Allocating to a Deferred Income Annuity in a Defined Contribution Plan

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Introduction

General acceptance of annuities among individuals has been limited despite a growing body of research noting their potential benefits. Recently, deferred income annuities, or DIAs, also referred to as longevity insurance, have received increased attention from defined contribution plan sponsors, providers, participants, and the federal government. DIAs are designed to provide guaranteed income for life, but unlike immediate annuities, the benefit payments for DIAs do not begin until a later date.

On July 1, 2014, the Treasury released regulations clarifying how to appropriately use DIAs in a DC plan (by creating qualified longevity annuity contracts or QLACs) and on October 24, 2014 the Treasury issued additional guidance on how DIAs can be included in target-date funds. This increased availability of DIAs presents both an opportunity and challenge to DC plan sponsors, providers, and participants, given the operational and fiduciary complexities associated with including annuities inside a DC plan.

This research paper will cover a variety of topics related to the use of DIAs in a DC plan. First, general information about DIAs will be provided. Next, recent guidance from the Treasury on the use of DIAs and potential fiduciary considerations with using annuities in DC plans will be summarized. Finally, general information about the potential benefits of annuities will be discussed and a model to determine the optimal allocation to a DIA in a DC setting is introduced, both for an individual participant as well as within a target-date fund.

There are a variety of important issues that DC plan sponsors and participants need to be aware of with respect to DIAs. First, unisex pricing creates a potential implicit cost for males who purchase a DIA in a DC plan because males generally receive lower relative payments than if an individual policy were to be purchased outside the DC plan; however, this cost may be able to be minimized by purchasing contracts with younger income start dates (e.g., age 65 instead of 85) and by adding benefits such as a return-of-premium and cash refund features. Costs may be further mitigated by the institutional pricing of DIA contracts in the DC space. Although a younger income start age and the inclusion of return-of-premium features reduces the amount of guaranteed income by approximately 10% (and the potential benefit noted from an academic perspective), including these features may improve acceptance by eliminating a behavioral hurdle to utilizing DIAs.

In order to determine the optimal DIA allocation an analysis is conducted. While the average optimal allocation to DIAs was 30.52% of the total portfolio across the 78,732 scenarios considered, there were significant differences in the optimal DIA allocation that varied by scenario. Attributes associated with higher allocations to DIAs include being younger, having an earlier income start date, having less existing guaranteed income, being less funded for retirement, higher benefit payouts, higher income shortfall risk preference, lower bequest preference, longer subjective life expectancy, more conservative asset allocations, and being female. These differences are important within the context of a DC plan, especially if DIAs are going to be used in a target-date setting, given the systematic similarities and differences that are likely to exist across DC plan participants.

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Deferred Income Annuities

Annuities have existed in various forms for thousands of years (Poterba 2001). For example, Romans sold financial instruments called "annua" that returned a fixed yearly payment, either for life or a specified period, in return for a lump sum payment. Over time, annuities have increased in complexity to meet the varying needs of retires. Deferred income annuities, or DIAs, also referred to as longevity insurance, have received increased attention recently from DC plan sponsors, providers, participants, and the government. DIAs are designed to provide guaranteed income for life, but unlike immediate annuities, the benefit payments for DIAs do not begin until some later date.

DIAs, in theory, offer a more efficient hedge against longevity risk than other types of annuities, such as immediate annuities, since the cost of the insurance is lower. For example, an immediate annuity provides immediate income for life, yet many individuals interested in annuities want them to hedge against the potential risk of outliving their savings. Because DIAs allow individuals to hedge this specific risk (often referred to as longevity risk), they can generally provide guarantees at lower effective costs when compared to immediate annuities.

Milevsky (2005) was one of the first to note the potential benefit of DIAs, which he referred to as an Advanced Life Deferred Annuity. Additional research by Pfau (2013) suggests that DIAs result in better retirement outcomes when compared to immediate annuities because they offer more liquidity and the same longevity protection at less cost. Blanchett (2014) notes that while immediate annuities may be slightly more attractive today than DIAs given current prices, DIAs may offer significant promise as an efficient form of guaranteed income, especially given the relatively low cost for the longevity hedge when compared to immediate annuities.

Table 1 provides some perspective on the potential income available from a DIA at different ages, based on quotes obtained from CANNEX on October 26, 2014. The values in Table 1 are the payout rates available from purchasing a DIA for males and females based on different purchase ages and different income start dates (assuming a $100,000 initial purchase amount for Illinois residents). For example, based on the information in Figure 1, a 55-year-old male who purchases a DIA with income scheduled to start at age 75 would receive a 24.88% payout rate. This means for every $100,000 used to purchase the DIA, the individual would receive $24,880 per year, for each year he survives past age 75.

Two different sets of quotes are provided in Table 1: the first set is for a straight life annuity (i.e., payouts are received only if the individual lives to the income start age and then for only as long as the individual lives past the income start age); and the second set includes both return-of-premium, or ROP, and cash refund features. If a DIA has an ROP, the premium will be returned if the annuitant dies during the deferral period (i.e., before benefits commence), and a cash refund assumes that the annuitant at least receives total payments equivalent to the premiums paid (even after the income starts).

Table 1: Payout Rates as a Percentage of Purchase Amount for Various Ages

Straight Life

	Income Starts at Age 65		Income Starts at Age 75		Income Starts at Age 85	
Age	Male	Female	Male	Female	Male	Female
50	13.41%	12.21%	29.34%	25.62%	93.49%	75.93%
55	10.64%	9.95%	24.88%	21.62%	83.45%	63.20%
60	8.44%	7.95%	20.45%	17.80%	73.44%	55.06%
65	6.72%	6.32%	16.38%	14.38%	61.43%	46.05%

Return-of-Premium and Cash Refund

	Income Starts at Age 65		Income Starts at Age 75		Income Starts at Age 85	
Age	Male	Female	Male	Female	Male	Female
50	11.94%	11.49%	25.66%	23.44%	75.32%	61.81%
55	9.73%	9.43%	21.34%	19.62%	64.83%	53.33%
60	7.62%	7.48%	17.01%	15.85%	53.58%	44.60%
65	5.85%	5.62%	13.38%	12.65%	42.06%	35.76%

Source: CANNEX

The longer the duration between the purchase age and the income start age the higher the respective payout. For example, the largest payouts are for DIAs purchased at age 50 where the income starts at age 85, while the smallest payouts are for the DIAs purchased at age 65 that start at age 65 (which are effectively immediate annuities).

