Beyond Averages: A More Robust Approach to Glide-Path Design

Key Inputs Should Reflect Diversity of DC Plan Populations.

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KEY INSIGHTS

- T. Rowe Price believes that failing to account for the heterogeneity of defined contribution participant populations in glide-path design may lead to poor retirement outcomes.
- Many target date providers use simple averages to represent key participant characteristics and behavioral preferences in their glide-path models.
- By using distributions of values within plan populations instead of averages, T. Rowe Price seeks to produce more robust target date offerings for all participants.

Many target date providers use averages as the primary population inputs when designing glide paths for defined contribution (DC) plans. We believe this method is not effective given that target date strategies are designed to be used by broad, diverse populations. These populations are not homogeneous—just the opposite, in fact. Plan participants may exhibit a variety of demographic characteristics and differing investment preferences.

We believe that not accounting for the heterogeneous nature of DC participants when designing and implementing target date glide paths ultimately may lead to retirement outcomes that fall wide of the mark for many plan participants.

Our research and insights into DC populations and participant behaviors suggest that glide-path models that use distributions of the key participant characteristics as design inputs instead of simple averages potentially can do a better job of capturing the diversity of participant characteristics within DC plan populations.

In solutions customized at the participant level, such as managed accounts, the problem of heterogeneity is avoided entirely, as glide paths can be designed based on each participant's specific circumstances, objectives, and preferences. However, use of managed accounts as the default option is neither typical nor necessarily desirable among DC plans due to a number of potential downsides, including potentially higher costs and the need for participants to engage and provide personalized inputs in order for the benefits to be achieved.

At T. Rowe Price, our glide-path work draws on our recordkeeping database of over 2 million DC plan participants. Based on aggregate, depersonalized data from this source, we have developed inputs that reflect the key

> ...DC plan populations inevitably include a range of individuals with differing demographic characteristics....

demographic attributes and behavioral preferences of a real-world universe of actual plan participants. In our view, this approach represents a more practical, lower-cost alternative to individually customized solutions while avoiding the inherent limitations of a design methodology based on simple averages.

The role of asset accumulation within DC plans as a critical lever in retirement planning emphasizes how important it is for plan sponsors and their investment advisors to understand the implications of different target date design approaches. In our view, plan sponsors would be well served by selecting target date strategies with glide paths that are based on realistic assumptions about participant demographics and preferences and, thus, seek to improve retirement outcomes for the entire plan population.

Designing Glide Paths for Diverse Populations

Target date strategies provide DC plan participants with appropriately diversified portfolios designed to pursue long-term retirement investment objectives. By moving along preset glide paths, target date asset allocations can reflect the evolving needs and risk tolerances of participants as they pass through the accumulation phase of their investment life cycle and into retirement.

However, DC plan populations inevitably include a range of individuals with differing demographic characteristics—such as age, current and expected earnings, and savings behavior—and risk preferences. Yet, many investment providers seek to design their glide paths based on inputs that reflect a single "average" participant.

With this as the backdrop, consider the mathematical definition of "average"—the result obtained by adding multiple quantities together and then dividing the total by the number of quantities. While simple averages are easy to understand and likely adequate for many uses, we believe using them as inputs in the glide-path design is a vast oversimplification.

Given the impact that glide-path design can have on long-term retirement outcomes, we believe the use of oversimplifying assumptions can create significant downside risks for plan sponsors and participants.

We can illustrate these risks by taking a closer look at two key participant demographic inputs that are integral to glide-path modeling:

- expected earnings levels
- savings behavior

The Importance of Preferences

There are a number of factors that need to be taken into account when designing target date glide paths for DC plans. A sound methodology for modeling the expected demographic characteristics (such as earnings levels and contribution rates) of participant populations is obviously critical.

