, how much will they have to spend in 5 years?

Figure 1 shows the historical variation in the value of $1 invested in relatively safer, long-term U.S. government bonds over a 5-year time horizon. In the above example, the investor who places $50,000 in bonds could have as little as $44,880 in 5 years, or as much $133,037. Although the annual volatility of the bond is lower than it would be from investing in equities, the investor nonetheless faces significant uncertainty regarding how much they will be able to spend from their investment in U.S. government bonds in the future. Most investors, especially those close to or in retirement, prefer greater certainty with their bond investments than a typical bond fund can provide.

Figure 1: Value of $1 Invested for 5 Years in U.S. Long-Term Government Treasury Bonds



One way to provide future income certainty is through a bond that has a fixed dollar payout in the future. A simple illustration of this would be accomplished through the use of what is known as a zero coupon bond that returns principal to an investor at a defined future date. For example, an investor might invest $750 today in a bond that matures in 5 years and pays $1,000 at maturity. Although the value of the bond may fluctuate between now and the maturity date, the investor will always receive the same $1,000 at maturity. Investing in a succession of zero coupon bonds (or any bonds held to maturity) that fund each year of spending in retirement is also known as bond laddering.

For participants in a DC plan, investing in a well-diversified and professionally managed portfolio of zero coupon bonds that are assembled to mature at a defined future date has not been possible. The most common fixed income strategy available to DC participants have been constant duration funds, which as described previously, impacts the fund's sensitivity to interest rates over time, but do not provide the same certainty that workers value when estimating how their defined contribution savings will translate into future income.

However, an exception is a series of defined maturity bond funds, which can be used to combine the precision of using individual bonds to support retirement spending goals with the ease of a mutual fund. These funds are designed to provide interest while also returning principal to shareholders at maturity. Rather than the constant-duration approach of typical bond funds, the duration and interest rate risk in the defined maturity bond fund declines as the maturity date approaches, because all of the bond holdings mature in the same year. When held to maturity, these funds can help provide the cash flows that their investors are expecting to receive.

A series of defined maturity bond funds can provide a new way to implement time segmentation strategies using mutual funds with a diversified collection of bonds maturing in the same year, rather than relying only on individual bonds to support each year's expenses. This makes time segmentation strategies much more user-friendly and practical for assets held inside qualified plans. Diversification also allows for the ability to include higher-yielding corporate bonds with greater credit risk, without jeopardizing retirement income in the same way that would happen with a default on a single bond meant to support a year's worth of spending power in retirement. This allows bonds to generate predictable cash flows in near-term time horizons, while stocks and constant duration bond funds provide less predictability but more growth potential.

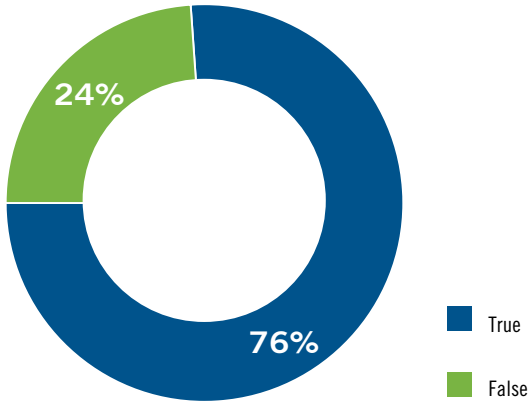
Behavioral Benefits for Time Segmentation

Participants in a DC plan have less income certainty than participants in a traditional DB pension. Put simply, it isn't easy to understand how savings translates into retirement income. This lack of income certainty can affect whether an employee feels comfortable that they have saved enough for retirement. Retirees are unsure how much they can withdraw each year without risking financial ruin late in retirement.

Among workers, income certainty is valued more than investment performance by better than a three to one margin (Figure 2). Despite the value, most workers place on income certainty within a retirement portfolio, few retirement fund strategies have been constructed to provide workers with a more precise estimate of how much they can safely spend each year.

Figure 2: When thinking about retirement income, income certainty is more important than the performance of my investment portfolio.

Income Certainty More Important Than Performance



Source: 2015 Texas Tech University Retirement Income Survey

Time segmentation can be more intuitive because it is easier for people to understand that certain assets are to be used for different time horizons in retirement. Bonds provide a specific level of spending in the near term, while a volatile portfolio funds a desired spending level later in retirement. Adding bonds with a defined maturity provide payouts that help support fixed levels of spending each year to give retirees an even greater certainty than low-risk bonds held within a conventional bond mutual fund. Separating assets held within a portfolio to fit time-segmented spending goals is simple and clear for a participant to understand.

Time Segmentation and Sequence of Returns Risk

The market value of any bond will fluctuate over time with changing interest rates. For defined maturity bonds funds, these price fluctuations that occur before maturity are immaterial to the success of a retirement spending plan. At maturity, these bond funds will pay the principal, and earlier unrealized gains or losses have no impact on how many dollars the retiree can actually spend. Investors financing a retirement goal can happily ignore the fluctuating value of their individual bonds knowing that the desired cash flows will be provided from the return of principal at maturity. When laddered bonds are held to maturity, cash flows are known and there is no realized interest-rate risk. In fact, rising interest rates could even reduce annual IRS RMDs amounts for bonds in tax-deferred accounts if market values fall, without affecting income received at maturity.

The concept of duration implies an investor is essentially made whole after a rate increase once a time period matching the fund's duration has passed. This is because that investor is able to re-invest coupon payments at higher interest rates to offset

the capital losses on bonds. However, that conclusion assumes the portfolio is not funding a spending goal. If those coupons are being used for spending and, if a greater number of shares of the bond fund are sold at a now lower price to cover this spending amount, then the bond portfolio will not be able to recover through its ability to reinvest cash flows at a new higher interest rate. Portfolio returns would need to be even higher to offset the loss in ability to fully reinvest funds at higher rates.

The risk of duration matching in an increasing interest rate environment using conventional constant-duration bond funds makes their use much more difficult in practice for household investors. With the proper implementation of a rule about when to sell other investment assets to extend the bond ladder, time segmentation does provide a practical way for retirees to duration-match their spending goals and to reduce their exposure to sequence risk.

Choosing How to Extend the Ladder over Time

In terms of deciding when to extend the ladder of defined maturity bond funds upon maturity of a rung in the "ladder" within a time segmentation strategy, Pfau (2017) investigates three different methods. These include (1) Automatic, (2) Market-Based, and (3) Personalized. Automatic rolling ladders keep the same time horizon perpetually by automatically rolling out the ladder length each year as the fund matures to keep the ladder length the same on an ongoing basis. Market-based rules for extending the ladder could be based on triggers such as positive stock growth, high stock market valuations, or high interest rates. The ladder is extended only when a trigger that suggests a change in expected market return is met.