An important benefit to consider when purchasing a DIA before the income start age is the implied rate of return. For example, the implied rate of return for buying a DIA at age 50 that annuitizes at age 65 is approximately 4.7%. An immediate annuity at age 65 costs roughly half what a DIA would cost at age 50 (with payout rates of 6.72% and 13.41%, respectively). An investment would have to achieve an annual rate of return of approximately 4.5% to double over a 15-year period, therefore the implied return from purchasing a DIA at age 50 with income starting at age 65 is 4.7%. The potential benefit for purchasing a DIA decreases to approximately 3.1% if purchased at age 55 and to approximately 1.5% if purchased at age 60, again both assuming an income start age of 65. This creates an incentive to having a longer delay period, similar to the higher yields than can be earned from buying longer duration bonds.

The author is not aware of any providers that currently offer an inflation-linked benefit rider (e.g., to CPI-U) to the income before the income start date. While there are inflation-linked cost-of-living adjustments once the benefit commences, this subjects the annuitant to a reasonable degree of inflation risk if the period between the purchase age and income start date is long. One potential way to mitigate this effect would be to purchase additional income, beyond what is necessary today, by trying to estimate what inflation may be over the period (e.g., the Cleveland Fed currently expects inflation to average 2.0% annually over the next 20 years). Additionally, although there are providers that offer inflation-linked COLAs after the income starts, this is a relatively expensive feature, and an annuitant may be better served with a rider that provides a fixed annual benefit increase (e.g., 2% per year) than have it explicitly tied to inflation.

The final regulations on the treatment of DIAs in DC plans were issued by the United States Department of the Treasury and the Internal Revenue Service, or IRS, on July 1, 2014. Prior to the final regulations, there was concern over using DIAs in a DC plan due to the required minimum distribution (RMD) rules. The concern was if a DIA had an income start date after 70 ½ it would run afoul of the RMD rule, which requires some minimum distribution to be withdrawn from qualified accounts annually following the year an individual turns 70 ½. The academic literature on DIAs has generally focused on them as more pure longevity risk hedge, with an income start age generally at age 80 or later.

A DIA that meets the rules set forth in the Treasury Department's guidance is what's known as a qualifying longevity annuity contract, or QLAC. In order to be a QLAC the insurance contract must meet a variety of provisions. It must have no cash value and required payments must begin no later than age 85. The QLAC must provide fixed payouts (e.g., the benefits cannot be variable or equity-linked); however there may be a cost-of-living adjustment (e.g., an inflation COLA). The final regulations also allow for return-of-premium death benefits, both before and after the annuity starting date, so long as the death benefits are distributed no later than the end of the calendar year following the year in which the employee dies, or in which the surviving spouse dies, whichever is applicable. It is also possible to have a joint spousal benefit with a QLAC. The QLAC can be purchased with up to 25% of total pre-tax assets, up to $125,000. Once the income start date begins, the QLAC income automatically meets any RMD requirements.

At the time of this writing, the author is not aware of any QLAC contracts available for purchase, although there likely will be companies with products available in the first quarter of 2015. There are still a number of questions DIA providers have that were not answered with the final regulations in July. It is unknown how the pricing of QLACs will compare to generic DIAs or how many DC plan sponsors/administrators will embrace them. Though the law now allows them, it does not require DC plans to offer QLACs to participants as an option.

On October 24, 2014, the Treasury Department provided guidance for retirement plan sponsors on how deferred income annuities can be included in target-date funds (Notice 2014-66). The notice contains information on a special rule where, if certain conditions are satisfied, a series of target-date funds in a DC plan will be treated as a single right or feature for the purposes of nondiscrimination requirements of § 401(a)(4)[1] of the Internal Revenue Code. Previously, questions regarding the use of DIAs had arisen because older participants, who are more likely

[1] Section 401(a)(4) provides in general that a plan is a qualified plan only if the contributions or the benefits provided under the plan do not discriminate in favor of highly compensated employees.

to hold DIAs, may disproportionately consist of highly compensated employees, which could run afoul of nondiscrimination requirements.

In order to qualify, the target-date strategy must be designed to serve as a single, integrated investment program under which the same investment manager overseas each target-date fund and applies the same generally accepted investment theories across the series. The deferred annuity contracts must be purchased from an insurance company that is independent from the investment manager. Also, none of the deferred annuities can provide a guaranteed lifetime withdrawal benefit, or GLWB, or guaranteed minimum withdrawal benefit, or GMWB, feature[2]. The target-date funds cannot hold employer securities that are not readily tradable and each target-date fund series must be treated in the same manner with respect to the rights and features of other assets (e.g., the fees and administrative expenses for each target-date fund must be determined in a consistent manner).

Payout rates for DIAs in an employer-sponsored retirement plan must be calculated on a gender-neutral basis. This is because the Supreme Court previously ruled that using gender-based mortality tables would be discriminatory[3]. Unisex pricing is a clear disadvantage to males (and a potential advantage to females) because males tend to have shorter life expectancies and would therefore receive higher benefits if they were to purchase DIAs on their expected mortality (versus a unisex basis inside a DC plan). DIAs purchased in IRAs are not subject to the unisex pricing requirement.

The relative impact of the unisex pricing requirement will differ by the provisions of the DIA. To provide some perspective on the relative potential cost of purchasing a DIA based on unisex rates, an analysis is conducted where the mortality-weighted net present value of a straight life DIA contract is calculated based on different discount rates and expected mortality rates. The analysis assumes the DIA is purchased at age 65 and that income begins at age 85. Mortality rates are based on the Society of Actuaries 2012 Immediate Annuity Mortality table. The results of the calculations are included in Figures 1 and 2.

Unisex payout rates are determined by averaging the payouts from male and female contracts. In reality, the insurance companies that price DIAs in DC plans (i.e., QLACs) are going to be fully aware of the adverse selection issues with respect to unisex pricing (i.e., they are more attractive to females) and will likely tilt the payout rates to be more similar to the female rates than the male rates versus taking a simple average. This effect has been noted by von Gaudecker and Weber (2006), who examined the effect of unisex pricing on single life annuities in Germany. They find that German issuers expected adverse selection issues and priced the contracts closer to the female-only annuities. This led to only a marginal benefit for women, with benefits increasing by 1.2%, while men received benefits that were 7% lower (due to the unisex pricing).

