

# Does a volatility management fund have a place in a target-date fund?

- Retirement looks very different for each participant in a defined-contribution (DC) plan. Their retirement journey depends on several factors like health status, household structure, financial goals, and plans to work postretirement. In the last two decades, wide-ranging solutions supplementing traditional target-date funds (TDFs) have been introduced to address the heterogeneous retirement needs of participants.
- A TDF with a volatility management fund (VMF) could provide another complementary approach in the decumulation ecosystem by helping participants stabilize their retirement savings. A VMF is a multiasset product that uses a structure similar to a stable value fund (SVF) and involves investment in an underlying portfolio of equities and fixed income, along with an insurance contract that provides downside protection against portfolio losses. The insurance contract enables the VMF to utilize accounting techniques and amortize the underlying portfolio's returns over an extended time frame, resulting in reduced volatility exposure for investors.
- We evaluate the investment merits for a VMF-based TDF using the proprietary Vanguard Life-Cycle Investing Model (VLCM). The enhanced balance stability from a VMF can be impactful for participants as they move from their working lives to the retirement phase. The value offered to a participant depends on the design of the investment strategy and is impacted by factors like the timing, amount, and composition of a VMF. But beyond the investment case, there are potential challenges around cost, scale, portability, complexity, suitability, and feasibility that must be addressed to unlock the full benefits of a VMF.

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## Introduction

For over five decades, DC plans have helped participants invest and grow their savings to meet retirement goals. As participants enter the decumulation stage and start using their nest eggs, the investment strategies of DC plans aim to support their goals around retirement income and bequests, while also providing stability for accumulated assets. TDFs have typically dominated as the preferred investment strategy in DC plans, followed by managed accounts. To effectively serve the wide range of DC plan participants, Vanguard constantly researches new themes. The work shared in this paper about the potential use of a multiasset VMF in a participant's investment portfolio is one such idea.

A VMF uses an SVF-like structure and involves investment in an underlying portfolio of equities and fixed income, along with an insurance contract. The insurance contract enables the VMF to amortize the underlying portfolio's returns over a long time period, resulting in reduced volatility exposure for investors. By including equities, a VMF could provide a higher return than a traditional SVF that includes only fixed income securities. When used in an investment strategy, a VMF could help reduce the volatility of accumulated assets without limiting their growth potential. This stability helps participants in financially securing both retirement income and bequest goals. We use the VLCM (Aliaga-Díaz et al., 2021) to evaluate the investment merits of including a VMF in a participant's investment strategy.

Given the ease, reach, and flexibility of TDFs, we have focused our analysis on using a VMF within a TDF.<sup>1</sup> But most of our observations could be extended to other professionally managed solutions like managed accounts. Beyond the investment merit showcased in this paper, there are important questions around product viability, client demand, and participant education that need to be answered. We discuss these considerations along with the key benefits, risks, and hurdles associated with a VMF.

## What is a multiasset VMF?

SVFs have been offered in DC plans for over 50 years, with 68% of plans covered in *How America Saves 2024* (Vanguard, 2024) including an SVF in their core menu lineups. SVFs typically invest in a portfolio of short- to intermediate-term fixed income securities. However, unlike traditional fixed income portfolios, SVFs also include an insurance contract ("wrap") issued by a financial institution that provides downside protection against portfolio losses. This insurance contract allows the SVF to utilize accounting techniques to amortize the underlying ("wrapped") portfolio's returns over an extended time frame (typically three to four years), resulting in reduced volatility exposure and a stable return stream for participants. An SVF investor receives this return in the form of the crediting rate. Our crediting rate calculations can be found in the Appendix.

A VMF is a multiasset SVF that works very similarly to a traditional SVF, with the key difference being the underlying portfolio used. Unlike a traditional SVF that includes only fixed income securities, a VMF invests in both equities and fixed income. By including equities in its wrapped portfolio, a VMF can potentially provide a higher return than a traditional SVF. The volatility smoothing offered by a VMF could be helpful for participants during their retirement phase, where the VMF could be included as part of the investment strategy.

## Should a VMF be included in a TDF?

Vanguard's *How America Saves 2024* report showed that 96% of plans offered TDFs, with 86% of all participants using TDFs at the end of 2023 (Vanguard, 2024). Mostly used as a qualified default investment alternative (QDIA), TDFs employ a glide-path approach to investing, where allocation to riskier growth-focused assets decreases with a participant's age, while allocation to stability-focused fixed-income-like assets increases.

<sup>1</sup> Additionally, just like a traditional SVF, a VMF could only be used in a qualified retirement plan. We focus on TDFs as they represent one of the most widely used investment strategies in qualified retirement plans.

At the beginning of a participant's life, most of their wealth (human capital) is in the form of future earnings. High human capital, along with a long investment horizon, implies younger participants are better able to withstand portfolio risk, thus making a higher allocation to growth-focused equity-like investments appropriate for their portfolios. As participants age, the accumulated wealth (financial capital) increases, shifting the focus to stability. TDFs facilitate this transition by increasing allocation to fixed-income-like assets for participants near or in retirement.

Portfolio stability becomes more important for participants as they move from their working lives to the retirement phase, for a few reasons:

- The time horizon decreases, leaving little room to alter the investment portfolio because of changes in market cycles.
- Participants start withdrawing from the portfolio to cover their retirement lifestyles, meaning any losses due to market movements get locked in as the amount withdrawn from the portfolio never has a chance to benefit from market recovery (commonly known as "sequence-of-returns" risk).

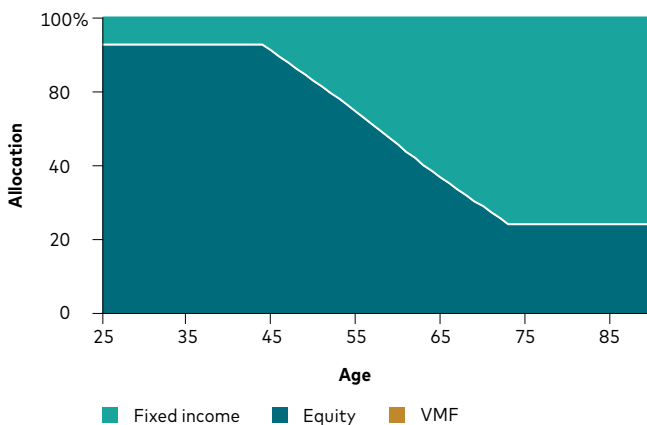
- Older participants have a greater tendency to react to market volatility than younger participants, making them more likely to sell off holdings during market downturns (Shleifer, 2000, and Gamble et al., 2015).