Finally, personalized rules can be based on a "glide path" for retirement wealth. The glide path helps to determine if the portfolio is on target to meeting the retirement goal. First, a retiree determines an end goal for the portfolio in terms of how long the portfolio should last, as well as how much spending it should support. These numbers are combined with the current portfolio value to determine a portfolio return assumption that will allow the end goal for the portfolio to be met as the necessary distributions are taken. This information is combined to determine a glide path for the value of remaining wealth throughout retirement, showing the wealth needed to remain precisely on track to meet the spending and portfolio end value goals. The glide path compares (in dollar terms) where the portfolio is and where it should be in order to be on track. When actual wealth exceeds the glide path value, the ladder of defined maturity bond funds can be extended further. But the ladder is not extended during years that wealth falls below the glide path. An investor instead hopes for growth assets to recover and get back above the glide path before extending the ladder. When falling behind, the ladder could be spent down completely with the intention that the more aggressive diversified portfolio will have greater potential to obtain upside growth and get the retirement plan back on track.

For these options, Pfau (2017) concluded that this personalized approach with a glide path was the most effective as compared to a total returns investment portfolio. This will be the time segmentation strategy used here with a ladder of defined maturity bond funds.

Impact of Longevity Risk

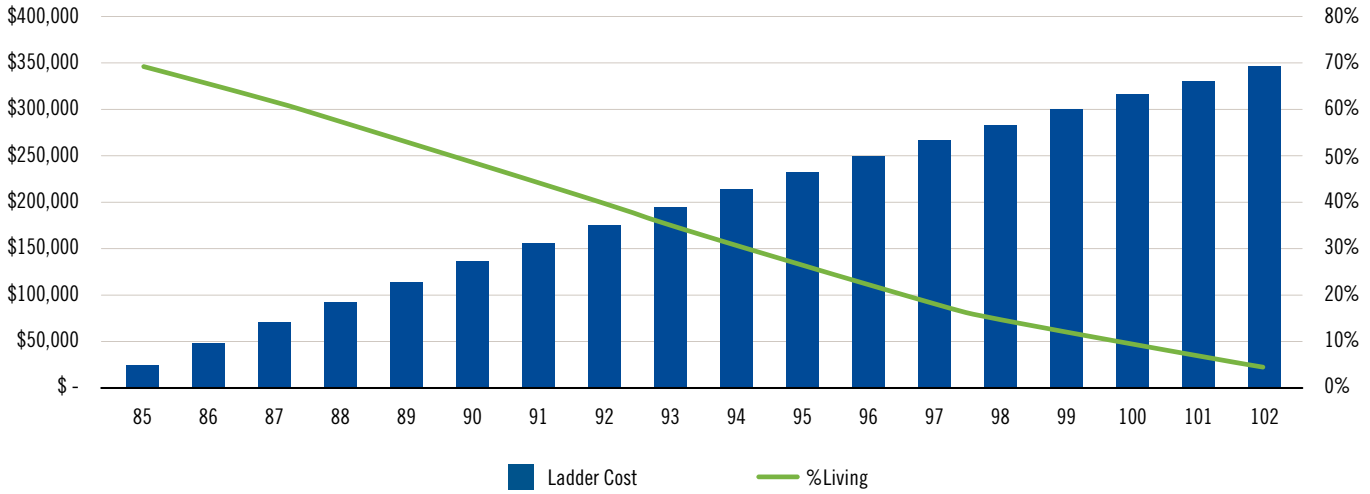
One potential disadvantage of using conventional investments to fund income in retirement is the simple fact that none of us knows exactly how long we will live. If 100 retirees each build a bond ladder to the median longevity, 50 will have enough money to fund spending over their lifetime and 50 will outlive their assets. It is unlikely that retirees are willing to take that kind of risk to fund their retirement.

Should a retiree build a bond ladder to an age at which they only have a 5% chance of being alive? Actually doing so creates two problems. First, the capital required to fund a long-term bond ladder will be significant, potentially resulting in lower average spending per year in retirement. Second, the retiree still cannot know if she will be one of the 5% who live a very long time and, as a result, possibly outlive her assets. This risk of funding a very expensive retirement that arises when a retiree lives well beyond expected longevity is known as longevity risk. All retirees with an uncertain lifespan face longevity risk.

Figure 3 shows just how much it would cost today to build a ladder of bonds that will mature at various ages late in life to provide income. The figure also shows the probability that a 65-year old female will still be living at that age according to the 2012 Society of Actuaries Individual Mortality Table. A retiree will first need to pick the age at which they can accept running out of money, and then invest in a ladder of bonds that will provide income up to that age. For example, at today's (September 2017) bond rates it would cost about $300,000 to fund safe income up to age 99. Despite the significant expense, 10 out of 100 healthy women will still live beyond age 99.

Figure 3: Cost today of funding $41,040 of spending to a given age through a bond ladder