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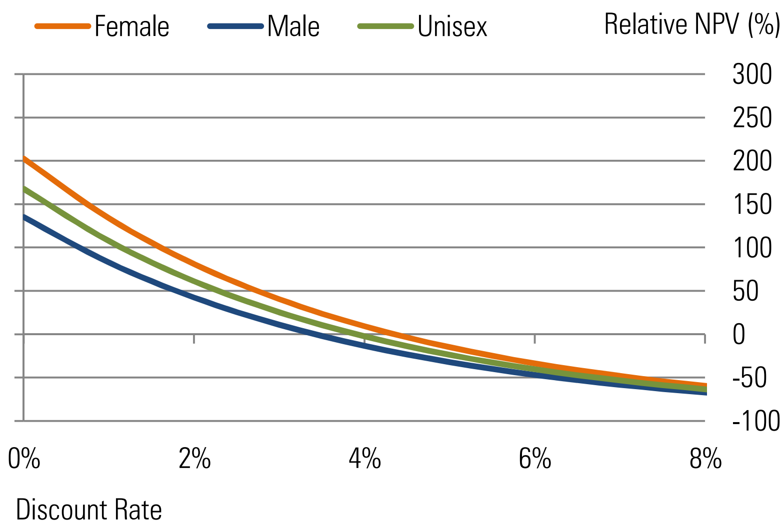
[2] The guidance states that the Treasury and the IRS are considering whether or not to provide guidance related to issues arising from the use of GLWB and GMWB features in DC plans.
[3] Arizona Governing Committee for Tax Deferred Annuity & Deferred Compensation Plans v. Norris, 463 U.S. 1073.

Figure 1: Relative Benefit from Purchasing a DIA, Based on a Unisex Payout, for Varying Discount Rates and Mortality Rates

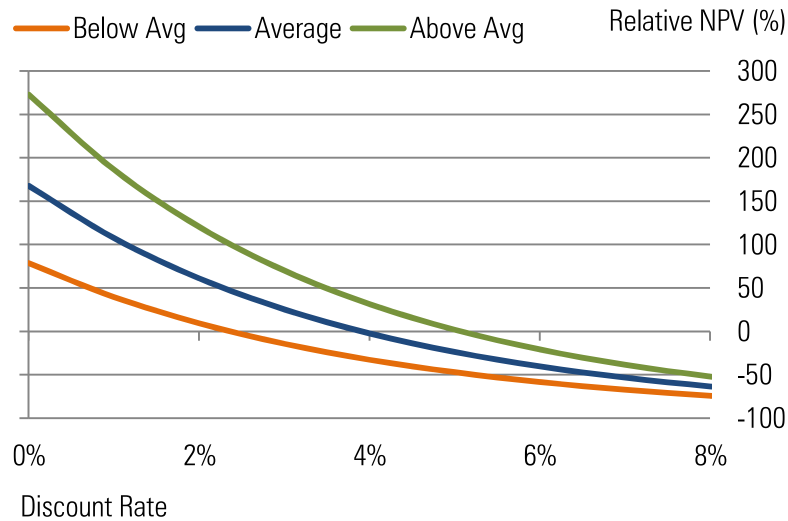


The relative benefit from purchasing a DIA can be positive or negative, depending on the discount rate and expected mortality. The higher the discount rate (i.e., the more the individual could potentially earn if they invested the monies in the market) the lower the relative benefit of purchasing a DIA. The approximate breakeven required nominal return (i.e., the discount rate in the net present value calculation) in Figure 1 is 4.0% (although it is slightly higher for females and slightly lower for males). This implies an investor that expects to earn a compounded rate of return of 4.0% would be indifferent between purchasing a DIA and attempting to generate the income from a portfolio[4].

Subjective life expectancy (i.e., how much longer, or shorter, an individual survives) also has a significant impact on the breakeven rate of return associated with purchasing a DIA. These differences are noted in Figure 2, where the mortality rates are based off unisex mortality, and above and below average subjective life expectancy is estimated by a modal change of either plus or minus three years, respectively.

[4] Note, this does not incorporate any kind of certain-equivalent preferences, which would tilt the potential benefits to the DIAs; this concept will be addressed in greater detail in a future section.

Figure 2: Relative Benefit from Purchasing a DIA, Based on a Unisex Payout, for Varying Discount Rates and Subjective Life Expectancies



When comparing Figure 1 to Figure 2 it should be obvious that a change in subjective life expectancy has a greater impact on the relative net present value than if the individual has average gender-based mortality. The required breakeven return decreases to approximately 2.2% for an individual with below average mortality but increases to approximately 5.0% for an individual with above average mortality. The fact that a retiree can potentially generate more wealth from a DIA versus self-funding retirement *and* have guaranteed income for life has important implications for annuity choice models, since annuities are expected to be wealth reducing, on average (like any other form of insurance that is correctly priced).

The differences in the expected benefits for males and females are also noteworthy, whereby the expected value for males is consistently lower than females. The mortality weighted net present values for females are approximately 17% higher than the unisex values, and the males values are approximately 17% lower than the unisex values. This is due to the fact males have shorter life expectancies than females. The actual payout rate for females is 33.4% less than the payout for males (see Table 1); therefore, pricing a DIA on a unisex basis creates a clear cost for males and clear benefit for females. This is an incredibly important point for plan sponsors, since the introduction of a unisex DIA results in a relatively large differential that could materially negatively affect a large part of the participant population (i.e., males).

One potential strategy to minimize the impact of unisex pricing (i.e., the expected wealth-loss for males) is to focus on those contract-types that have more similar payout yields for males and females. Policies with younger income start dates (e.g., age 65) and those that include features such as return-of-premium and cash refund tend to have similar yields across gender-type. For example, the differential in the payout rate for a male and female contract purchased at age 65 where income starts at age 85 is 33.4% (implying a ~17% cost for males if unisex pricing is the average of the two quotes), while the differential in the payout rate for a male and female contract purchased from ages 50 to 65, where the income start date is age 65 (i.e., at retirement), with return-of-premium and cash refund features is only approximately 3.0% (implying a ~1.5% cost for males).

Including return-of-premium and cash refund features for younger individuals reduces the payment by approximately 10% (as noted in Table 1). However, the mortality weighted net present values are only slightly lower for return-of-premium and cash refund DIAs when compared to straight-life DIAs. Therefore, including DIAs with return-of-premium and cash refund features should minimize the potential impact of unisex pricing. Also, including these features may reduce/eliminate a key behavioral reason some people choose not to purchase an annuity (because they are concerned about dying after the purchase, thereby making the DIA a poor investment from a realized return perspective).

Fiduciary Considerations with Annuities in Defined Contribution Plans

Annuities represent an interesting challenge for plan sponsors from a fiduciary perspective. While the due diligence principles used for selecting and monitoring the investments in the plan's core menu are effectively the same as the principles for selection and monitoring of annuities, there are obviously different issues to consider. For example, while it is readily easy to replace a mutual fund, there can be significant costs associated with exiting an annuity contract, especially if participants have been purchasing the contract for a number of years. According to the Employee Retirement Income Security Act, or ERISA, DC fiduciaries should act for the exclusive purpose of providing benefits to participants and their beneficiaries and to defray reasonable expenses of administering the plan. They must act with "the care, skill, prudence, and diligence under the circumstances then prevailing that a prudent man acting in a like capacity and familiar with such matters would use in the conduct of an enterprise of a like character and with like aims" and must "act in accordance with the documents and instruments governing the plan" (the "prudent man standard of care").