TDFs have done a good job of addressing these concerns by using a fixed-income-heavy allocation during a participant's decumulation stage. There could be an opportunity to further enhance a participant's experience by adjusting the TDF's asset allocation so it reduces portfolio volatility without limiting growth potential. Using a VMF within a TDF is one such alternative that we explore in this paper, although most of our observations could also be applied to other structures like managed accounts.

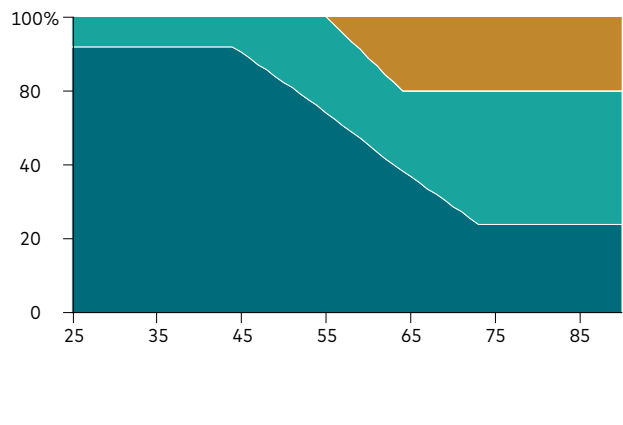
A TDF with a VMF would combine the asset accumulation offered by a traditional TDF with reduced exposure to market volatility during the decumulation phase. By replacing part of the fixed income allocation with a VMF, a TDF investor could obtain exposure to higher growth potential with the same (or even a lower) level of market risk. A hypothetical TDF with a VMF is illustrated in **Figure 1**, where the allocation to growth-focused equity assets decreases while the allocation to the VMF increases as a participant ages before both level off.

**FIGURE 1**  
**Illustrative asset allocation of a traditional TDF versus a TDF with a VMF**

a. TDF



b. TDF with a VMF



**Notes:** The VMF start age is 55, and the maximum allocation to the VMF is 25%. The VMF composition is 20% U.S. equity and 80% U.S. fixed income.  
**Source:** Vanguard.

## Evaluation framework

We evaluate the investment merits of a TDF with a VMF by using the VLCM, a utility-based framework that incorporates participants' goals and preferences while evaluating different investment strategies (see **Figure 2**).<sup>2</sup> Utility is a proven and academically accepted way to quantify human behavior and decision-making. It captures the asymmetric trade-offs between the positive feelings arising from a good outcome and the amplified negative feelings that typically accompany a bad one. We use the Constant Relative Risk Aversion utility function that economists have used to solve life-cycle problems for over 50 years, starting with Merton (1969) and Samuelson (1969).

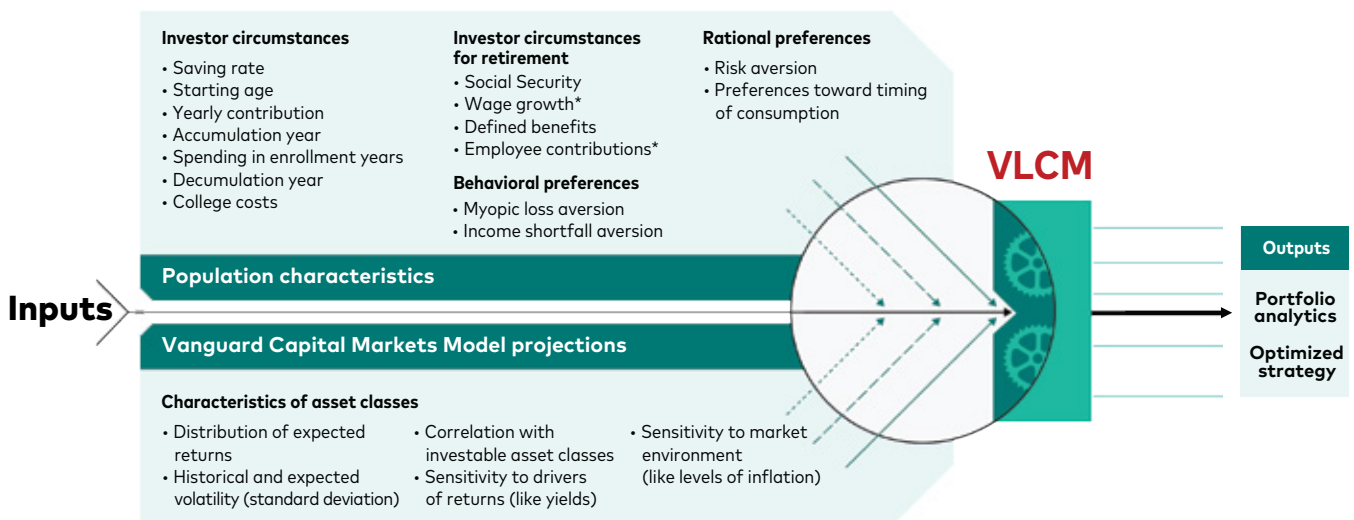
The VLCM evaluates investment strategies by quantifying the utility derived by the participant from spending and bequests that can be funded from their investment portfolio and other sources over their lifetime in the presence of uncertain asset returns. While evaluating investment strategies, the VLCM also considers the balance stability offered by the investment portfolio.

The model leverages long-term asset return expectations derived from the Vanguard Capital Markets Model® (VCMM);<sup>3</sup> incorporates multiple income sources such as defined benefits (DBs), annuities, and Social Security; and accounts for different participant goals like retirement consumption, bequests, and portfolio balance stability.

### What is certainty fee equivalent?

Throughout this paper, we use certainty fee equivalent (CFE) as a metric to evaluate TDFs. CFE incorporates a participant's preferences and translates the improvements in consumption, wealth, and portfolio stability into units of returns. It can be thought of as the additional annual fee a participant would be willing to pay for an improved or optimal asset allocation (for example, a TDF with a VMF) relative to a reference asset allocation (for example, a traditional TDF).<sup>4</sup> The higher the CFE, the greater the utility a participant would derive from the optimal TDF compared with the reference TDF.

**FIGURE 2**  
**Vanguard Life-Cycle Investing Model**



\*Data sourced from Vanguard's report, *How America Saves 2024*.

**Note:** See the "Life-cycle modeling inputs" section in the Appendix for additional details.

**Source:** Vanguard.

- See the "Life-cycle modeling inputs" section in the Appendix for additional details on the VLCM.
- See the Appendix for additional details on the VCMM.
- To evaluate CFE, we calculate the expected utility  $x$  of a TDF with a VMF from the full range of market scenarios in our Monte Carlo simulation. With the same participant characteristics (savings, expenses, and preferences), we calculate the expected utility  $y$  for the reference portfolio, a traditional TDF. CFE is the haircut applied to a full range of uncertain asset returns that makes the utility  $x$  from the TDF with a VMF the same as the utility  $y$  from the traditional TDF.