Cost of funding $41,040/year at age 85

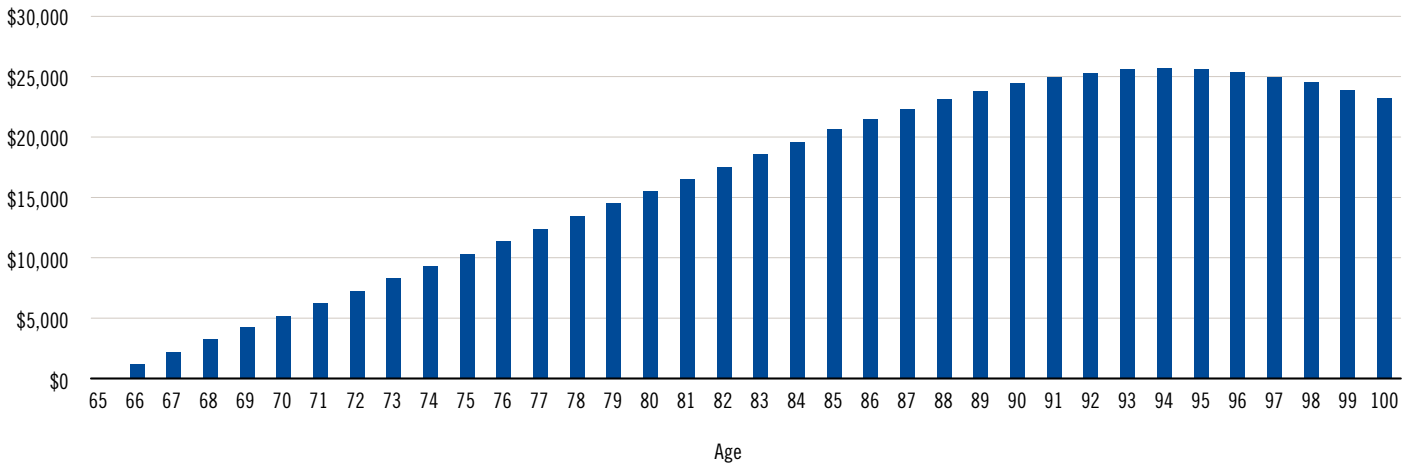


What if, instead of building a bond ladder to an advanced age, the 100 female retirees in the previous example had instead pooled their money together to fund spending late in life? If they live a long time, their longevity risk will be completely hedged and they will continue to receive income from the pool. If they die early in retirement, their money stays in the pool to fund retirees who live a long time. By pooling their assets, however, retirees will receive guaranteed monthly (or annual) income for as long as they are still living, and all will need to set aside less today in order buy this income. In fact, it will cost $125,000 for a 65-year old woman to fund a late-life annuity that begins paying approximately $41,000 per year for life at age 85 instead of $300,000 to fund spending to an age where she has a 10% chance of survival. This example demonstrates the value of income annuities as a retirement income strategy.

Figure 4 shows the difference in price between funding later-life income through individual bonds versus the mortality-weighted cost of funding income through pooling of risk for a 65-year old male. Since a certain percentage of retirees will die each year, and this percentage increases at older ages, it becomes less expensive to buy income in years when fewer retirees are alive. This reduction in the cost of buying a dollar of income later in life is referred to as the mortality premium. Unlike a risk premium on stocks, the mortality premium is guaranteed and is available to all retirees who pool assets in order to receive a higher amount of annual spending per dollar invested.

Figure 4: Difference in cost today of funding $100,000 income from bond ladder compared to an income annuity

Annual Annuitization Benefit



Longevity Annuities as a Retirement Income Strategy

The financial product that allows retirees to pool their assets so that they can more efficiently buy later-life income is known as longevity insurance. It is a type of deferred income annuity (DIA) because income does not immediately commence after the annuity is purchased. With longevity insurance, retirees typically purchase the product at the point of retirement but defer taking the income benefit until age 80 or 85. The longer the retiree waits, the less the retiree will pay today per dollar of future income.

Economists have long called for the government to encourage annuitization among DC participants in order to maximize the amount they can safely spend each year and avoid the risk of outliving assets. A 2014 final regulation from the Treasury Department on Qualified Longevity Annuity Contracts (QLACs) allows retirees to defer taxation triggered by RMDs until up to age 85 when the annuities are purchased with qualified retirement dollars. The advent of QLACs means that the infrequently-used longevity insurance DIA, which MetLife introduced in 2004, has developed even greater potential to be used inside qualified plans to support late-in-life retirement spending goals. Like the rarely-used target date fund that was embraced by financial economists prior to its widespread acceptance as an investment default, the adoption of QLACs by plan sponsors could give participants access to a tool that could significantly improve their retirement security.

QLACs are an effective tool for managing market and longevity risk. Retirees may worry about outliving their assets, which can happen if market returns are poor during retirement and the retiree lives well beyond life expectancy. The income from a QLAC helps alleviate these concerns when they are most likely to materialize in late retirement. Longevity insurance DIAs also provide a form of "cognitive decline insurance," which highlights the reality that individuals will face increasing difficulties in managing their portfolios and making withdrawal decisions as they approach their 80s and 90s, without necessarily being aware that they are experiencing cognitive decline. A QLAC provides a predetermined plan to help manage household finances automatically when clients may be most vulnerable.

Finally, rather than having to worry about potentially living for 30 or 40 years into retirement, a QLAC can help to effectively cap the planning horizon. If the income from the QLAC begins 20 years from the point of retirement, then the retiree needs only to develop a plan for the remaining assets to last 20 years until QLAC income commences, rather than 30 or 40 years. This approach can help to increase the overall efficiency of a retirement plan in terms of being able to support more spending while also preserving assets for liquidity and bequest.

Maximizing Retirement Income: Combining Defined Maturity Bond Funds and QLACs

Analysis Methodology

We consider a new retiree at age 65 with $500,000 in a DC plan who is seeking to fund a $20,000 spending goal with a 2% cost-of-living adjustment throughout her retirement from this portion of her assets. This aligns with a common shorthand rule-of-thumb about sustainable retirement spending from a conventional investment portfolio with stocks and constant-duration bond funds. As a baseline, the retiree in this example displays a notable degree of risk aversion and is comfortable holding a 30/70 portfolio of stocks and constant-duration bond funds, which is typical for retirement allocations within target date funds commonly used within qualified plans. These investments are rebalanced annually to this targeted asset allocation and no investment fees are deducted from the portfolio.

Another option for the retiree is to fund front-retirement expenses using defined maturity bonds funds. As an example, using an interest rate of 2.11%, which represents the yield for a basket of investment grade corporate bonds and treasuries maturing in five years as of September 2017, the first five years of retirement expenses ($20,000 per year with the 2% annual COLA) requires 19.8% of the retirement date assets to cover the first five years of retirement expenses. When using this strategy, the allocation for the defined maturity bond fund is taken entirely from the bond portion of the conventional investment portfolio. Not counting the payout fund portion, the remaining investment portfolio now has a 37.4% stock allocation. As retirement progresses, the amount of assets required within the defined maturity bond funds to meet upcoming retirement expenses will vary, but we do assume that the conventional investment portfolio portion of the assets will remain permanently at a stock allocation of 37.4%. The overall stock allocation will vary over retirement depending on the relative size and performance of the investment portfolio and on the amount of assets held by the fund.