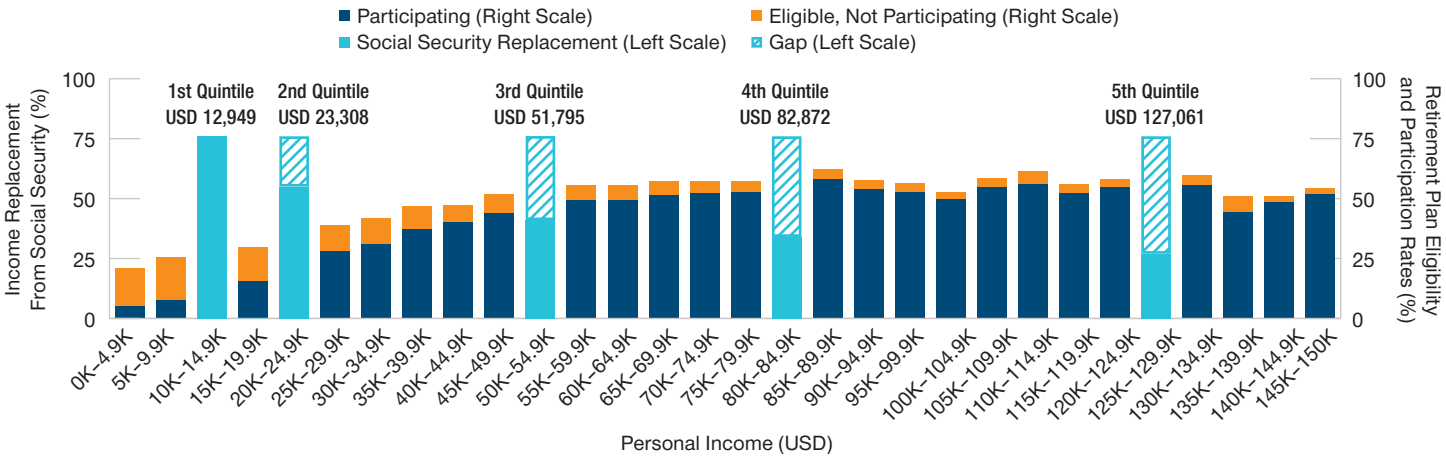
However, T. Rowe Price also believes that glide-path providers should seek to understand and model a range of investment preferences, such as tolerance for risk and the relative importance placed on potentially conflicting objectives (for example, how the goal of consumption replacement during retirement is prioritized relative to the goal of mitigating balance variability at or near retirement).

By including these preferences as inputs in our design models along with key participant demographic characteristics, T. Rowe Price seeks to offer glide paths that are more robust and have the potential to improve retirement outcomes across diverse plan populations.

(Fig. 1) Lower and Higher Income Groups Are Both Likely to Need More Portfolio Growth

Social Security Replacement[1] and Retirement Plan Access by Income[2]

As of April 2019



Sources: Social Security Administration and University of Minnesota.

[1] Clingman, M., Burkhalter, K., and Chaplain, C. (April 2019), Replacement Rates for Hypothetical Retired Workers. Actuarial Note 2019.9. Social Security Administration, Office of the Chief Actuary. On the Web at: www.ssa.gov/OACT/NOTES/ran9/an2019-9.pdf.

[2] ASEC 2018, IPUMS-CPS. University of Minnesota, www.ipums.org.

Each of these inputs has substantial influence in glide-path design—in particular, in setting the appropriate allocation between equity and fixed income assets at any given point on the path, both before and after retirement.

However, the ranges of salaries and contribution rates within a DC plan population may be quite wide. A design methodology based on simple averages may result in suboptimal asset allocations and retirement outcomes for a significant number of participants.

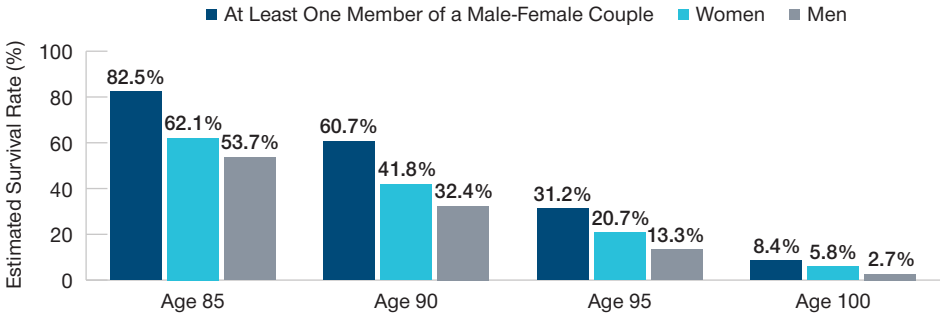
Take, for example, the hypothetical income groups in Figure 1, which displays both their plan participation rates and their projected income replacement from Social Security. The lower-income cohorts (such as the participants in the second quintile) have less discretionary income and, thus, may not be able to save as large a share of their earnings as the middle- and higher-income cohorts. The lower-income groups are likely to need more growth from their DC plan accounts to mitigate their relatively low saving rates and close the gap between their expected Social Security benefits and their consumption needs in retirement.