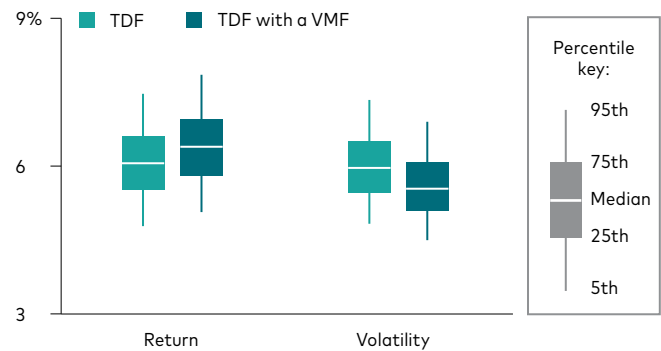
## How does a VMF create value for a TDF investor?

TDFs have played a key role in providing investment strategies for participants saving for retirement. They help participants accumulate and grow assets throughout their working lives. During a participant's retirement, TDFs aim to ensure that accumulated assets remain invested in capital markets while supporting the ability to meet lifestyle goals. By including a VMF in a TDF, participants can enhance the effectiveness of their investment strategies by reducing portfolio volatility without adversely impacting their ability to meet retirement income or bequest goals.

In our analysis, a VMF is introduced in a TDF as the participant approaches retirement, which is often a time of heightened anxiety. In this section, we compare the participant outcomes for a TDF using a VMF with a traditional TDF. The asset allocations used for the two TDFs were previously shown in Figure 1. Both TDFs have similar equity allocations, but the VMF replaces part of the fixed income allocation in the second TDF.

Figure 3 and Figure 4 show metrics from Monte Carlo simulations where we analyze outcomes from 10,000 different market scenarios. The impact of a VMF on the investment portfolio's return and risk outcomes is shown in Figure 3, where we compare expected return and volatility during a participant's decumulation phase (from age 65 to the end of life). The inclusion of a VMF reduces the expected portfolio volatility, providing stability at a time when it's most critical for the participant. This reduction in expected volatility does not come at the cost of the portfolio's expected return. The combination of these two dynamics leads to an improved portfolio outcome compared with the traditional TDF.

**FIGURE 3**  
**Portfolio return and volatility during the decumulation phase**



**Notes:** The VMF start age is 55, and the maximum allocation to the VMF is 25%. The VMF composition is 20% U.S. equity and 80% U.S. fixed income.

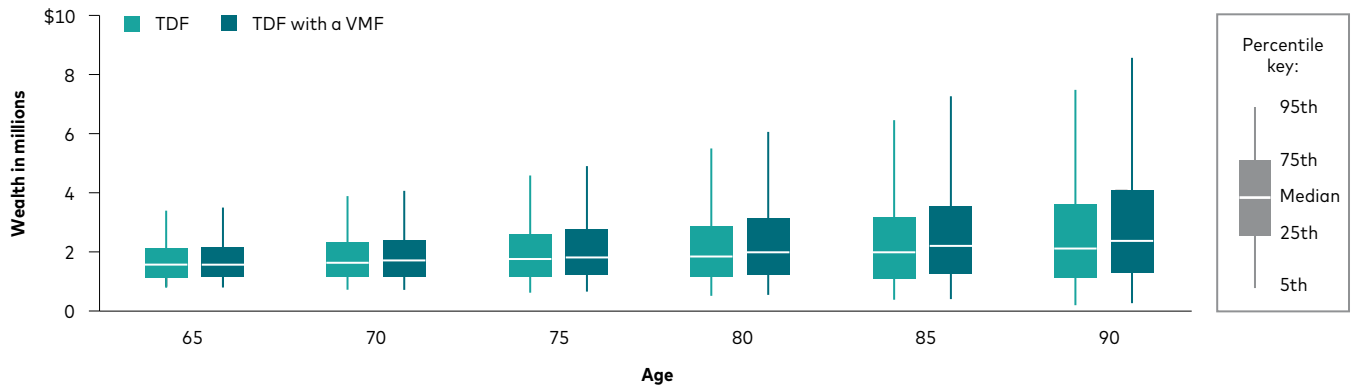
**Source:** Vanguard, with the simulated performance calculated using the VLCM and VCMM.

**IMPORTANT:** The projections and other information generated by the VCMM regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. Distribution of return outcomes from the VCMM are derived from 10,000 simulations for each modeled asset class. Simulations are as of December 2024. Results from the model may vary with each use and over time. For more information, please see the Appendix.

By using a TDF with a VMF, a participant could achieve improved balance stability while experiencing similar (or better) outcomes for income and bequest goals compared with a traditional TDF. As shown in Figure 4, the TDF with a VMF increases accumulated wealth during the later years of retirement (the median wealth increase is around 13% by age 90) compared with a traditional TDF. At the same time, a lower-volatility portfolio doesn't compromise a participant's retirement income goal, as total retirement income remains comparable when using a VMF.

To holistically accommodate the impact of balance stability, wealth, and retirement income, we use the VLCM to evaluate the two TDFs discussed above. With the VLCM, we can use the CFE (utility metric) to measure the degree of improvement in a participant's ability to meet retirement expenses, the reduction in the risk of outliving one's wealth, and the mitigation of market risk when using a TDF with a VMF versus a traditional TDF. Driven primarily by better balance stability during retirement, the TDF with a VMF provides a CFE value of 0.24% compared with a traditional TDF.

**FIGURE 4**  
**Accumulated wealth: TDF versus a TDF with a VMF**



**Notes:** The VMF start age is 55, and the maximum allocation to the VMF is 25%. The VMF composition is 20% U.S. equity and 80% U.S. fixed income.  
**Source:** Vanguard, with the simulated performance calculated using the VLCM and VCMM.

## How does asset allocation impact the investment merits of a TDF with a VMF?

To analyze the investment merits of a TDF with a VMF, we evaluate its performance under different design elements. The timing, amount, and composition of a VMF could impact the investment value a participant receives in a TDF that uses a VMF. We evaluate each of these design parameters by using the VLCM and compare the utility (CFE) a participant experiences in a TDF with a VMF versus a traditional TDF. We analyze the potential value offered by different VMF-based TDFs in consideration of the three key design elements shown in **Figure 5**—VMF start age, VMF maximum allocation, and VMF composition.