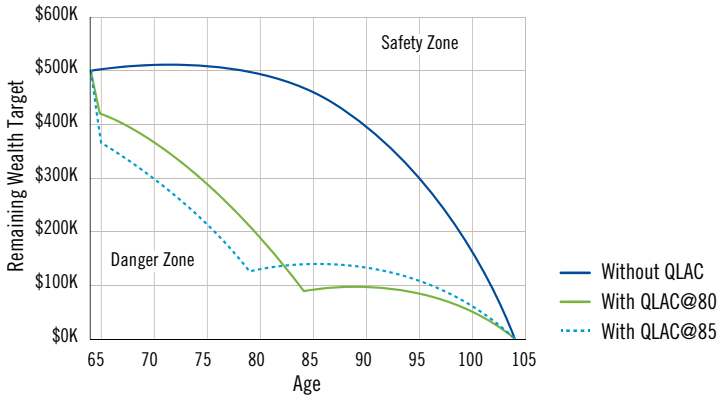
The explanation thus far is for the beginning of retirement. Over time as the funds reach their maturity and provide back the interest and principal to the retiree to cover the year's retirement expenses, the ladder of the defined maturity bond series must be extended. As discussed earlier, the personalized strategy based

on a retirement wealth glide path will be used to determine the threshold for when to extend the ladder. Whenever remaining wealth is above the glide path threshold for that age, the ladder of the bond series is extended to include a full five years of payouts. When remaining wealth falls below the threshold for that age, the ladder is not extended and will be gradually spent down. Should wealth subsequently exceed the glide path again, the ladder will be built back out to the full five years for as long as sufficient assets remain in the investment portfolio to achieve this. Once the conventional investment portfolio depletes, any rungs left in the ladder will continue to be spent down until all investment assets are fully depleted.

Figure 5 provides the glide path for remaining retirement wealth as based on three different scenarios with regard to whether a life-only fixed QLAC is also used as part of the plan. With a QLAC, the investment portfolio only needs to maintain enough assets to cover the portion of the retirement spending goal not covered by QLAC income. The $500,000 initial wealth must cover 40 years of retirement expenses starting at $20,000 with a 2% COLA. Wealth is allowed to be depleted at the end of 40 years. The figure tracks the path of required wealth needed within the conventional investment portfolio and defined maturity bond funds to meet the retirement spending goal assuming that the portfolio earns a fixed annual investment return that makes the goal achievable. Having wealth above the glide path represents a potential safety zone and the bond fund ladder can be extended, while retirement is in more dangerous territory whenever wealth falls below its glide path value and the ladder is not extended to help avoid the need to sell portfolio assets at a loss.

Figure 5: Glide paths for Sustainable Retirement Spending to Support an initial $20,000 Spending Goal with a 2% COLA from an initial $500,000 Retirement Date Asset Portfolio

QLAC Characteristics: Purchased at age 65; Life-Only, No Cost-of-Living Adjustment



The next retirement income tool available in this qualified plan is the QLAC. Table 1 provides details about the QLAC options used in this study. There are two options for QLACs related to their start age (80 or 85), and whether there is an annual cost-of-living adjustment on income payments (0% or 2%). Initial QLAC payout rates are higher (1) when income starts at older ages such as age 85 because income payments can be expected for a shorter period of time and (2) when there is no cost-of-living adjustment applied to the payments. Table 1 provides the payout rates for four different combinations of these options using numbers provided by MetLife in September 2017 for qualified plans using unisex life tables.

Table 1: AC Options for a 65-Year-Old (Using Unisex Life Tables)

Retirement Spending Goal: $20,000 with a 2% COLA from a $500,000 Retirement Date Asset Portfolio

Age Income Starts	Cost-of-Living Adjustment (COLA)	Payout Rate	Overall Spending Goal When Income Starts	QLAC Premium to Meet Spending Goal	Adjusted QLAC Premium: 25% of Qualified Account up to $125,000 Allowed	QLAC Allocation
80	0%	21.60%	$26,917	$124,617	$124,617	24.92%
85	0%	42.36%	$29,719	$70,158	$70,158	14.0%
80	2%	19.20%	$26,917	$140,195	$125,000	25.0%
85	2%	38.76%	$29,719	$76,674	$76,674	15.3%

Source: QLAC payout rates were provided by MetLife in September 2017.

The idea for incorporating the QLAC into the retirement income plan is to target as much of the spending goal as possible for the period after the QLAC begins paying income. With the 2% cost-of-living adjustment desired, the spending target is $26,917 at age 80 and $29,718 at age 85. Dividing these targets by the payout rates provides the amount of QLAC premium needed to meet the spending goal. A life-only QLAC with no cost-of-living adjustment only meets the spending goal at age 80 or 85, and then portfolio distributions will subsequently be needed to fill in for subsequent cost-of-living adjustments. The QLAC with the 2% COLA fully hedges longevity risk for the remainder of the lifetime after QLAC income begins. Finally, we must apply limits when the desired QLAC premiums exceed the allowable levels, which represent 25% of the qualified plan assets up to a maximum limit of $125,000. This constraint on the premium is binding for the QLAC with a 2% COLA starting at 85. In these two cases, although longevity risk is hedged, retirement spending is not fully hedged and the portfolio will still be needed to make up the difference. The final column of table 1 shows the QLAC premium needed as a percentage of retirement date qualified assets. This will be the portion allocated to the QLAC. It will be taken from the bond portion of the investment portfolio, which will, in the same manner described for the defined maturity bond funds, permanently increase the fixed asset allocation for the remaining investment assets. The longer the deferral period, the lower the percentage of assets to be allocated to the QLAC at the point of retirement.

Table 2 shows how all of these allocations work in practice at the start of retirement for different combinations and options of QLACs and defined maturity bond funds. The retiree always maintains 30% of the retirement date assets in stocks, which will alter the asset allocation for the remaining conventional investment portfolio when defined maturity bond funds and QLACs are used. At the extreme, adding these funds and a QLAC starting at 80 with a 2% COLA will increase the stock allocation for the remaining investment assets to 54.3% for the remainder of retirement. This asset allocation stays fixed and is justified because the funds and QLACs are both either bonds or bond-like assets with insurance protection (in the case of the QLAC) that raise the risk capacity of the retiree.