The Department of Labor has issued guidance to plan sponsor fiduciaries with respect to the use of annuities in a DC plan. Interpretive Bulletin 95-1 provided initial guidance for plan sponsors with respect to selecting an annuity provider for the purpose of making defined benefit plan distributions, which was subsequently extended to DC plans (in DOL Advisory Opinion 2002-14A). In response to the Pension Protection Act of 2006, the Department of Labor issued a proposed regulation addressing the selection of annuity providers and issued final regulations (29 C.F.R. §2550) in December of 2008. The final regulation establishes a safe harbor for satisfying the fiduciary duties under the prudent man rule of ERISA for selecting an annuity provider and contract for benefit distributions from an individual account plan.

The selection of an annuity provider in connection with a benefit distribution, or a benefit distribution option made available to participants and beneficiaries under the plan, is governed by the fiduciary standards of section 404(a)(1) of ERISA. Section 404(a)(1)(A) provides that the fiduciary must act for the exclusive purpose of providing benefits to the participants and beneficiaries and defraying reasonable plan administration expenses. The safe harbor does not apply to the selection of the investment options offered in annuity contracts (e.g., the subaccounts in GLWBs). The safe harbor is established if the fiduciary follows these five steps:

1. Engages in an objective, thorough and analytical search for the purpose of identifying and selecting providers from which to purchase annuities;
2. Appropriately considers information sufficient to assess the ability of the annuity provider to make all future payments under the annuity contract;

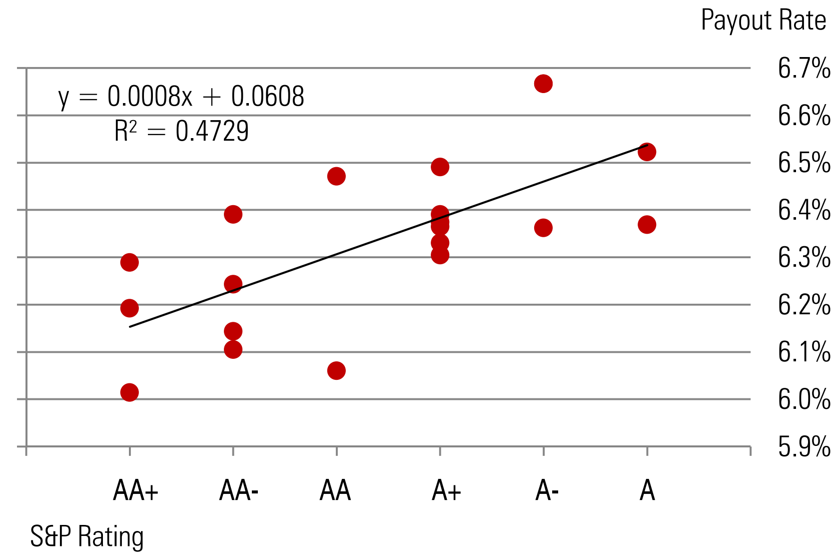
3. Appropriately considers the cost (including fees and commissions) of the annuity contract in relation to the benefits and administrative services to be provided under such contract;
4. Appropriately concludes that, at the time of the selection, the annuity provider is financially able to make all future payments under the annuity contract and the cost of the annuity contract is reasonable in relation to the benefits and services to be provided under the contract; and
5. If necessary, consults with an appropriate expert or experts for purposes of compliance with the provisions of this paragraph.

It is important to note that "prudence" is judged based on information known at the time the decision was made. While hindsight will obviously provide perspective as to whether or not the decision to include annuities was a good one, the best protection for fiduciaries is to engage in a thorough due diligence process that is well documented.

While the final regulation did not provide specific information that a fiduciary should consider when selecting an annuity, the proposed regulation did include some guidance. For example, fiduciaries should consider the annuity provider's experience, financial expertise, level of capital, ratings by insurance rating services, the structure of the annuity contact, as well as any additional protections available through state guaranty association. Insurance company ratings, such as those provided by A.M. Best Co. Inc., Fitch Ratings Inc., Moody's Investor Services, and Standard & Poor's Financial Services LLC, can provide insight as to the company's likely ability to make future payments under the annuity contract.

There is an important relation between the payout rates for annuities and the financial strength of the insurance company. This relation is noted in Figure 3, which includes the payout rates for an immediate annuity for a 65-year-old male (quotes obtained from CANNEX on October 26, 2014) and the respective Standard & Poor's rankings. Companies with lower ratings tend to have higher payout rates. This creates an obvious balancing act for plan sponsors when selecting an annuity for the plan (e.g., a DIA) because the highest yielding may have a higher risk of default.

Figure 3: Immediate Annuity Payout Rates by S&P Rating



Source: CANNEX

The Potential Benefit of Guaranteed Income

There is a significant body of research noting the potential benefits of guaranteed income (i.e., annuities). Early research by Yaari (1965) demonstrated how investors with no bequest motive should significantly invest in annuities based on a model of intertemporal choice with lifetime uncertainty. Other researchers have confirmed Yaari's conclusions, for example Strawczynski (1999) noted that an individual with no utility of bequest will annuitize all of his or her liquid assets in retirement. Even after relaxing the somewhat restrictive assumptions in Yaari's model, Davidoff, Brown, and Diamond (2005) still find potential benefits associated with full annuitization for a large set of individual preferences.

There are also potential behavioral benefits associated with guaranteed income. For example Panis (2003) found that individuals with guaranteed income were more satisfied in retirement than those without. This relation has also been noted by Bender (2004) and Nyce and Quade (2012). In particular, Nyce and Quade note that among retirees with similar wealth and health characteristics, those with annuitized incomes are happiest.

There are a variety of reasons annuities (i.e., guaranteed income) can potentially (or at least theoretically) improve retirement outcomes for individuals. First, an annuity can be used to help hedge against longevity risk, which is the risk associated with outliving one's assets. DIAs provide a potential method to "pensionize" DC plans, something that participants may find increasingly valuable given the shift away from defined benefit plans. Second, annuities represent a method designed to generate more income for life than self-funding retirement through a systematic withdrawal strategy because payments under such strategies are usually based on retirement periods that are significantly longer than the individual's life expectancy to minimize the potential for a lifetime income shortfall. Third, annuities can be relatively simple products that aim to reduce/eliminate potential market risk and reduce potential mismanagement risk of the assets (by either the retiree or a financial advisor) if those monies are not annuitized. Finally, DIAs represent an attractive option for retirement income planning because they change an uncertain planning horizon to a relatively certain period, allowing the retiree to focus on creating a sustainable income stream from a portfolio up until the DIA income start age, whereby he or she can plan on living off the DIA proceeds from that point until death.