Key observations from our analysis of the investment merits of a TDF with a VMF include:

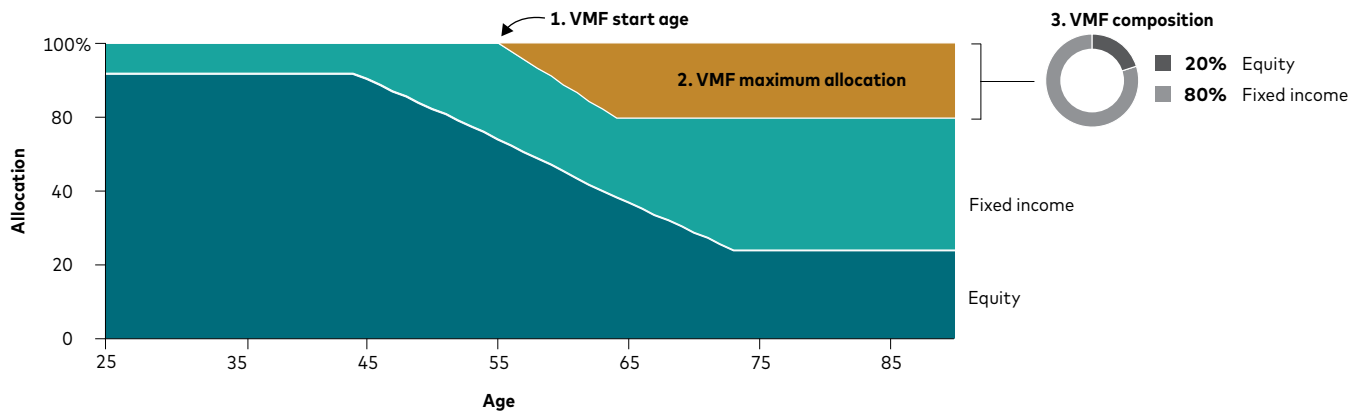
- A VMF would be most effective when used in the decumulation stage. Our analysis suggests the VMF allocation should be built gradually by starting 5–10 years before retirement.

- Increasing the allocation to a VMF improves the balance stability of a TDF.
- Theoretically, a higher equity allocation within a VMF increases its value to the participant. The actual equity allocation that can be realistically included within a VMF depends on several provider-specific factors like capacity, demand, and the economic feasibility of the VMF.

### Optimal allocation for a TDF with a VMF

All CFEs shown in this section are for optimized TDFs. We identify the optimal TDF allocation based on three VMF variables: start age, maximum allocation, and composition. These variables determine the overall exposure to a VMF in a TDF. For the remaining TDF allocation, there could be numerous choices in the form of equity-bond glide paths. We evaluate multiple potential glide paths and select the one that provides the highest utility to a TDF participant.

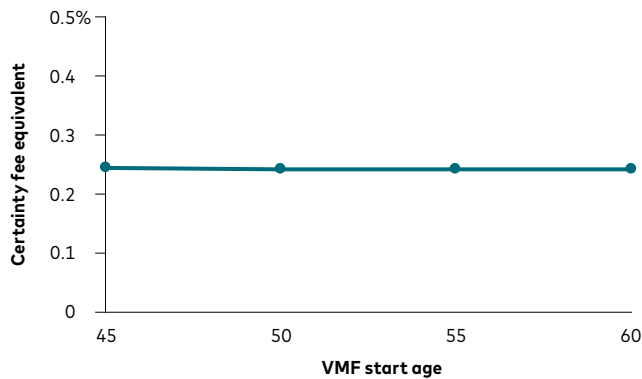
**FIGURE 5**  
Design elements of a TDF with a VMF



Source: Vanguard.

**VMF start age** is the age when a TDF starts allocation to a VMF. As most of the value is driven by the balance stability offered by a VMF during the decumulation stage, changing the VMF start age (and hence the overall exposure to a VMF during the accumulation stage) has marginal impact on the CFE. **Figure 6** shows the impact of different VMF start ages on optimal TDF CFEs. As CFEs don't change much with VMF start age, the participants will be better served by using an equity-bond portfolio during the accumulation stage and including a VMF only during the decumulation stage for improved balance stability. This VMF allocation needs to be developed gradually, so it could be helpful to start VMF exposure 5–10 years before retirement and then build it slowly.<sup>5</sup>

**FIGURE 6**  
Impact of VMF start age on TDF value

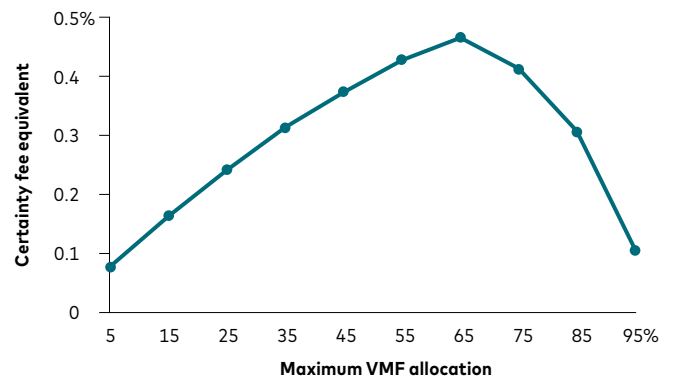


**Notes:** The VMF start age is 45–60, and the maximum allocation to the VMF is 25%. The VMF composition is 20% U.S. equity and 80% U.S. fixed income.

**Source:** Vanguard, with the simulated performance calculated using the VLCM and VCMM.

**VMF maximum allocation** is the highest VMF exposure that a participant receives over their lifetime. In our analysis, the allocation to the VMF increases with a participant's age and reaches its highest value near retirement. There is an inherent trade-off between the growth offered by equities and the balance stability provided by a VMF. Due to this trade-off, the value offered by a TDF with a VMF initially increases with VMF allocation and then starts decreasing. This is shown in **Figure 7**, where the enhanced balance stability provided by a VMF leads to an initial increase in CFE as the VMF allocation is increased. As the VMF allocation increases to a level where it starts crowding out the growth from equities, however, the investment value begins to decrease.

**FIGURE 7**  
Impact of maximum allocation to a VMF on TDF value



**Notes:** The VMF start age is 55, and the maximum allocation to the VMF is 5%–95%. The VMF composition is 20% U.S. equity and 80% U.S. fixed income.