Our model for glide-path design has evolved to emphasize the role of nondiscretionary consumption in the spending model in a systematic manner. Recognizing that the share of total expenses dedicated to discretionary spending tends to be lower for lower-earning participants, we tie this observation to a preference for avoiding balance depletion that is a feature of our behavioral spending model.[1] Namely, lower income reflects a lower share of discretionary spending and, thus, a lower preference for avoiding depleting assets. Likewise, higher income reflects a larger share of income devoted to discretionary spending, greater ability to save, and a reduced focus on immediate consumption—resulting in a higher preference for avoiding the depletion of assets.

[1] For additional details on our behavioral spending model, please see the Appendix.

(Fig. 2) Today's DC Plan Participants Can Expect Lengthy Retirements

Actuarial Estimates of Expected Survival Rates at Age 65[1]



Sources: DrinkerBiddle, BNY Mellon, Cannex Financial Exchange, and Society of Actuaries.

[1] Estimates developed by the Cannex Financial Exchange based on the Society of Actuaries RP 2014 Mortality Table with MP 2014 Projection Scale for 2015, which reflects the mortality experience of participants in U.S. pension plans.

> We believe that longevity risk—a shortfall of funds during retirement—has become one of the most important risks that must be addressed in retirement planning.

Next, consider a participant who falls somewhere in the middle of the earnings distribution (in the fourth quintile in Figure 1, for example) but also has a relatively low savings rate. This individual is likely to experience an even larger shortfall in his or her ability to cover consumption needs in retirement because Social Security benefits will close less of the gap. This example illustrates the potential pitfalls in relying on simple averages when seeking to design optimal glide paths, which may miss the mark in terms of serving the entire plan population well.

Longevity Risk Is an Increasingly Critical Design Factor

Savers face many risks throughout the course of financially preparing for retirement. These may include market risks (such as price volatility and the erosion of real portfolio values by inflation) as well as behavioral risks (such as insufficient savings or failed attempts to time the market). We believe that longevity risk—a shortfall of funds during retirement—has become one of the most important risks that must be addressed in retirement planning.

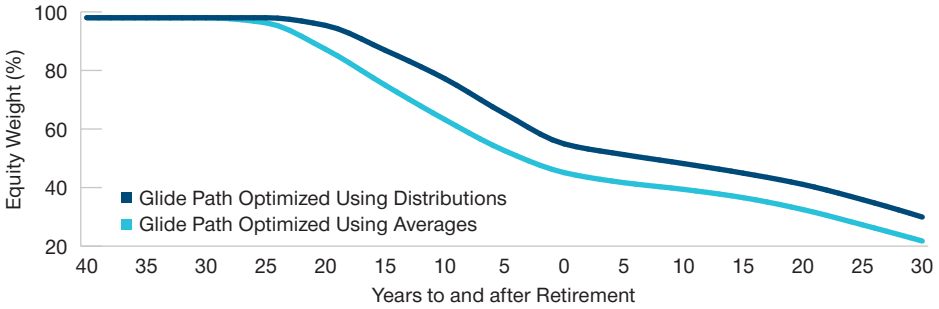
Americans now are living longer, which means a career's worth of savings might need to fund a retirement lasting many decades. For example, recent actuarial estimates indicated that for a hypothetical male-female couple, both 65 years old, at least one member had an 80% probability of living to age 85, or another two decades, a 60% probability of living to age 90, or two and a half decades, and a nearly 33% chance of living to 95—three full decades of retirement (Figure 2).

Our modeling approach reflects these considerations by thinking of glide-path optimization as a planning problem. Namely, we allow each individual to have a specific retirement planning horizon, which is tied to a timing preference in our behavioral spending model. The mortality discount that we apply to each time period scenario in our analysis is conditional on an individual living until their specific plan horizon, rather than simply living until retirement age. In practice, we calibrate these planning horizons to the preferences of plan sponsors, allowing us to incorporate sponsors' views into our glide-path design in a systematic manner.