Table 2: Overall Product Allocations and Asset Allocations for Different Retirement Income Strategies

		OVERALL ASSET ALLOCATION				ASSET ALLOCATION WITHIN TOTAL	
		Total Return Portfolio		Defined Maturity Bond Funds	QLAC	Returns Portfolio	
		Stocks	Bonds			Stocks	Bonds
	QLAC: LIFE-ONLY, NO COST-OF-LIVING ADJUSTMENT						
1	**Total Returns Portfolio**	30.0%	70.0%	0%	0%	30.0%	70.0%
2	**Defined Maturity Bond + Portfolio**	30.0%	50.2%	19.8%	0%	37.4%	62.6%
3	**QLAC@80 + Portfolio**	30.0%	45.1%	0%	24.9%	40.0%	60.0%
4	**QLAC@85 + Portfolio**	30.0%	56.0%	0%	14.0%	34.9%	65.1%
5	**Defined Maturity Bond + QLAC@80 + Portfolio**	30.0%	25.3%	19.8%	24.9%	54.3%	45.7%
6	**Defined Maturity Bond + QLAC@85 + Portfolio**	30.0%	36.2%	19.8%	14.0%	45.3%	54.7%
	QLAC: LIFE-ONLY, 2% ANNUAL COST-OF-LIVING ADJUSTMENT						
1	**Total Returns Portfolio**	30.0%	70.0%	0%	0%	30.0%	70.0%
2	**Defined Maturity Bond + Portfolio**	30.0%	50.2%	19.8%	0%	37.4%	62.6%
3	**QLAC@80 + Portfolio**	30.0%	45.0%	0%	25.0%	40.0%	60.0%
4	**QLAC@85 + Portfolio**	30.0%	54.7%	0%	15.3%	35.4%	64.6%
5	**Defined Maturity Bond + QLAC@80 + Portfolio**	30.0%	25.2%	19.8%	25.0%	54.3%	45.7%
6	**Defined Maturity Bond + QLAC@85 + Portfolio**	30.0%	34.9%	19.8%	15.3%	46.2%	53.8%

We simulate portfolio returns using 10,000 Monte Carlo simulations for up to a 40-year retirement period, for bond yields, equity premiums, home prices, short-term interest rates, and inflation.[1] The details for the underlying market simulations are provided in Appendix A. These simulations reflect the lower bond yields available to retirees today, but they do include a mechanism for interest rates to gradually increase over time (on average) and approach historical norms. The simulations begin with a 2.11% initial bond yield (representing the yield in September 2017 for a 2023 defined maturity bond fund) and assume a flat yield curve. While we allow interest rates to fluctuate randomly over time, we do simplify by assuming a flat yield curve. Bond returns are calculated from the simulated interest rates and their changes, and stock returns are calculated by adding a simulated equity premium on top of the simulated (variable-and-rising) interest rates. Strategies are simulated with annual data, assume withdrawals are made at the start of each year, and use annual rebalancing to restore the targeted asset allocation. **Taxes are not part of this analysis.**

Analysis Results

We now consider results for a 65-year-old plan participant reaching retirement with $500,000 saved in the DC plan who is seeking to fund a $20,000 spending goal with a 2% cost-of-living adjustment during retirement from these assets. We consider six different retirement income strategies: use only a conventional total returns investment portfolio with constant-duration bond funds, add the five-year ladder of defined maturity bond funds for the start of retirement with the intention of extending based on where assets are relative to the glide path, use a QLAC for retirement expenses starting at age 80, use a QLAC for retirement expenses starting at age 85, and also combine the five-year payout fund ladder with each these two types of QLACs. For the baseline results described here, the QLAC option is life-only and does not offer a COLA. Appendix B provides figures that also show the outcomes for QLACs with 2% COLAs.

Figure 6 shows the probabilities of success over time for each strategy for up to 40 years from age 65 through 104. This outcome measure only has limited applicability for strategies that include lifetime income guarantees, and so it serves only as a starting point. The probability of success shows the percentage of cases in which assets remain in the investment portfolio. However, the impact of asset depletion is different in each scenario. When a QLAC is not part of the retirement strategy, all income stops once the investment portfolio and defined maturity bond funds deplete. With the QLAC, income from a portion of spending continues for life, providing at least for a partial ability to continue meeting spending goals in retirement. This ensures that the retiree will never completely deplete their assets.

For the first two strategies that do not include a QLAC, success rates plummet in later retirement as the 4% rule is not sustainable when interest rates are low as retirement begins. Nonetheless, the use of defined maturity bond funds does provide an edge over relying only on a total return investment portfolio. The relatively greater success achieved when incorporating defined maturity bond funds can be attributed to a combination of three factors:

1) Because overall asset allocation is allowed to fluctuate as the relative size of the total return investment portfolio and the ladder of defined maturity bond funds fluctuates, a time segmentation approach will have a varying asset allocation path as opposed to a total return investing approach. This asset allocation path can lean more aggressive, providing greater upside potential. Retirees must be aware of and understand this point.

2) The personalized glide path approach for extending the ladder of defined maturity bond funds introduces a degree of effort in attempting to avoid selling stocks at inopportune times.

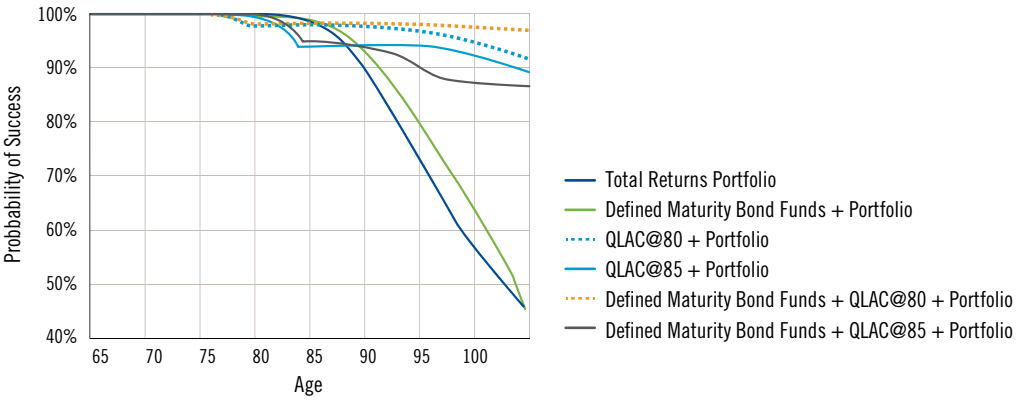
3) By holding these funds to their targeted maturity, the underlying bonds are held to their maturity, and bonds do not need to be sold at a loss to support retirement spending.

Meanwhile, the inclusion of QLACs substantially improves probability of success rates over the long-term. In the short-term, failure (i.e., depleting all investment assets) can potentially happen sooner because the removal of assets for the QLAC premium raises the required distribution rate from the remaining assets to meet the spending goal. But once QLAC income begins, success rates are able to hold much more steadily because the vast majority of spending is subsequently supported by the QLAC. Failure for the remaining assets can still happen because the investment assets must support the difference between the QLAC income and the overall spending goal (unless COLA protection is selected, the QLAC does not have a COLA while the spending goal does), but the rate of failure slows dramatically. The highest probabilities of success for retirement security are supported with the combination of defined maturity bond funds and the QLAC with income from age 80, in addition to the conventional investment portfolio.