**Source:** Vanguard, with the simulated performance calculated using the VLCM and VCMM.

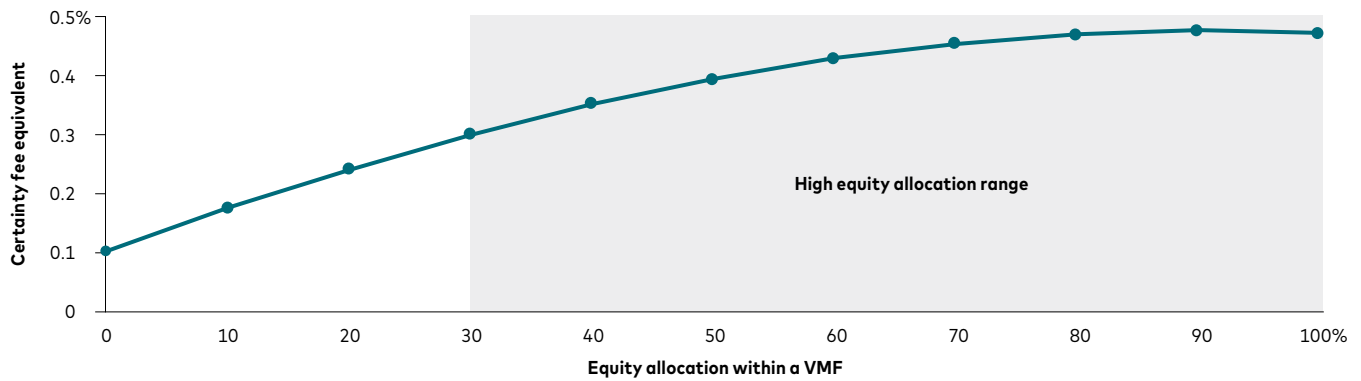
**5** Introducing significant changes in a portfolio at or near retirement could expose participants to sequence-of-returns risk. During retirement, the participants start withdrawing from the portfolio to cover their retirement lifestyles, meaning that any losses due to market movements or allocation changes become locked in, as the amount withdrawn from the portfolio never gets a chance to benefit from market recovery.



**VMF composition** is the allocation of the portfolio included inside a VMF. In our analysis, we have assumed that a VMF holds a portfolio of U.S. equities and fixed income. This portfolio is then wrapped under an insurance product and offers amortized returns to the participant. The impact of changing the mix of equity and fixed income within a VMF is illustrated in **Figure 8**. As shown, a higher equity allocation inside the VMF generally leads to greater potential growth for the TDF and potential value for the participant.

It's worth noting that the allocations shown here are hypothetical. It might not be economically feasible for a VMF provider to offer a product that includes a very high equity allocation within a VMF (represented by the shaded area in Figure 8). Using a higher equity allocation within a VMF would increase the risk for the insurer, as it would have to amortize a return stream with higher volatility. This would not only increase the cost of a VMF but could also make it unfeasible for an insurer to support the product beyond a certain equity-bond mix.

**FIGURE 8**  
**Impact of VMF composition on TDF value**



**Notes:** The VMF start age is 55, and the maximum allocation to the VMF is 25%. The VMF composition is 0%–100% U.S. equity and 100%–0% U.S. fixed income.  
**Source:** Vanguard, with the simulated performance calculated using the VLCM and VCMM.

## Does a VMF provide value under stressed conditions?

The analysis shared up to this point shows that a VMF could improve participant outcomes when included in a TDF. To evaluate if a VMF continues to provide value even in stressed scenarios, we tested its performance in incrementally adverse conditions. There are several factors that could impact the VMF performance, but those with the most prominent effect are market drawdowns, participant-directed outflows, and a default by the insurance provider. Under all these conditions, a TDF with a VMF continued to perform well compared with a traditional TDF.

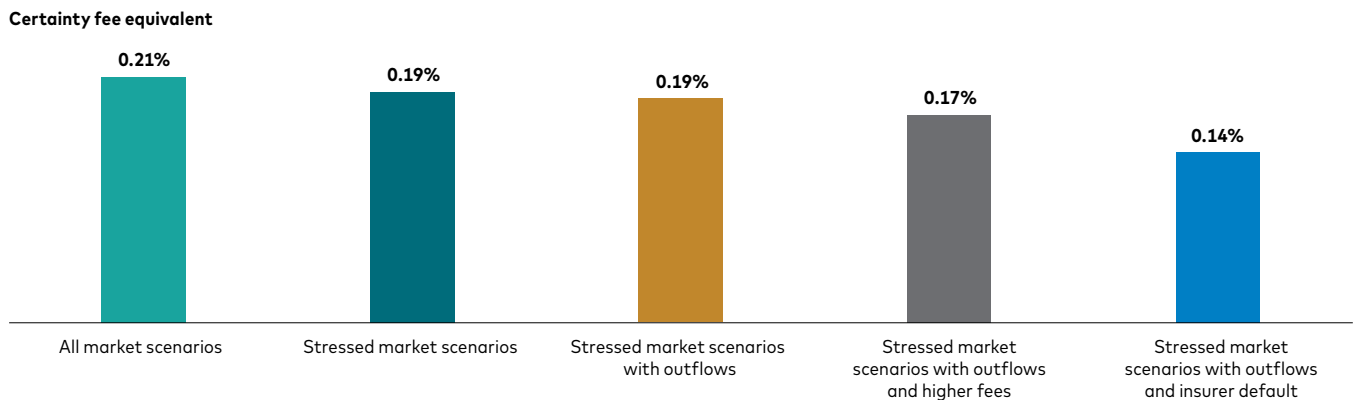
The results of stress tests are shown in **Figure 9**, where we used the VLCM to evaluate a VMF-based TDF<sup>6</sup> under the following conditions:

- Stressed market scenarios where the underlying portfolio provides negative returns for three or more consecutive years during the retirement phase.

- Stressed market scenarios that include high outflows from the VMF.<sup>7</sup>
- Stressed market scenarios that include high outflows from the VMF and an increase in VMF fees.<sup>8</sup>
- Stressed market scenarios that include high outflows from the VMF and a default by the insurance provider.

We started with the market-driven stressed scenario where the VMF's underlying portfolio underperforms. Given that the VMF amortizes portfolio returns over a long time period, the participant experiences these market drawdowns over a much longer time compared with what they would have experienced without the VMF. This leads to better performance of the TDF with a VMF versus a traditional TDF.

**FIGURE 9**  
**Performance of a TDF with a VMF under different market scenarios**



**Notes:** The VMF start age is 55, and the maximum allocation to the VMF is 25%. The VMF composition is 20% U.S. equity and 80% U.S. fixed income.

**Source:** Vanguard, with the simulated performance calculated using the VLCM and VCMM.

<sup>6</sup> For stress testing, we evaluated TDF performance in Monte Carlo simulation paths that reflect the scenarios being tested.

<sup>7</sup> For stress testing, we assumed that participants withdraw 15% of the VMF investment annually.

<sup>8</sup> For stress testing, we assumed that VMF annual fees increase by 30 basis points. (A basis point is one-hundredth of a percentage point.)

Next, we tested VMF performance under adverse participant behavior. Following a market drawdown, if there are large outflows from a VMF, the portfolio losses would be allocated among participants who stay invested in the VMF. This could lead to lower VMF returns compared with the case where such outflows don't occur. Looking at a participant's entire life cycle, we still saw positive value from a TDF with a VMF, driven primarily by the volatility smoothing from the VMF in the years leading up to and after the market drawdown events.