In our view, relying on a default asset allocation for the "average" person ignores the full participant population in favor of building a glide path designed to serve a mathematical value, not real people.

(Fig. 3) Glide Paths Based on Distributions May Feature Higher Equity Exposure

Hypothetical Glide Paths Based on Average Earnings and Preferences and on Distributions of Those Values Within a Plan Population[1]



Source: T. Rowe Price.
The chart shown above is based on hypothetical data. See Appendix for important disclosures.
[1] See Appendix for a description of the study methodology and the hypothetical participant demographic and behavioral values modeled in the simulations.

> Changes in participant behavior also have strengthened the case for higher long-term equity exposure, in our view.

Our modeling work suggests that the use of inputs based on distributions within actual participant populations can have a significant impact both on glide-path design and real-world retirement outcomes. Figure 3, for example, shows the "optimal" glide path suggested by our methodology using simple average values for participant savings, earnings, and preferences, and, alternatively, distributions of those same values across a hypothetical plan population.[2]

As can be seen, the "distributions" and "averages" glide paths run in parallel in the initial years of the accumulation cycle but begin to diverge about 30 years before retirement. The distributions-based glide path then begins to allocate a higher weight to equities relative to the averages-based path, a positive differential that climbs to almost 14 percentage points by the 10th year before retirement. After that point, the two glide paths begin to converge, although the distributions-based glide path continues to maintain a higher equity weight through the 30th year of retirement.

The higher equity weights suggested by glide paths designed using value distributions rather than simple averages have obvious implications for portfolio performance and retirement outcomes. Historically, the compounding of the equity risk premium—essentially, the additional return on stocks relative to bonds—has led to meaningful differences in outcomes for investors. Our research suggests that the potential benefits of capturing this equity premium outweigh the potential risks, such as the possibility of a large market decline at or near retirement, for investors with a longer-term focus on longevity.

Changes in participant behavior also have strengthened the case for higher long-term equity exposure in our view. Until fairly recently, many plan sponsors assumed that participants would exit their plans at or soon after retirement, rolling their balances over into individual retirement accounts. This presumption may have led some sponsors to have concerns about adopting higher-equity glide paths, out of concern that a major market decline might force some exiting participants to "lock in" their losses upon retirement.

While we believe plan sponsors should make target date and glide-path decisions based on their own beliefs

[2] Please see the Appendix for a description of T. Rowe Price's glide-path methodology.

and intended objectives, we encourage them to consider that participants today are expected to live longer in retirement and are likely to depend more heavily on their DC plans for income during retirement. Data also show that participants now are more likely to keep assets in their DC plans after retirement while plan sponsors have grown more interested in seeing them stay there:

- T. Rowe Price's recordkeeping data show that in 2018 over 61% of DC participant balances at the time of retirement were still invested in plan accounts one year after retirement, up from 55.4% in 2017 and only 48.7% in 2016.[3]
- A 2018 T. Rowe Price survey of 289 DC plan sponsors found that almost 70% believed retention of participant assets was preferable to retirees transitioning their account balances out of the plan. Almost 30% said that keeping retired participants in the plan had become more of a priority for them recently. Only 15% preferred that their participants roll their balances out of the plan at retirement.[4]

We believe this behavioral evolution has significantly strengthened the need for careful evaluation of the desired level of potential growth exposure leading up to and into retirement. However, we also recognize that for some plans there may be relatively unique characteristics or preferences that could justify lowering equity exposure in the glide path near the age of retirement.

Measuring the Impact of Distributions-Based Inputs

We believe using real distributions of participant variables, such as those based on our own DC plan database, to inform glide-path design guards against one key pitfall of relying on simple averages: the tendency for such a methodology to recommend glide-path allocations with relatively low potential growth trajectories. Use of distributions as design inputs typically results in glide paths with a higher growth potential due to their higher equity allocations, with a corresponding improvement in their potential to mitigate income shortfalls in retirement.