When noting the potential benefits of annuities, it's also important to note some concerns. First, common concerns with annuities is irreversibility and illiquidity. In most cases, once annuitized, the decision is irreversible and the annuity is transformed into a relatively illiquid asset. The risks of irreversibility and illiquidity vary by annuity-type, and could potentially be greater with DIAs than other forms of annuities, especially if there is a significant amount of time between the purchase age and the income start age (unless the DIA has some type of commutation rider). Second, because annuities are a form of insurance they should not be expected to be wealth-maximizing (i.e., they have a negative mortality-weighted net present value for the average person). There is obviously some adverse selection in the insurance marketplace, though, which should help minimize this risk. Third, there is a general lack of understanding of some guaranteed income products, especially given the complexity in some products (e.g., variable annuities with guaranteed income riders). Fourth, the costs associated with annuities can be high and relatively opaque. Fifth, many Americans already have a form of guaranteed lifetime income: Social Security retirement benefits, which decrease the need for and potential benefit of annuities. Sixth, it can be expensive and/or difficult to hedge inflation risk using annuities. Although there are some annuity providers that offer cost-of-living-adjustments that track in inflation, the cost of the rider is generally relatively expensive and it is not currently possible to have an inflation-linked COLA with a DIA before the income start date. Finally, a current concern among retirees is that they may be "buying low" if they purchase an annuity today given the possibility of interest rates rising in the future.

While all of the benefits and concerns noted previously apply to the DC space, there are a number of specific issues to be aware of with respect to annuities in DC plans. For example, a potential benefit of DIAs in DC plans is institutional pricing, higher levels of fee transparency, and product simplicity. Common concerns with respect to annuities include portability, i.e., the ability to roll over the contract, as well as what happens if the plan changes providers, as well as the general fiduciary concerns discussed previously.

An important consideration when determining the value of any type of insurance policy is understanding the true costs and benefits. An annuity, as a form of insurance, should generally not be expected to have a positive net present value; however, as noted in a previous section, the potential benefit may be positive (e.g., if the individual's discount rate is low enough). In this section we explore the potential benefits and costs of using a DIA. We use a statistical model to determine the optimal DIA allocation for an individual, and then the model is applied to a variety of scenarios to determine the relative sensitivity of optimal DIA allocations.

Model

The approach used to determine the optimal level of annuitization is outlined in Appendix 1, and is based on the approach introduced by Blanchett and Kaplan (2013). To summarize briefly, the model uses a utility function based on the constant relative risk aversion (CRRA) utility function, whereby negative outcomes (especially extreme negative outcomes) are weighted more heavily than positive outcomes. The model incorporates both shortfall risk preferences (which is the risk associated with running out of money during one's lifetime) as well as bequest preferences (which is the preference to pass on wealth at death).

For the analysis, 10 different factors are considered. These 10 variables, along with an explanation of each and the respective values used for the analysis, are:

1. Current Age: this is the current assumed age of the participant. Four ages are considered: 50, 55, 60, and 65.
2. Income Start Age: this is the age the income is assumed to begin from the DIA, and three ages are considered: 65, 75, and 85.
3. Total Guaranteed Income: this is the percentage of total income in retirement that will be received from guaranteed income sources. For the analysis this is assumed to be Social Security retirement benefits, where the benefit increases annually with inflation. Existing guaranteed income as a percentage of total income is assumed to be 20%, 50%, and 80%. Research by Butrica et al. (2004) and Rhee (2011) has noted that Social Security retirement benefits represent between 40% and 51% of a retiree's aggregate income, respectively.
4. Funded Ratio: this variable deals with how "on track" an individual is to accomplishing his or her retirement goal. The higher the funded ratio, the lower the required distribution from the portfolio during retirement. Funded ratios of 1.0, 1.25, and 1.5 are assumed for the analysis. The funded ratio is estimated based by dividing the mortality weighted net present value of net cash flows by the current assets (which are assumed to be $1 million). The retirement withdrawal amount is solved for in each scenario. The higher the funded ratio the lower the initial withdrawal rate (and subsequent withdrawals) from the portfolio.
5. Glide Path: the portfolio is assumed to be invested in the Morningstar Lifetime Allocation Conservative, Morningstar Lifetime Allocation Moderate Index, or Morningstar Lifetime Allocation Aggressive index glide paths. The allocations for the respective glidepaths are included in Appendix 3.

6. Benefit Payout Change: the benefit payout rate from the DIA is adjusted to determine the sensitivity of benefit changes to the potential benefit of DIAs. Changes of -20%, 0%, and 20% are tested.
7. Mortality Type: while the DIA payout rates are based on unisex mortality, actual expected mortality is estimated using male, female, and unisex mortality tables to determine how the optimal DIA allocation changes based on expected mortality-type. This is important from an advice perspective (e.g., in advice or managed accounts platform) where it may be possible to provide a more customized recommendation if information about gender is available.
8. Shortfall Preference Risk Aversion Factor: this is the retiree's concern for running out of money during retirement. Low, moderate, and high values are tested. Information about these coefficients is included in Appendix 1.
9. Bequest Preference Factor: this is the relative importance of passing on wealth to heirs upon death. Three different preferences are tested: low, moderate, and high. Information about these coefficients is included in Appendix 1.
10. Subjective Life Expectancy: this is a change in expected mortality based on the subjective life expectancy of the individual. Individuals who are going to have longer life expectancies are expected to benefit more from annuities, and vice versa. The Gompertz Model is used for mortality estimates, as outlined in Appendix 2, where a modal change of either plus or minus three years is assumed for either above- or below-average life expectancy, respectively. No change in subjective life expectancy is also tested.

The 10 different factors considered create a total of 78,732 different scenarios for the analysis. For each scenario, DIA allocations from 0% to 50% in 5% increments are considered and the optimal allocation is determined. The maximum assumed DIA allocation of 50% is included as a reasonableness constraint. The DIAs used for the analysis are assumed to include return-of-premium and cash refund features and are based on unisex pricing determined by averaging the payout rates for males and females, based on quotes obtained from CANNEX on October 26, 2014 (as noted in Table 1).

The assumed return on equities is 9% with a standard deviation of 20%. The assumed return on bonds is 3% with a standard deviation of 7%. The correlation between equities and bonds is assumed to be 0.1. The base annual inflation rate is assumed to be 2.5%. The market assumptions are approximately based on Ibbotson's 2014 Capital Market Assumptions. The portfolio is assumed to have an annual fee of 0.5%.

Results

Given the significant number of scenarios considered for the analysis (78,732) it is difficult to distill the relative impact of each factor into a single chart. Therefore, an ordinary least squares regression is conducted, where the optimal DIA allocation is the dependent variable and the various factors are the independent variables. Separate dummy variables are created for the equity glidepath (Conservative and Aggressive) and gender-type (male and female). For the regression, the preference factors for shortfall income risk and bequest are treated as continuous, where the values for low, moderate, and high preferences are assumed to be one, two, and three, respectively. The results of the regression are included in Table 2.