Finally, we added adverse actions from a VMF provider that could impact VMF performance. For such scenarios, we assumed that along with the market underperformance and significant participant outflows, the VMF insurance provider either increases VMF fees or, in the worst case, defaults on its obligations. An insurer default has the most prominent impact on VMF performance, as the loss of insurance coverage causes the VMF to lose the return-amortization benefit, and participants start receiving market returns from the VMF portfolio rather than the smoothed return they received before the default.<sup>9</sup>

### **Potential appeal of a TDF with a VMF**

Retirement looks very different for each participant. Their retirement journey depends on several factors like health status, household structure, financial goals, and plans to work postretirement. In the last two decades, wide-ranging solutions supplementing traditional TDFs have been introduced to help participants create effective decumulation strategies. Through products such as annuities and hybrid annuity TDFs (Dave et al., 2024), services such as withdrawal guidance and paycheck services, or hybrid offerings such as dynamic QDIAs, these solutions help participants draw income from their accumulated nest eggs. A TDF with a VMF

could provide another complementary approach in the decumulation ecosystem by helping participants keep their retirement savings stable and providing them with more time to firm up their decumulation strategies.

A VMF combines the balance stability offered by an SVF with the growth potential of equities. A VMF could be used in a TDF to either decrease portfolio volatility for a return level similar to that of a traditional TDF, or to increase portfolio return for a volatility level similar to that of a traditional TDF. When a VMF is included in a TDF, the portfolio volatility is likely to improve in the short term without decreasing growth potential in the long term.

The balance stability is more important for participants in the retirement phase due to a shorter time horizon, higher sequence-of-returns risk, and age-specific behavioral biases, as discussed earlier in the section, "Should a VMF be included in a TDF?" All these factors make a VMF an appealing option for participants transitioning from the accumulation phase to the decumulation phase. Whether such an alternative is feasible would depend on a host of implementation and operational factors like participant population characteristics, complexity, cost, and adoption.

VMFs are liquid instruments, just like fixed-income-based SVFs. Participants could get in and out of a VMF contract while remaining in a qualified retirement plan. Compared to some other products where participants might feel like they lose control of assets after starting a guaranteed income stream, a VMF could offer an alternative solution where participants benefit from stabilizing their accumulated assets while retaining control of them. Participants who value such control could find more value in a VMF, although another key consideration is the portability to IRAs or other plans, which we discuss in the next section.

<sup>9</sup> As observed in the previous scenario, there is a decrease in the VMF-based TDF value, but it remains positive because of the volatility smoothing from the VMF in the years leading up to and after the hypothetical developments used for the stress test.

## Limitations and considerations for a TDF with a VMF

Either through a TDF or as part of advice, using a VMF could help certain participants. The main value provided by a VMF is an improvement in balance stability without limiting a portfolio's potential growth. But beyond the investment case is the question of whether such a product could be viable for participants, plan sponsors, and providers. Here, we list some of the challenges that must be tackled before participants could effectively realize the investment value offered by a VMF.

**Costs:** With the additional expenses of a stable value wrap and provider-specific fund fees, a TDF with a VMF would cost more than a traditional TDF. That cost remains one of the significant considerations for many participants and plan sponsors. Adoption of a VMF would require transparent expense information and a meaningful focus on product evaluation by considering both the benefits and associated costs.

**Scale and cashflows:** One of the requirements for a VMF provider to support such a product is a regular stream of cash inflows to balance outflows. Given that a VMF is an insurance product, the insurer would need to step in and support the product if there are withdrawals following a market downturn. During such a market event, supporting a VMF could be challenging for an insurer if outflows are significantly higher than cash inflows.<sup>10</sup>

**Portability:** Although a VMF has been used by some plan sponsors as a menu item in their 401(k) plans, it remains a fairly new product. Portability at the participant level (from the employer's plan to an IRA) or the plan sponsor level (related to a change in the provider or recordkeeper) could be challenging. A lack of portability might deter plan participants from opting for VMF investments, as they fear losing flexibility in managing their retirement funds. This might also present an obstacle to plan sponsor adoption of VMF-based products. Portability could potentially be supported by middleware providers, but that would require broader demand for such a product in the retirement industry.

**Complexity:** Although a VMF works like an SVF, a product that has been used extensively in retirement plans, the complex product structure of a VMF could make it difficult for participants to effectively evaluate the trade-offs involved. Plan sponsors and participants would need considerable support and education to adopt a TDF with a VMF.

**Suitability:** The VMF component may not be optimal for everyone. Given that retirement income needs are quite heterogeneous across the participant population, the required timing, amount, and composition of a VMF could vary significantly.

**Feasibility:** The stable value industry has grown to over \$882 billion in retirement plan assets (MetLife, 2024), with the majority of SVFs today using a fixed income portfolio. Offering a VMF would require SVF providers to evaluate capacity and tolerance for the additional risk associated with the inclusion of equity investments in a VMF.

<sup>10</sup> This is mainly due to the dynamic between the book value and market value of a VMF. Following a market downturn, the market value of a VMF could drop substantially below its book value. To support the product, the insurer provides the difference between the book value and market value whenever there are outflows from a VMF. When the market value is significantly lower than the book value, increased support is required from the insurer for any cash outflows. However, this risk can be effectively managed by the VMF investment manager through stringent insurer selection criteria and rigorous ongoing due-diligence review of the wrap providers.

## Conclusion

Wide-ranging new products and services have been introduced in the market as the retirement industry tries to address the decumulation challenge for participants. Most of these solutions aim to provide a form of either guaranteed or nonguaranteed income stream. A VMF offers an alternative solution that could stabilize the accumulated assets when used in an investment portfolio. We analyzed a range of strategies that could be created by combining a TDF with a VMF. The value offered to a participant depends on the design of the investment strategy and is impacted by factors like the timing, amount, and composition of the VMF. Our analysis shows that a TDF with a VMF could provide investment merit for some participants, especially those looking for balance stability during retirement.

While this innovative solution appears promising, there are questions around product viability, client demand, and participant education that must be answered. We have discussed some of the considerations related to cost, scale, portability, complexity, suitability, and feasibility that need addressing. Participants seeking a simple and transparent solution are generally well served by traditional TDFs. That said, a VMF represents another tool for participants to potentially improve retirement security if the challenges discussed here could be effectively addressed.

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## Appendix

### Vanguard Capital Markets Model (VCMM)

**IMPORTANT: The projections and other information generated by the VCMM regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. VCMM results will vary with each use and over time.**

The VCMM projections are based on a statistical analysis of historical data. Future returns may behave differently from the historical patterns captured in the VCMM. More importantly, the VCMM may be underestimating extreme negative scenarios unobserved in the historical period on which the model estimation is based.