As part of their design research, T. Rowe Price analysts compared the hypothetical performances of two glide paths, one based on simple averages and one based on distributions within an assumed plan population.[5]

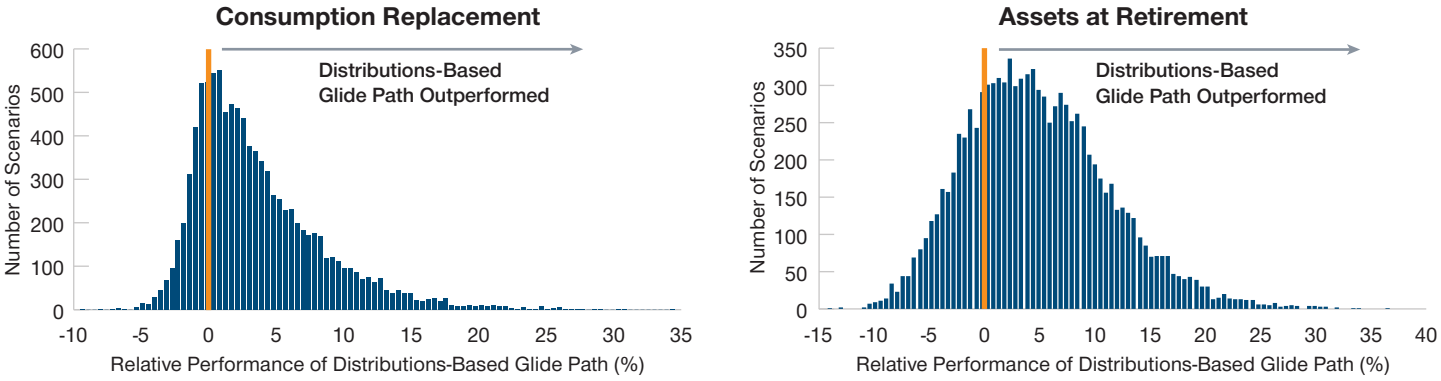
- The exercise was based on T. Rowe Price's glide-path design model, which incorporates a variety of demographic and behavioral characteristics and preferences.
- One version of the glide path was designed using simple mathematical averages for the key inputs, while the other was based on distributions of those values across the hypothetical participant population.
- Scenario analysis was used to estimate the likelihood that the distributions-based glide path could outperform the averages-based one, given the design model's economic and capital market assumptions, such as expected economic growth, inflation, and asset returns (expressed as probability distributions).[6]

Figure 4 highlights the results of this analysis across two critical outcome metrics: consumption replacement during retirement and portfolio values at retirement. We defined consumption as income minus savings. The consumption replacement rate was the percentage of preretirement income, net of savings, that could be sustainably withdrawn

[3] Among those aged 65 or older after one calendar year following separation from service.
[4] See: Lorie Latham, *Advancing the Way We Think About Perceptions of Risk and Achieving Outcomes*, T. Rowe Price, July 2018.
[5] Please see the Appendix for the details of the study methodology.
[6] For a more detailed description of T. Rowe Price's glide-path methodology, please see the Appendix.

(Fig. 4) Hypothetical Distributions-Based Glide Paths Outperformed Averages-Based Glide Paths in a Majority of the Scenarios We Tested

Results of 10,000 Scenarios[1]



Source: T. Rowe Price.

The results shown above are hypothetical, do not reflect actual investment results, and are not a guarantee of future results. See Appendix for important disclosures.

[1] Assumes a 40-year working life and a 55-year retirement. Consumption replacement is over the first 30 years of retirement. See Appendix for further details on the study methodology.

from the portfolio over a defined period after retirement—in this case, 30 years.

Relative to the glide path based on average values, the glide path that was designed using participant distributions resulted in an improved consumption replacement in almost 76% of the 10,000 hypothetical scenarios generated. It also produced larger portfolio values at retirement in almost 76% of those hypothetical scenarios. Put differently, in more than three out of four hypothetical scenarios, portfolio values at retirement were higher for the glide paths designed using distributions-based inputs.

Figure 5 shows the hypothetical gains in consumption replacement made possible in the analysis described above. The 10,000 scenario results were ranked according to the relative performance of the distributions-based glide path versus the averages-based glide path. The resulting hypothetical improvements in consumption replacement are shown for each year of retirement, out to 30 years.