1. Though simulations for short-term interest rates and home prices are included in the modeling to provide for a more complete economic framework, they are not used in this article.

Figure 6: Probability of Success for Different Retirement Income Strategies to Support an initial $20,000 Spending Goal with a 2% COLA from an initial $500,000 Retirement Date Asset Portfolio

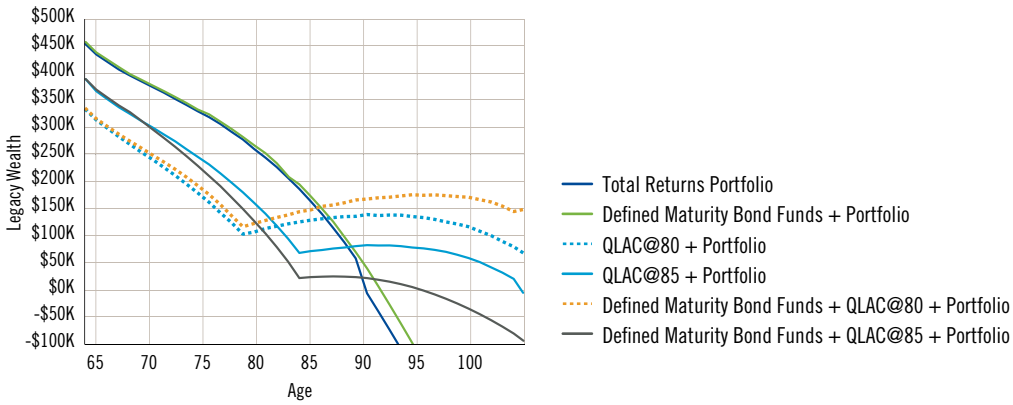
QLAC Characteristics: Life-Only, No Cost-of-Living Adjustment



Because of the limitations for success rates to account for partial income from the annuity when failure for the investments happens, Figure 7 shows the path of legacy wealth at the 10th percentile unlucky end of the distribution of outcomes. Legacy wealth is defined as the remaining investment portfolio balance (conventional portfolio plus defined maturity bond funds). When remaining wealth falls below zero, it means that cumulative shortfalls are tracked relative to the spending goal as a better means for understanding the potential magnitude of failure. Shortfalls will not grow as quickly for strategies with a QLAC because of its partial funding of retirement expenses with the provision of guaranteed monthly income. Legacy wealth is shown for the 10th percentile of the distribution, which corresponds to a 90% chance for success in the previous figure. Again, the inclusion of defined maturity bond funds supports slightly greater wealth preservation and extends the portfolio sustainability by about two years from 89 to 91. Meanwhile, including a life-only QLAC does result in less legacy wealth earlier in retirement, because a portion of the retirement date asset portfolio is used to purchase the QLAC. However, when the QLAC income begins and supports a significant portion of retirement expenses, distribution needs from the portfolio reduce dramatically. This helps to extend portfolio longevity and helps to make sure that a legacy is possible even with a long-life relative to an investments-only strategy. Late in retirement, much of the spending is met by the mortality credits offered through the QLAC (the subsidies from those who did not live as long), which is a unique source of guaranteed income not available to an investment portfolio. The most effective strategy for preserving wealth at the 10th percentile after age 86 is to combine the conventional investment portfolio with the ladder of defined maturity bond funds and the QLAC with income beginning at age 80.

Figure 7: 10th Percentile Legacy Wealth for Different Retirement Income Strategies to Support an initial $20,000 Spending Goal with a 2% COLA from an initial $500,000 Retirement Date Asset Portfolio

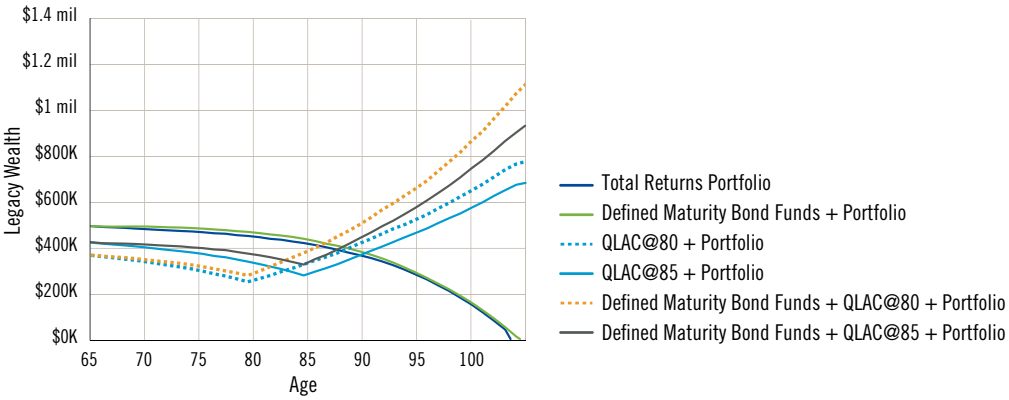
QLAC Characteristics: Life-Only, No Cost-of-Living Adjustment



Finally, Figure 8 illustrates the results at the median retirement outcome. Again, a defined maturity bond fund provides an edge over only using a conventional investment portfolio, and at the median, both strategies are able to maintain portfolio longevity past age 100. Later in retirement, again, the larger legacy is increasingly provided by the strategy that includes a QLAC with its lifetime income guarantee. This results from the lower distribution needs later in retirement and the more aggressive asset allocation for the remaining investment portfolio. The strategy which works best, again, is the combination of defined maturity bond funds and the QLAC at 80 with the conventional investment portfolio. The defined maturity bond funds help to manage sequence of returns risk, which in turn improves the odds that the risk premium from the stock market will be realized and investment growth does occur.

Figure 8: Median Legacy Wealth for Different Retirement Income Strategies to Support an initial $20,000 Spending Goal with a 2% COLA from an initial $500,000 Retirement Date Asset Portfolio

QLAC Characteristics: Life-Only, No Cost-of-Living Adjustment



Conclusions

Few DC investment solutions exist that help retirees better envision how much they can safely spend in retirement as well as provide a more efficient solution for turning a nest egg into guaranteed retirement income.