The VCMM is a proprietary financial simulation tool developed and maintained by Vanguard's Investment Strategy Group. The model forecasts distributions of future returns for a wide array of broad asset classes. Those asset classes include U.S. and international equity markets, several maturities of the U.S. Treasury and corporate fixed income markets, international fixed income markets, U.S. money markets, commodities, and certain alternative investment strategies. The theoretical and empirical foundation for the VCMM is that the returns of various asset classes reflect the compensation participants require for bearing different types of systematic risk (beta).

At the core of the model are estimates of the dynamic statistical relationship between risk factors and asset returns, obtained from statistical analysis based on available monthly financial and economic data. Using a system of estimated equations, the model then applies a Monte Carlo simulation method to project the estimated interrelationships among risk factors and asset classes as well as uncertainty and randomness over time. The model generates a large set of simulated outcomes for each asset class over several time horizons. Forecasts are obtained by computing measures of central tendency in these simulations. Results produced

by the tool will vary with each use and over time. The asset-return distributions used in this paper are drawn from 10,000 VCMM simulations based on market data and other information available. The model uses index returns, without any fees or expenses, to represent asset classes. Taxes are not factored into the analysis.

We implement the framework using five assets. We have assumed a 60/40 home bias within equities and a 70/30 home bias within fixed income toward the U.S. International fixed income is assumed to be currency hedged back to U.S. dollars. We refer to the combined allocation toward U.S. and international (or world ex-U.S.) equities as the overall equity allocation. Equity is the more risky asset and fixed income is the less risky asset. We assume that asset returns follow a vector autoregression (VAR) with one lag. VAR is a statistical model used to capture the relationship between multiple quantities as they change over time. VAR(1) means that the probability of achieving each equity and fixed income state in the next period is conditional on the current state of equities and fixed income.

$$\begin{bmatrix} r_t^e \\ r_t^b \end{bmatrix} = \begin{bmatrix} c^e \\ c^b \end{bmatrix} + \begin{bmatrix} \beta_{1,1}^{t-1} & \beta_{1,2}^{t-1} \\ \beta_{2,1}^{t-1} & \beta_{2,2}^{t-1} \end{bmatrix} \begin{bmatrix} r_{t-1}^e \\ r_{t-1}^b \end{bmatrix} + \begin{bmatrix} \varepsilon_t^e \\ \varepsilon_t^b \end{bmatrix}$$
$$\begin{bmatrix} \varepsilon_t^e \\ \varepsilon_t^b \end{bmatrix} \sim N \left( 0, \begin{bmatrix} \sigma_{et}^2 & \sigma_{e,bt} \\ \sigma_{e,bt} & \sigma_{bt}^2 \end{bmatrix} \right)$$

In the formula above:

- $r_t^e$  and  $r_t^b$  are the returns for equity ("e") and fixed income or bonds ("b") for year  $t$ .
- $c^e$  and  $c^b$  are the returns realized if prior returns are zero.
- $\beta$  is the coefficient relating prior returns to current returns.
- $\varepsilon^e$  and  $\varepsilon^b$  are the error terms that are normally distributed with a mean of 0 and covariance matrix ( $\sigma$ ).

## Indexes for VCMM simulations

The long-term returns of our hypothetical portfolios are based on data for the appropriate market indexes. We chose these benchmarks to provide the most complete history possible, and we apportioned the global allocations to align with Vanguard's guidance in constructing diversified portfolios. Asset classes and their representative forecast indexes are as follows:

- **U.S. equities:** MSCI US Broad Market Index.
- **Global ex-U.S. equities:** MSCI All Country World ex USA Index.
- **Global ex-U.S. developed market equities:** MSCI World ex USA Index.
- **Emerging markets equities:** MSCI Emerging Markets Index.
- **U.S. REITs:** FTSE Nareit U.S. Real Estate Index.
- **U.S. Treasury bonds:** Bloomberg U.S. Treasury Index.
- **U.S. short-term Treasury bonds:** Bloomberg U.S. 1–5 Year Treasury Bond Index.
- **U.S. intermediate-term Treasury bonds:** Bloomberg U.S. 5–10 Year Treasury Bond Index.
- **U.S. long-term Treasury bonds:** Bloomberg U.S. Long Treasury Bond Index.
- **U.S. intermediate credit bonds:** Bloomberg U.S. Credit Bond Index.
- **U.S. high-yield corporate bonds:** Bloomberg U.S. Corporate High Yield Bond Index.
- **U.S. bonds:** Bloomberg U.S. Aggregate Bond Index.
- **Global ex-U.S. bonds:** Bloomberg Global Aggregate ex-USD Index USD Hedged.
- **U.S. Treasury Inflation-Protected Securities (TIPS):** Bloomberg U.S. Treasury Inflation Protected Securities Index.
- **Emerging markets sovereign bonds:** Bloomberg Emerging Markets USD Sovereign Bond Index—10% Country Capped.
- **Mortgage-backed securities:** Bloomberg U.S. Mortgage Backed Securities Index.

All equity indexes below are weighted by market capitalization:

- **Small-cap equities:** Stocks with a market cap in the lowest two-thirds of the Russell 3000 Index.
- **Large-cap equities:** Stocks with a market cap in the highest one-third of the Russell 1000 Index.
- **Growth equities:** Stocks with a price/book ratio in the highest one-third of the Russell 1000 Index.
- **Value equities:** Stocks with a price/book ratio in the lowest one-third of the Russell 1000 Index.

**FIGURE 10**  
**Forward-looking long-run correlation expectations**

	U.S. cash	U.S. equities	U.S. nominal bonds	International equities	International bonds	Short-term TIPS
U.S. cash	1.0	—	—	—	—	—
U.S. equities	0.0	1.0	—	—	—	—
U.S. nominal bonds	0.2	-0.1	1.0	—	—	—
International equities	0.0	0.8	-0.1	1.0	—	—
International bonds	0.4	-0.1	0.7	-0.2	1.0	—
Short-term TIPS	0.5	-0.3	0.6	-0.2	0.5	1.0

Source: Vanguard, as of December 2024.

**FIGURE 11**  
**Annualized forward-looking long-run return and volatility expectations**

	Median return	Volatility
U.S. cash	3.5%	1.9%
U.S. equities	5.7%	17.9%
U.S. nominal bonds	5.0%	6.1%
International equities	8.5%	18.9%
International bonds	4.6%	4.7%
Short-term TIPS	3.8%	3.9%

Source: Vanguard, as of December 2024.

### TDF with VMF assumptions

The VMF is represented by an SVF that wraps U.S. equities and U.S. nominal bonds. The SVF is an insurance product that utilizes accounting techniques to amortize the underlying portfolio's returns over a long time period, resulting in reduced volatility exposure for the participant. In an SVF, the crediting rate is used to determine the returns experienced by the participant.