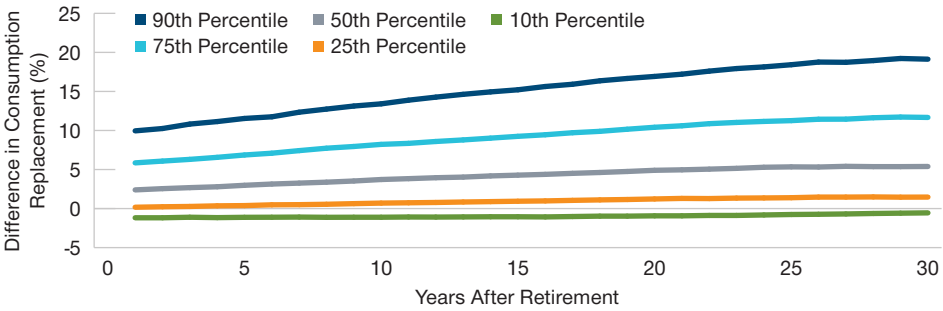
Using the 50th percentile (the median scenario) in each year as the benchmark, the distributions-based glide path produced hypothetical improvements in real (after inflation) consumption across the first 30 years of retirement that ranged from almost 2.4% to more than 5.4% per year relative to the averages-based glide path. Those gains increased most rapidly in the fifth through the 20th year of retirement, before tapering off slightly near the end of our 30-year post-retirement horizon. For many retirees, these may be the key spending and consumption years, depending on health care-related costs, and, thus, the retirement segment where higher portfolio balances may be most desirable to guard against unforeseen spikes in health care or other expenses.

In percentage terms, the improvements in consumption replacement demonstrated in our analysis might appear relatively modest. However, for individuals who will need to support themselves in what could be a lengthy retirement, the benefits in dollar terms could be quite meaningful.

For a hypothetical plan participant who retired at age 65 with a USD 100,000 final salary and an average annual post-retirement consumption of USD 80,000 after inflation, a 4% increase in salary replacement made possible by following the distributions-based glide path instead of the averages-based

(Fig. 5) Distribution-Based Glide Paths May Lead to Better Retirement Outcomes

Improvements in Post-retirement Consumption Replacement by Scenario Quantile
Distributions-Based Glide Path Versus Averages-Based Glide Path
Results of 10,000 Scenarios[1]



Source: T. Rowe Price.
The results shown above are hypothetical, do not reflect actual investment results, and are not a guarantee of future results. See Appendix for important disclosures.
[1] Assumes a 40-year working life and a 55-year retirement. Consumption replacement is over the first 30 years of retirement. See Appendix for fuller details on the study methodology.

> Our glide-path designs are based on distributions, not averages, derived from our database of over 2 million DC plan participants.

glide path in our model would add USD 3,200 in additional average annual after-inflation resources.

Even larger hypothetical gains in post-retirement consumption replacement were indicated in the top two scenario groups in our analysis (i.e., the 75th and 90th percentile results). The probabilities associated with those hypothetical outcomes were correspondingly smaller, however.

Conclusions

There are many levers that impact retirement outcomes, and we believe plan sponsors need to carefully consider the many trade-offs involved in the design of their plan's target date strategies and the impact those choices may have on retirement outcomes.

In this paper, we have sought to illustrate the importance of glide-path modeling, with an emphasis on the key inputs that drive those models—the risk tolerances, investment goals, and other individual preferences of the participants they are intended to serve.

T. Rowe Price's approach to glide-path design is guided by the fact that the characteristics and preferences of plan participants are heterogeneous. A glide path based on a profile of the "average" participant is unlikely to be highly desirable for at least some participants.

Our glide-path designs are based on distributions, not averages, derived from our database of over 2 million DC plan participants. We believe this methodology produces more robust offerings in that it seeks to minimize the degree to which potential outcomes for one group of participants are sacrificed in favor of any other group.

One effect of our methodology is to increase the recommended exposure to equities and other growth-oriented assets across both the pre- and post-retirement portions of a given glide path. This tendency largely accounts for the hypothetical performance of the distributions-based glide paths in our modeling work and reinforces our belief that longevity risk—the possibility that retirees might outlive their resources—has increasingly become one of the most important risks DC plan participants face and should be a key factor to consider in building portfolios for retirement.