In multiple simulations, we find that the combined use of a bond fund that provides a defined payout and a QLAC decreases the risk that a participant will not be able to fund a spending goal late in life. We also find that there is little tradeoff in terms of expected legacy for heirs from purchasing a $125,000 QLAC because late-life income from the annuity allows a retiree to draw less from their investments once payments commence. Finally, our results don't fully capture the positive benefit from the QLAC because the retiree will maintain this lifetime income even in the scenarios when they deplete their investment assets.

Further Reading

Huxley, Stephen J., and J. Brent Burns. 2004. Asset Dedication: How to Grow Wealthy with the Next Generation of Asset Allocation. New York City: McGraw-Hill.

Pfau, Wade. 2017. "Is Time Segmentation a Superior Investing Strategy for Retirement?" Presentation at the Academy of Financial Services Annual Conference (October 1).

Appendix A: Capital Market Expectations

The capital market expectations in this article connect the historical averages from Robert Shiller's dataset (*http://www.econ.yale.edu/~shiller/data.htm*) together with the current market values for inflation and interest rates. This approach makes allowance for the fact that interest rates and inflation are currently far from their historical averages, but it also respects these averages and does not force returns to remain low for the entire simulated time horizon.

Table A1: Summary Statistics for U.S. Returns and Inflation Data, 1890-2016

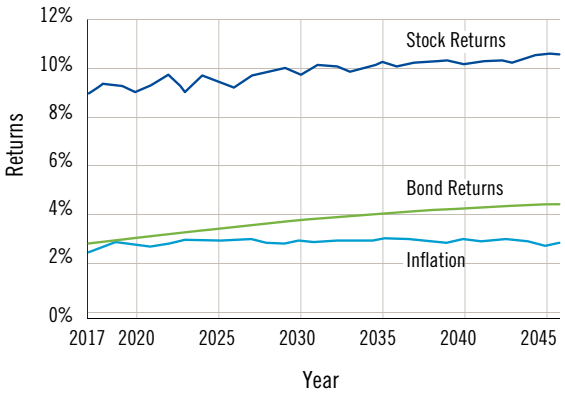
						CORRELATION COEFFICIENTS				
	Arithmetic Means	Geometric Means	Standard Deviations	Stocks Returns	Risk Premium	Bond Yields	Bond Returns	Home Prices	Bills	Inflation
Stock Returns	10.7%	9.2%	18.1%	1	0.99	0.05	0.06	0.15	-0.09	0.06
Risk Premium	6.1%	4.5%	18.2%	0.99	1	–0.09	–0.01	0.13	-0.2	0.03
Bond Yields	4.6%	—	2.4%	0.05	-0.09	1	0.52	0.13	0.85	0.22
Bond Returns	4.8%	4.6%	6.6%	0.06	-0.01	0.52	1	-0.06	0.33	-0.09
Home Prices	3.4%	3.2%	7.1%	0.15	0.13	0.13	-0.06	1	0.05	0.39
Bills	4.4%	—	3.0%	-0.09	-0.2	0.85	0.33	0.05	1	0.15
Inflation	2.9%	2.8%	5.3%	0.06	0.03	0.22	-0.09	0.39	0.15	1

Source: Data from Robert Shiller's webpage. The U.S. S&P 500 index represents the stock market, 10-year Treasuries represent the bond index, the Case-Shiller home price index for homes, 6-month Treasuries for bills, and the Consumer Price Index for inflation.

Table A1 provides summary statistics for the historical data, which guides the Monte Carlo simulations for investment returns. A Cholesky decomposition is performed on a matrix of the normalized values for the risk premium, bond yields, home prices, bills and inflation. A Monte Carlo simulation is then used to create error terms for these variables, which preserve their contemporaneous correlations with one another. Then the variables are simulated with these errors using models that preserve key characteristics about serial correlation.

Inflation is modeled as a first order autoregressive process starting from 1.7% inflation in 2016 and trending toward its historical average over time with its historical volatility. Bond yields are similarly modeled with a first order auto regression with an initial seed value of 2.11%. This represents the yield to maturity for a sample defined maturity bond fund as collected on September 27, 2017. Next, home prices and the risk premium are both modeled as random walks around their historical averages and with their historical volatilities. Bond returns are calculated from bond yields and changes in interest rates, assuming a bond mutual fund with equal holdings of past 10-year Treasury issues. Stock returns are calculated as the sum of bond yields and the equity premium over yields. Figure A1 shows the medians for the key variables.

Figure A1: Medians of Simulated Outcomes for Inflation, Bonds, and Stocks



Appendix B: Figures Providing Results for Different QLAC Options

Figure B1: Probability of Success for Different Retirement Income Strategies To Support an initial $20,000 Spending Goal with a 2% COLA from an initial $500,000 Retirement Date Asset Portfolio

QLAC Characteristics: Life-Only, 2% Annual Cost-of-Living Adjustment

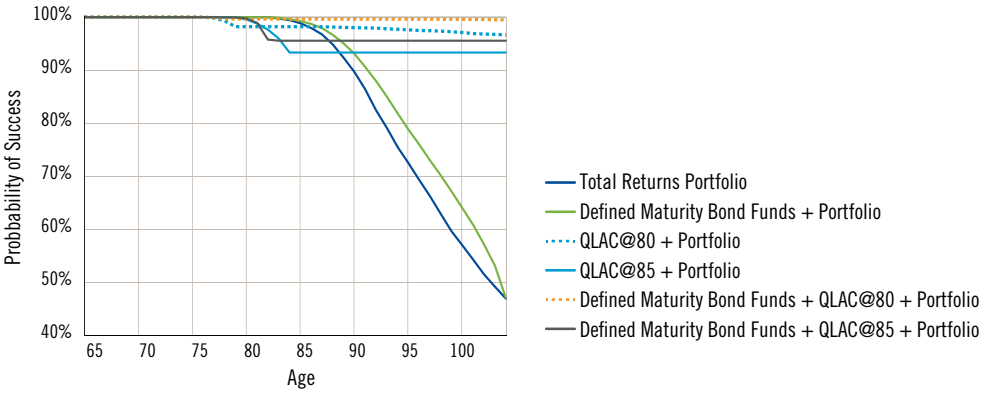


Figure B2: 10th Percentile Legacy Wealth for Different Retirement Income Strategies To Support an initial $20,000 Spending Goal with a 2% COLA from an initial $500,000 Retirement Date Asset Portfolio