Table 2: OLS Regression for Optimal DIA Allocation

	Coefficient	Standard Error	t statistic	p-value
Intercept	34.78%	0.009	37.178	0.0000
Current Age	-0.10%	0.000	-10.198	0.0000
Income Start Age	-0.31%	0.000	-45.373	0.0000
Total Guaranteed Income	-20.23%	0.002	-88.447	0.0000
Funded Ratio	-1.01%	0.003	-3.673	0.0002
Benefit Payout Change	33.59%	0.003	97.937	0.0000
Shortfall Risk Preference Factor	27.91%	0.003	-82.203	0.0000
Bequest Preference Factor	-10.02%	0.001	142.429	0.0000
Subjective Life Expectancy	1.80%	0.000	78.630	0.0000
Conservative Glidepath (Dummy)	1.99%	0.001	14.476	0.0000
Aggressive Glidepath (Dummy)	-0.34%	0.001	-2.480	0.0131
Male (Dummy)	-1.96%	0.001	-14.262	0.0000
Female (Dummy)	1.69%	0.001	12.320	0.0000
R^2	40.62%			
Observations	78732			

While the average DIA allocation across all 78,732 simulations was 30.52%, the optimal DIA allocation varied significantly by scenario, as is demonstrated in Table 2. Attributes associated with higher allocations to DIAs include being younger, having an earlier income start date, having less existing guaranteed income, being less funded for retirement, higher benefit payouts, higher shortfall risk preference, lower bequest preference, longer subjective life expectancy, more conservative asset allocations, and being female. Each of the coefficients except the Aggressive Glide Path dummy was significant at the 0.01% level (and it was significant at the 5% level).

Not surprisingly, the average DIA allocation was higher for females than males (both dummies are compared to unisex mortality), with the optimal DIA allocation being 3.65% higher (1.69% - -1.96% = 3.65%). This represents a relative allocation increase of approximately 10% (given an overall average optimal DIA allocation of 30.52%). However, even though the allocations were lower for males, they still featured heavily in the optimal allocations, suggesting that even unisex priced DIAs can be a valuable form of guaranteed income for males.

Table 2 also demonstrates the importance of helping participants determine their optimal DIA allocation. For example, this analysis suggests that a participant who begins purchasing the DIA at age 55 versus age 60, has 20% less guaranteed income, receives a DIA with a 5% higher payout, has a subjective life expectancy of plus one, and was going to invest in a Conservative portfolio (but invests in a Moderate portfolio instead) would be expected to have a 10% higher DIA allocation, on average.

These differences are especially important when determining the allocation to a DIA in a target-date setting because the demographics of DC plans are likely to exhibit systematic differences with respect to participants. For example, some companies may have a pension, better funded employees, healthier employees, a greater male population, the ability to receive more attractive pricing, a more aggressive target-date fund, etc., all of which can materially affect the optimal DIA allocation.

Allocating to DIAs in a Glide Path Setting

In the previous section the optimal DIA allocation was determined in an individual setting. In this section some of the important implications associated with incorporating DIAs into a DC plan target-date strategy are explored.

Building a target-date strategy that includes DIAs can either be highly customized (e.g., based on the specific demographics of a plan) or relatively general (e.g., based on nationwide DC participant averages). In either case the allocation to DIAs should likely be determined using a model similar to the one outlined in Appendix 1 to ensure the level of annuitization is appropriate given the intended user base. This is especially true given the implicit costs associated for males given unisex payout rates since the target-date strategy will be the plan default.

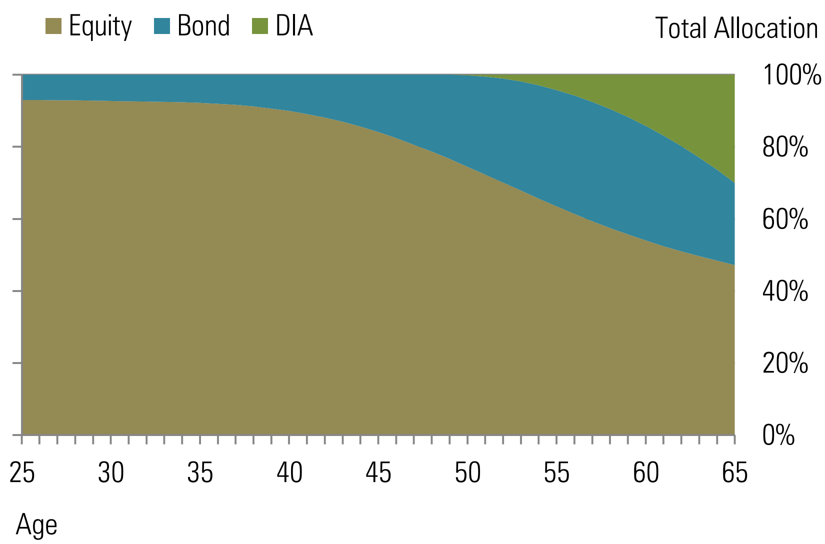
When determining the optimal DIA allocation for a DC plan the allocation could be based on individual participant demographics or using representative plan-wide metrics. Using individual participant data would provide information about the optimal spectrum of potential DIA allocations, where the resulting targets could be based on either the average, the median, or some kind of weighted average. An alternative would be to create a hypothetical individual based on some kind of participant-wide average or median.

Determining how to phase in the DIA allocation is also important. For example, if the target total DIA allocation is 30% a retirement, the appropriate age to purchase the DIAs must be determined. The results of the regression in the previous section suggest that younger participants are likely to benefit most from DIAs, which would suggest DIAs should be purchased at a younger age. However, purchasing DIAs at younger ages creates an irrevocable transaction unless the contract has a commutation rider that allows dollars to be distributed from the contract prior to the contract start date (however, these provisions are rare). The ability to access funds early presents adverse selection issues for the insurance company; therefore, even if the annuitant has the ability to access the funds, a loss should be expected. Overall, a consistent buy-in approach is likely the best strategy for adding a DIA to a target-date strategy.

Incorporating a DIA into a target-date glide path should have an impact on the equity allocation for the non-DIA portion. DIAs, from a total wealth perspective, are bond-like assets. Similar to a bond, a DIA provides a fixed annual payment. Therefore, if there is a target equity allocation for the glide path, and DIAs are going to be added to the target-date strategy, the remaining monies (i.e., non-DIA monies) should likely be invested more aggressively to offset the DIA allocation. This can potentially result in significant differences the equity allocations for the liquid portion of the DC plan assets (i.e., non-DIA assets).