Methodological Appendix

T. Rowe Price's Glide-Path Model

The analysis described in this paper was based on T. Rowe Price's standard glide-path design methodology, which has three components: a macroeconomic model of economic and capital market conditions, a behavioral model of participant savings and consumption rates, and a utility satisfaction model of sponsor and participant attitudes.

- The macroeconomic model incorporates assumptions about expected long-run economic and capital market performance over the time horizon of a typical retirement investor, including variables such as economic growth, interest rates, inflation, and asset class returns.
- The behavioral model includes the career salary and deferral rate variables described above, as well as pre- and post-retirement spending variables.
- The utility model not only determines the optimal asset allocation in the recommended glide path, but also the spending function for individual participants in retirement. A constant relative risk aversion (CRRA) is applied over an assumed 40-year working career and a 55-year retirement. The results are a function of the parametric inputs as well as mortality assumptions.

The spending model is static during the assumed working years with consumption equal to income minus salary deferrals. However, spending in retirement is a dynamic function in which an individual's consumption in any given year reflects their expected permanent income and current level of wealth, as well as their behavioral preferences.

Consumption levels—and thus the consumption replacement rate expressed as a percentage of final salary net of pre-retirement savings—reflect a utility trade-off between present consumption and future consumption as a function of preserved wealth. The spending model is adaptive in that it seeks to avoid fully depleting accumulated wealth before the end of the 55-year retirement period. Thus, consumption levels in the model are influenced both by the glide path and by simulated market conditions.

To reflect the uncertainty associated with future market conditions and the impact of that uncertainty on participant utility preferences, the T. Rowe Price model uses an initial Monte Carlo simulation to generate 100 different scenarios for potential equity and bond returns in each year of the assumed pre- and post-retirement time horizon. Those results, in turn, shape the dynamic evolution of the modeled consumption levels both before and after retirement.

Averages Versus Distributions Study Methodology

To measure the potential benefits of using distributions-based inputs rather than simple averages when designing target date glide paths, T. Rowe Price conducted an analysis of potential retirement outcomes for a hypothetical DC plan population using a Monte Carlo simulation exercise.

The analysis was based on a hypothetical population of 10,000 plan participants with demographic and behavioral characteristics that primarily reflected six key inputs:

1. First-year career salary
2. First-year deferral rate
3. A risk-aversion parameter
4. A time preference parameter (a measure of the individual's expected retirement time horizon)
5. A depletion aversion parameter (a measure of the minimum "buffer level," or percentage of wealth, that an individual wishes to maintain to avoid depleting assets)
6. A goal preference parameter, reflecting the degree that a participant wishes to prioritize consumption replacement versus stability of wealth

The last four inputs constituted the "preference parameters" used to model participant behavior.

Career salaries were sampled by a model that was calibrated to the participant universe in T. Rowe Price's recordkeeping database of defined contribution plans. This model used a salary rank (drawn for each hypothetical participant from a simple random sample) that was specified for the first working year (at age 25) and that influenced career salary growth in subsequent years. At each age, the nominal salary level was determined by a Gaussian mixture model (a mixture of normal random variables). This age-conditional Gaussian mixture model also was calibrated to our recordkeeping database.

Deferral rates were modeled similarly to salaries, as a function of age and age-relative salary rank based on our recordkeeping database. A deferral rate rank for each individual was sampled in the first working year, and this determined the deferral rate trajectory at each subsequent age. The model determining the exact deferral rate in a given year

was a probit model (a discrete choice model with underlying normality assumptions) that was fitted to the participants in our database. An individual's position in the hierarchy of deferral rates was modeled as constant throughout time.

The value of the risk-aversion parameter was required to be positive and, theoretically, could have been arbitrarily large, with higher values representing larger levels of risk aversion. Practically, values between zero and eight for this parameter were commonly used. The value of the time preference parameter ranged between zero and one and represented a discount factor on future utility from consumption. This discount factor sets the expected planning horizon, with a value of one representing an indefinitely long retirement and zero representing no expected post-retirement lifespan.

The depletion aversion parameter ranged between zero and one and represented a percentage of wealth as described above. The goal preference parameter also ranged between zero and one, with one representing consumption replacement as the sole objective and zero representing stability of wealth as the sole objective.