For each of the 10,000 market scenarios, we compute the crediting rate using the formula:

$$CR_t(i) = \max \left[ 0, \left( \frac{MV_t(i)}{BV_t(i)} \right)^{1/Duration_t(i)} * (1 + Yield_t(i)) - Fee - 1 \right]$$

$$MV_t(i) = MV_{t-1}(i) * (1 + PR_t(i))$$

$$BV_t(i) = BV_{t-1}(i) * (1 + CR_{t-1}(i))$$

In the formula above:

- $i$  is the market scenario.
- $t$  is the participant age.
- $CR_t(i)$  is the crediting rate (return) from the SVF for age  $t$  and market scenario  $i$ .
- $Fee$  is the wrap fee for the SVF. We use an annual fee of 0.20%.
- $MV_t(i)$  and  $BV_t(i)$  are the market value and book value of the SVF for age  $t$  and market scenario  $i$ .
- $PR_t(i)$  is the return on the wrapped portfolio in the SVF for age  $t$  and market scenario  $i$ .
- $Duration_t(i)$  and  $Yield_t(i)$  are the duration and yield of the wrapped portfolio in the SVF for age  $t$  and market scenario  $i$ .



## Life-cycle modeling inputs

FIGURE 12  
Inputs to the Vanguard Life-Cycle Investing Model

Input	Assumption	Notes
Starting age	25	—
Horizon age	111	—
Retirement age	65	—
Social Security withdrawal age	65	—
Savings rate (as % of salary)	8.8%–12.0%	The savings rate increases over time because of the expectation of savings escalation for retirement plan enrollees as the participant approaches their retirement date.
Starting real salary	\$52,000	For a participant in the workforce at age 25.
Ending real salary	\$75,000	For a participant starting at age 25 and retiring at age 65. We add productivity growth and inflation to this over time.
Wage scale	Wage Index	Based on the U.S. Social Security Administration National Average Wage Index.
Total replacement ratio	79%	This represents the percentage of preretirement income needed in retirement. It is based on real replacement rate estimates for an ending salary of about \$75,000 and a savings rate of 15% (Lobel, Jaconetti, and Cuff, 2019).
Social Security replacement ratio	37%	This is based on real monthly Social Security benefit estimates for an ending salary of about \$75,000 and savings rate of 15%.
DB replacement ratio	None (0%)	—
TDF replacement ratio	42%	This represents retirement expenses that need to be funded by the investment portfolio. It is calculated as: Total replacement ratio – Social Security replacement ratio – DB replacement ratio.
Spending rule	Hybrid spending*	Withdrawal amounts target a specified replacement ratio aimed at maintaining lifestyle in retirement. When wealth balances run low, spending reduces to a sustainable withdrawal amount that is dependent on the years of spending the portfolio is expected to support.

\* We use a hybrid spending rule to reflect a participant aiming to maintain their lifestyle while moving into retirement. We achieve this by using a replacement ratio, which is a conventional practice in the financial planning industry. The VLCM does allow for other spending rules like required minimum distributions, fixed percentage withdrawals, etc.

Source: Vanguard.

### **Wage scale**

Participant salary growth is modeled after the U.S. Social Security Administration's National Average Wage Index. The index is based on reported wages across workers' age spectrum of 25–65 for low-, medium-, and high-income earners. This allows us to trace the earnings progression of an average earner over a 40-year working career, accounting for factors such as career development. As modeled, the average participant reaches a peak salary at age 55 (in real terms) and experiences a decline in real salary through age 65. In our life-cycle simulations, we also allow for 1.1% annual salary growth, on a real basis, in addition to the cross-sectional increase in the wage scale, which reflects the historical average productivity growth of the U.S. economy.

### **Contribution rates**

Age-specific contribution rates are derived from *How America Saves 2024* (Vanguard, 2024), a report surveying the approximately 5 million participants served by Vanguard's recordkeeping business. Contribution patterns account for the likelihood that participants will start with a lower savings rate in their early working years and increase their contributions as retirement approaches. Contributions start at approximately 5% at age 25 and increase to approximately 10% by age 65. In addition, the simulations include a company match of \$0.50 per dollar up to 3% of salary, which is consistent with industry averages.

### **Replacement ratios and drawdown scenarios**

We follow industry convention in assuming that retirees will spend a percentage of their age-65 salary every year in retirement from a combination of Social Security benefits and investment income from private sources. In our baseline analysis, the replacement ratio assumption (as a percentage of the age-65 salary) is consistent with retirees maintaining the same standard of living enjoyed during their final working years. Replacement ratios vary by income level, as Social Security makes up a smaller percentage at larger salaries.

### **Survival probability**

Participant survival probabilities are calculated using the U.S. Social Security Administration's actuarial life tables. We use gender-neutral survival probabilities in this paper.

### **Taxes**

For simplicity, we ignore the impact of taxes in our model.

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The Vanguard Life-Cycle Investing Model (VLCM) is designed to identify the product design that represents the best investment solution for a theoretical, representative investor who uses the target-date funds to accumulate wealth for retirement. The VLCM generates an optimal custom glide path for a participant population by assessing the trade-offs between the expected (median) wealth accumulation and the uncertainty about that wealth outcome, for thousands of potential glide paths. The VLCM does this by combining two sets of inputs: the asset class return projections from the Vanguard Capital Markets Model (VCMM) and the average characteristics of the participant population. Along with the optimal custom glide path, the VLCM generates a wide range of portfolio metrics such as a distribution of potential wealth accumulation outcomes, risk and return distributions for the asset allocation, and probability of ruin, such as the odds of participants depleting their wealth by age 95.

The VLCM inherits the distributional forecasting framework of the VCMM and applies to it the calculation of wealth outcomes from any given portfolio.

The most impactful drivers of glide-path changes within the VLCM tend to be risk aversion, the presence of a defined benefit plan, retirement age, savings rate, and starting compensation. The VLCM chooses among glide paths by scoring them according to the utility function described and choosing the one with the highest score. The VLCM does not optimize the levels of spending and contribution rates. Rather, the VLCM optimizes the glide path for a given customizable level of spending, growth rate of contributions, and other plan sponsor characteristics.

A full dynamic stochastic life-cycle model, including optimization of a savings strategy and dynamic spending in retirement, is beyond the scope of this framework.

All investing is subject to risk, including the possible loss of the money you invest.

Diversification does not ensure a profit or protect against a loss.

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Investments in target-date funds are subject to the risks of their underlying funds. The year in the fund name refers to the approximate year (the target date) when an investor in the fund would retire and leave the workforce. The fund will gradually shift its emphasis from more aggressive investments to more conservative ones based on its target date. An investment in target-date funds is not guaranteed at any time, including on or after the target date.

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