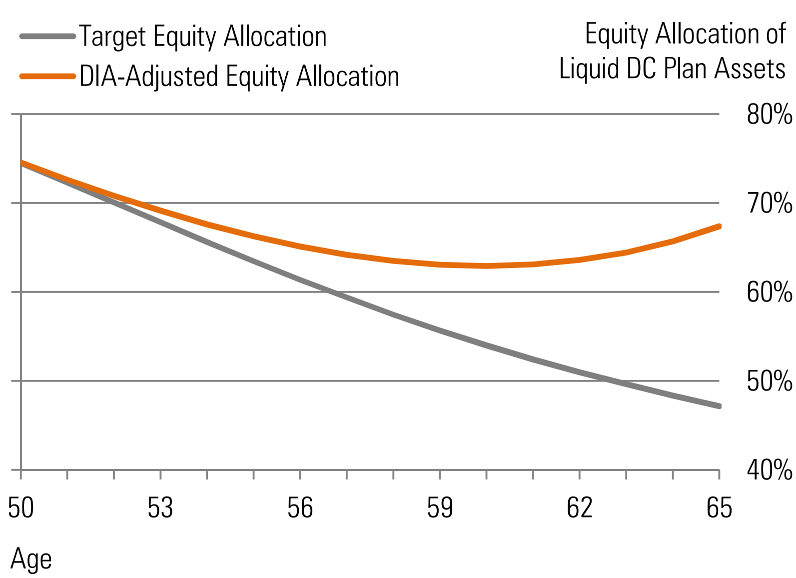
For example, if it is assumed the optimal target equity allocation for the target-date strategy is the same as the Morningstar Lifetime Allocation Moderate Index (as outlined in Appendix 3) and the DIA purchase will be phased in to a total allocation of 30% by age 65 (the assumed retirement age for the glidepath) and starting at age 50. The resulting weights across stocks, bonds, and DIAs would look like Figure 4.

Figure 4: Hypothetical Glide Path Incorporating DIAs



The differences in the respective equity allocations for the target allocations with (i.e., Figure 4) and without the DIA (i.e., the Moderate allocation in Appendix 2) are included in Figure 5.

Figure 5: Equity Allocation Differences for the Liquid Portion of a Target-Date Fund with and without DIAs



The differences between the equity levels for the portfolios with and without the DIA increases as the target-date glide path approaches retirement. These differences could create potential issues for things like benchmarking and performance reporting that should be considered. Alternatively, if the DIA is just added to a target-date strategy and the remaining equity weight is unchanged, the portfolio will likely become relatively conservative. Overall, it probably makes the most sense to consider the DIA when building the target-date strategy's allocation and then create a custom benchmark based on the new respective weights.

In addition to changing the equity allocation for the non-DIA assets, it would also make sense to consider adjusting the intra-stock and intra-bond allocations (especially the intra-bond allocation). For example, from an income perspective a DIA is similar to a long duration bond; therefore the duration of the remaining fixed income assets should generally also be reduced. When thinking about the potential impact on the equity asset classes the addition of a DIA likely enables the glidepath to take on additional volatility, e.g., having higher allocations to asset classes like small cap and emerging markets than would normally considered optimal for near-retirees. Again, these adjustments may create implications for benchmarking and performance reporting.

Conclusions

While the usage of deferred income annuities (DIAs) in defined contribution (DC) plans is still in its infancy, there will likely be significant growth in the space over the next decade given recent guidance from the Treasury. This paper provides an overview of DIAs, reviews the recent Treasury guidance, discusses potential fiduciary concerns with using annuities in DC plans, introduces a model that was used to determine the optimal DIA allocation, and then discusses some considerations when allocating to a DIA in an individual participant and target-date strategy setting.

Unisex pricing creates a cost for males who purchase DIAs in a DC plan because males generally receive lower relative payments than if an individual policy were to be purchased outside the plan. This cost can be partially mitigated by only including contracts with younger income start dates (e.g., age 65, or retirement) and adding return-of-premium and cash refund features. While a younger income start age and the inclusion of return-of-premium features reduces the amount of guaranteed income by approximately 10% (and the potential benefit noted from an academic perspective), including these features may improve acceptance by eliminating a behavioral hurdle to utilizing DIAs. The costs may be further mitigated by institutional pricing of DIA contracts in the DC space.

While the average DIA allocation across all 78,732 scenarios was determined to be 30.52% based on the analysis conducted for this paper there were significant differences in the optimal DIA allocation for each investor. Attributes associated with higher allocations to DIAs include being younger, having an earlier income start date, less existing guaranteed income, being less funded for retirement, having higher benefit payouts, higher shortfall risk preference, lower bequest preference, longer subjective life expectancy, more conservative asset allocations, and being female. These differences are important within the context of a DC plan, especially if DIAs are going to be used in a target-date setting, given the systematic similarities and differences that are likely to exist across DC plans.

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Appendix 1: Utility Model

The majority of research on retirement income views retirement consumption from a lifecycle perspective, where the implied goal of a retiree (or couple) is to smooth consumption over his or her (or their) retirement. This is determined primarily through an approach that either incorporates risk aversion (i.e., utility) or the likelihood of achieving some goal (i.e., the probability of success/failure). While both approaches have their merits, an approach that considers risk aversion with respect to the amount of income is likely a better reflection of individual preferences because it allows for a wider set of outcomes when compared to the relatively binary nature of whether a goal is achieved (i.e., a probability of success approach).

Risk aversion is a concept developed by Arrow (1965, 1971) and Pratt (1964), where the goal is to determine some level of constant consumption a person would accept in exchange for a higher average level of consumption with greater variability. While there are several utility functions used to estimate risk aversion, the most common is a Constant Relative Risk Aversion (CRRA) utility function, shown in equation 1, where the amount of utility (U) received varies depending on level of consumption (c) and level of investor risk aversion (γ).

$$U(c) = \frac{c^{1-\gamma}}{1-\gamma} \qquad [A1.1]$$

Implied within the CRRA utility function is the law of diminishing marginal utility, whereby negative outcomes (especially extreme negative outcomes) are weighted more heavily than positive outcomes. This utility function lends itself to retirement income modeling, and can be used to determine the optimal level of annuitization, because it heavily penalizes scenarios where the retiree is left destitute (i.e., when the portfolio's lifetime ends before that of the retiree). The penalty increases with the degree of risk.