In optimizing glide paths for our hypothetical plan population, two alternative methodologies were employed:

- The first approach was based on arithmetic mean values for the initial salary, deferral rate, and preference parameters of the 10,000 hypothetical participants in the model.
- An alternative, "robust" analysis attempted to capture plan heterogeneity by basing key inputs on distributions of the key parameters within the hypothetical population. For modeling purposes, these distributions were specified in statistical terms.

The preference parameters (risk aversion, time preference, depletion aversion, and goal preference) for each hypothetical participant in the model were drawn from beta distributions, which were described by two shape parameters. The parametric values for the preference beta distributions were as follows:

- A risk aversion parameter of 1 + 4*X, where X was drawn from a Beta (2.5,2.5) distribution with a mean of 3.0 and a standard deviation of 0.82.
- A time preference parameter drawn from a Beta (38.675,1.325) distribution with a mean of 0.967 and a standard deviation of 0.03.
- A depletion aversion parameter drawn from a Beta (27.0,3.0) distribution with a mean of 0.9 and a standard deviation of 0.054. The depletion aversion parameter for each hypothetical participant is then applied with a weight that is inversely related to the expected proportion of the individual's consumption (based on salary) that is nondiscretionary spending. After applying these weights, the depletion aversion parameter values have a mean of 0.113 and a standard deviation of 0.054.
- A goal preference parameter drawn from a Beta (5.5,4.5) distribution with a mean of 0.55 and a standard deviation of 0.149.

The following inputs were used for the key demographic parameters when optimizing the averages-based glide path:

- Starting salary: USD 41,988
- Starting deferral rate: 6%
- Annual salary growth: Randomized (mean annual growth 1.06%), based on participant data
- Change in the deferral rate: One increase, from 6% to 7% in the 30th working year.

The risk aversion, time preference, depletion aversion, and goal preference parameters in the averages-based design were the arithmetic means for the beta distributions described above, which were based on the sample values for the 10,000 hypothetical participants.

In our study, separate Monte Carlo analyses were used to determine the recommended glide-path weights for a hypothetical population described by the distributions outlined above and for a separate hypothetical population described by the arithmetical averages for those same inputs.

Subsequently, we generated two sets of 10,000 potential retirement outcomes for the two glide paths over the same "test scenario" set of individuals representing the same heterogeneous inputs as the sample used to construct the distributions-based glide path. The same heterogeneous test scenario set was used to compare outcomes of the two glide paths in order to simulate exact participant-to-participant comparisons across our hypothetical populations.

For each scenario in the test set, we measured the potential relative performance, positive or negative, of the distributions-based glide path versus the comparable averages-based glide path along two critical outcome metrics: annual consumption replacement during retirement and asset values at retirement. Both values are expressed in percentage terms: A positive percentage indicated a scenario in which the distributions-based glide path outperformed, while a scenario in which the averages-based glide path outperformed resulted in a negative percentage.

For each year in the assumed post-retirement time horizon, the relative scenario results were ranked in quantiles—corresponding to the scenarios at the 10th, 25th, 50th, 75th, and 90th percentiles in outcomes, with the 10th percentile indicating the lowest and the 90th percentile the highest relative performance by the distributions-based glide path.

It should be noted that the specific scenarios represented by these percentile rankings changed each year over the course of the time horizon modeled, producing considerable variability from year to year in the actual dollar-consumption amounts represented by those rankings, although less so in the percentage differences between the averages-based and the distributions-based glide paths.

Monte Carlo simulations model future uncertainty. In contrast to tools generating average outcomes, Monte Carlo analyses produce outcome ranges based on probability thus incorporating future uncertainty. The projections are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. The simulations are based on assumptions. The materials present only a range of possible outcomes. As a consequence, the results of the analysis should be viewed as comprehensive, but not exhaustive. Actual results are unknown therefore results may be better or worse than the simulated scenarios. The potential for loss (or gain) may be greater than demonstrated in the simulations. Users should also keep in mind that seemingly small changes in input parameters, including the initial values for the underlying factors, may have a significant impact on results, and this (as well as mere passage of time) may lead to considerable variation in results for repeat users.

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