QLAC Characteristics: Life-Only, 2% Annual Cost-of-Living Adjustment

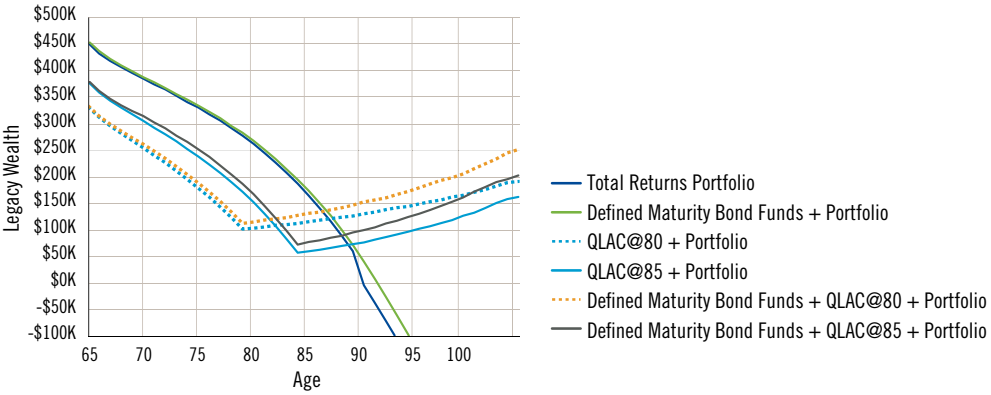
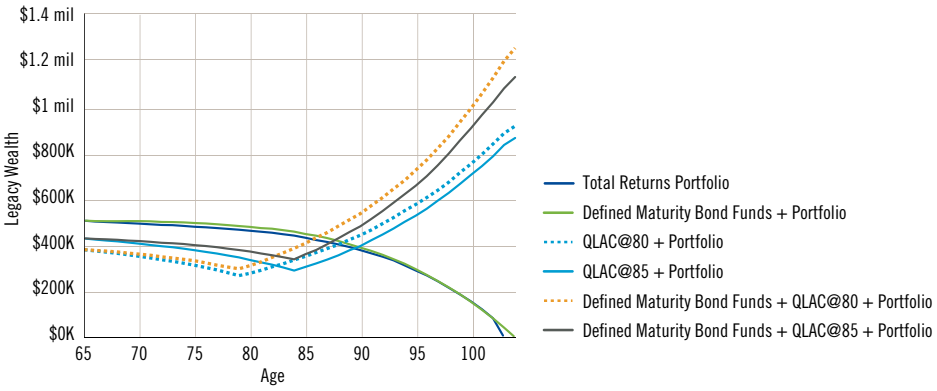


Figure B3: Median Legacy Wealth for Different Retirement Income Strategies To Support an initial $20,000 Spending Goal with a 2% COLA from an initial $500,000 Retirement Date Asset Portfolio

QLAC Characteristics: Life-Only, 2% Annual Cost-of-Living Adjustment



IMPORTANT INFORMATION ABOUT MONTE CARLO SIMULATIONS

Monte Carlo Simulations

Monte Carlo simulations model future uncertainty. In contrast to tools generating average outcomes, Monte Carlo analyses produce outcomes based on probability—thus incorporating future uncertainty. Each Monte Carlo simulation generates a randomized scenario consistent with the projected characteristics of the asset classes using our assumptions. The projections can be used to help an investor to understand the probability of various allocation strategies and withdrawal rates sustaining assets throughout the specified time period (simulation survival rates).

Material Assumptions

- Underlying long-term rates of return for each asset class are not directly based on historical returns. Rather, they represent assumptions that take into account, among other things, historical total returns, which may include our estimates for reinvested dividends and capital gains. See APPENDIX A for underlying market details.
- These assumptions, as well as an assumed degree of fluctuation of returns around these long-term rates, are used to generate random monthly returns for each asset class over the specified time period.
- The monthly returns are then used to generate 100,000 simulations, representing a spectrum of possible return outcomes for the modeled asset classes. The projections are directly based on these simulations.

Key Limitations

- It is important to note that these projections are estimates only, are not predictions, and should be viewed as approximations, and they do not guarantee or predict any particular investment result. There can be no assurance that the assumptions and the return model will accurately estimate asset class return ranges going forward or that the simulation survival rates will be achieved or sustained. Actual results will vary and may be better or worse than the probabilities indicated, which only present a range of possible outcomes based on the simulations and assumptions. Consequently, investors should allow a margin for error and not place undue reliance on the apparent precision of the projections. It may also be prudent for an investor to be more conservative with the withdrawal rates, especially early in retirement, given the unpredictable nature of market performance.
- This type of Monte Carlo simulations also assumes that the distribution of returns is normal. A normal distribution means that returns are concentrated near the average (arithmetic mean) and decrease in frequency as the distance from the average increases. Should actual returns not follow this pattern, results may vary significantly.
- The simulations do not take into account taxes on withdrawals, nor early withdrawal penalties or required minimum distributions.
- The projections are based on a limited collection of asset classes. Other investments or asset classes not considered may have characteristics similar or superior to those being analyzed, may provide different returns or outcomes, and may be more appropriate for one's individual situation.
- Some asset classes may have relatively short histories. Actual long-term results for each asset class going forward may differ from our assumptions—with those for asset classes with limited histories potentially diverging more.
- Market crises can cause asset classes to perform similarly, lowering the accuracy of our return assumptions and diminishing the benefits of diversification (that is, of using many different asset classes) in ways not captured by the simulations. As a result, returns actually experienced by investors may be more volatile than those assumed in the simulations.
- Results also may significantly vary over time and each time the simulations are run. Periods of significant market volatility, which may occur more often than assumed in the simulations, may increase the chances that actual results will differ, possibly significantly, from the examples provided.
- The simulations do not take into consideration fluctuations in correlations among asset class returns over the short term.
- Inflation is assumed constant, so variations are not reflected in the simulations.
- The simulations model asset classes, not investment product. As a result, the actual experience of an investor in a given investment product (e.g., a mutual fund) may differ from the range generated by the simulations, even if the broad asset allocation of the investment product is similar to the one being modeled. Possible reasons for divergence include, but are not limited to, active management by the manager of the investment product, or the costs, fees, and other expenses associated with the investment product. Active management for any particular investment product – the selection of a portfolio of individual securities that differs from the broad asset classes modeled in the simulations – can lead to the investment product having higher or lower returns than the range in the simulations.
- Indexes are unmanaged, include reinvestment of dividends and, as they are unmanaged, do not include any fees and expenses. A mutual fund, or other managed account, will include investment management fees and other expenses, which will reduce returns. One cannot invest directly in an index.

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