The utility approach used in this paper is a modified version of the approach introduced by Blanchett and Kaplan (2013). The two primary adjustments are the introduction of a bequest preference factor and an irreversibility discount for annuities purchased before retirement.
For each simulated income path, the utility-equivalent constant income level is calculated based on the elasticity of intertemporal substitution parameter, which is denoted as II. That is, for a given simulated income path, II is the constant amount of income with the same utility as the actual income path. This is given by

$$II = \left(\frac{\sum_{t=0}^{T} q_t (1+\rho)^{-t} I_t^{\frac{\eta-1}{\eta}}}{\sum_{t=0}^{T} q_t (1+\rho)^{-t}} \right)^{\frac{\eta}{\eta-1}} \qquad [A1.2]$$

Where I_t is the level of income in year t, q_t is the probability of surviving to at least year t, using the Gompertz Law of Mortality, outlined in Appendix 2, T is the last year for which $q_t>0$, and ρ is the investor's subjective discount rate (so that d_t in equation [A5] is $q_t(1+\rho)^{-t}$). The value of the potential bequest is denoted along path i at time t, B_{it}. Above the probability of surviving is defined to at least year t as q_t. So the probability of dying in year t is $q_t – q_{t+1}$. These probabilities are used together with the subjective discount rate to calculate a weighted average bequest for each path i.

$$\bar{B}_i = \frac{\sum_{t=0}^{T}(q_t - q_{t+1})(1+\rho)^{-t}B_{it}}{\sum_{t=0}^{T}(q_t - q_{t+1})(1+\rho)^{-t}} \qquad [A1.3]$$

$\bar{B}_i$ and II_i are combined to form a measure of the utility of path i in the same units as income. Since II_i is the constant level of income that has the same utility as the actual path of income, it can be expressed as a lump sum at time 0 by multiplying it by

$$\Delta = \sum_{t=0}^{T} q_t(1+\rho)^{-t} \qquad [A1.4]$$

Therefore $\bar{B}_i$ can be converted to an equivalent constant level of income by dividing it by Δ. To translate $\bar{B}_i/\Delta$ into the incremental benefit of the possibility of leaving a bequest in addition to the stream of income under path i, the parameter τ is introduced, which measures the strength of the bequest motive. Hence the constant level of income that is equivalent to the income path together with the possible bequests of each year is $II_i + \tau\bar{B}_i/\Delta$.

The expected utility is measured using the CRRA utility function with its risk tolerance parameter θ that was introduced in equation 1:

$$EU = \sum_{i=1}^{M} p_i \frac{\theta}{\theta-1}(II_i + \tau\bar{B}_i/\Delta)^{\frac{\theta-1}{\theta}} \qquad [A1.5]$$

where M is the number of paths, the subscript i denotes which of M paths is being referred to, and p_i is the probability of path i occurring which is set to $1/M$. Y is defined as the constant value for II that will yield this level of expected utility. This is the certainty-equivalent of the stochastic utility-adjusted income II. Y is given by

$$Y = \left[\sum_{i=1}^{M} p_i\,(II_i + \tau\bar{B}_i/\Delta)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}} \qquad [A1.6]$$

For the final step, an irreversibility discount is applied when an annuity is purchased before retirement. This discount reflects the potential costs associated with making irrevocable decisions with respect with how to fund retirement when things may change at some point in the future. The irreversibility discount (π) changes the optimal utility-adjusted wealth value (Y) based on the years until retirement (R), the percentage of total retirement income that will be funded with the portfolio (ω), and the percentage of total wealth annuitized (A), as noted by equation A1.7. For simplicity purposes the irreversibility discount is set to equal the real discount rate (ρ)

$$\bar{Y} = Y\,((1-\pi)^R - 1)\omega A \qquad [A1.7]$$

The optimal strategy would be the one that maximizes the value of $\bar{Y}$. For the analysis it is assumed that $\rho = 2.5\%$ and $\eta = 0..333$. An investor with a high, moderate, and low shortfall income risk aversion preference is assumed to have θ values of 0.125, 0.25, and 0.5, respectively. An investor with a high, moderate, and low bequest preference is assumed to have τ values of 0.05, 1, and 2, respectively.

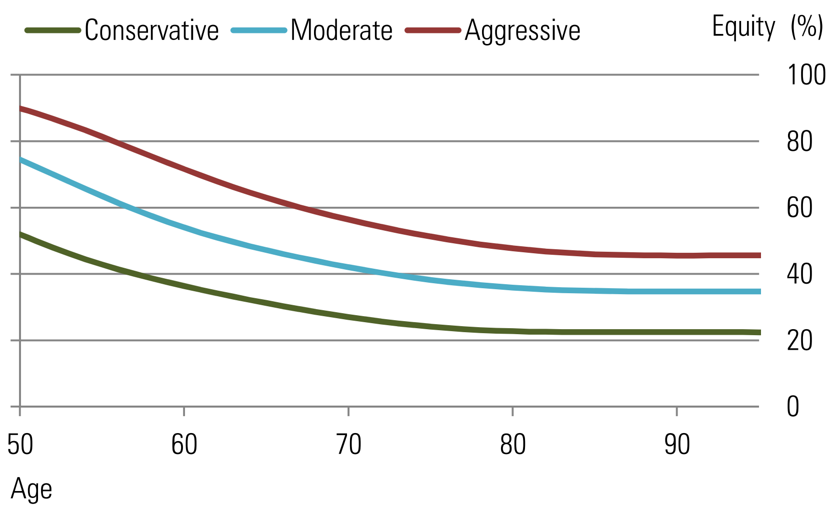
Appendix 2: Gompertz Law of Mortality

A fitted Gompertz method is used for estimating mortality to estimate the probability of the retiree household living to (or dying at) each age, up to 50 years in retirement, similar to Milevsky (2012), where the probability of survival to age t, conditional on a life at age (a), is given by A2.1, where m is the modal life span and b is the dispersion coefficient.

$$q_t = \exp\left\{\exp\left\{\frac{a-m}{b}\right\}\left(1-\exp\left\{\frac{t-a}{b}\right\}\right)\right\} \qquad [A2.1]$$

The Gompertz parameters are "fitted" to the Society of Actuaries 2012 Immediate Annuity mortality table by minimizing the sum of squared differences from the parameters and the actual mortality estimates in the Table. The modal life span for males is determined to be 89.84 with a dispersion coefficient of approximately 8.49 years and a modal life span for females to be 91.98 with a dispersion coefficient of approximately 8.39 years. Unisex mortality is assumed to be the average mortality for males and females.

Appendix 3: Equity Allocations for the Morningstar Conservative, Morningstar Moderate, and Morningstar Aggressive Lifetime Allocation Index Glide Paths



Disclosures

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The results from the simulations described, while hypothetical in nature and not actual investment results or guarantees of future results, can provide an important look at strategies designed to help retirees reach their goals.

Monte Carlo is an analytical method used to simulate random returns of uncertain variables to obtain a range of possible outcomes. Such probabilistic simulation does not analyze specific security holdings, but instead analyzes the identified asset classes. The simulation generated is not a guarantee or projection of future results, but rather, a tool to identify a range of potential outcomes that could potentially be realized. The Monte Carlo simulation is hypothetical in nature and for illustrative purposes only. Results noted may vary with each use and over time. This should not be considered tax or financial planning advice. Please consult a tax and/or financial professional for advice specific to your individual circumstances.

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