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The impact of life events on target-date participants' retirement income sufficiency

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Introduction

Investors grapple with a seemingly endless list of questions and considerations as they formulate a plan to prepare adequately for retirement. The following questions are all sensible ones that nearly all participants would want to be able to confidently answer:

- How much do I need to save to have enough for retirement?
- When should I start saving?
- How do I know if I'm on the right track for a successful outcome?
- What specific investments or strategies can help me navigate uncertain markets and are appropriate for a long-term goal?

One bit of good news for retirement savers is that the answer to the last question has largely been addressed for millions of participants via the development and implementation of the target-date fund (TDF) in defined contribution (DC) plans. By starting to save early and saving consistently throughout their working years while investing in a well-designed TDF, participants have a strong chance of maintaining their current lifestyle in retirement. According to Vanguard research (*How America Saves 2025*), 84% of all DC participants had some investment in TDFs by the end of 2024, with about 71% relying on TDFs as their sole investment choice.

However, life is unpredictable, and various circumstances can arise that hinder participants' ability to save as they originally planned and put them in a position where they are not on track to achieve their retirement goals. In this paper, we explore how certain life events during a participant's accumulation phase can affect their retirement readiness and outcomes as target-date investors. Additionally, we evaluate potential saving and spending adjustments that participants could make following such events that may put them back on track for a successful retirement.

Our baseline TDF participant: Saving and investing assumptions and common life events

Since the passage of the Pension Protection Act of 2006, the use of TDFs in employer-sponsored plans has increased dramatically, helping participants construct professionally managed, diversified investment portfolios with a suitable level of risk that evolves over their time horizon. TDFs are generally designed to serve a large, diverse population of investors and to ensure that participants who start saving early and save consistently throughout their working years stand a good chance of meeting their retirement spending goals. Getting an early start on saving for retirement provides a longer time horizon for investment balances to grow through compounding as well as to recover from the inevitable market downturns. Even relatively small but consistent savings amounts over a long period of time can add up significantly while also being more manageable for participants who are trying to balance multiple priorities in their lives.

The inherent uncertainty of life and the timing and frequency of any savings disruptions can sidetrack even the best-laid retirement savings plans. In this paper, we use our proprietary Vanguard Life-Cycle Investing Model (VLCM)[1] to assess how different life events might affect retirement readiness for a generalized baseline target-date participant. Absent any life events that result in disruptions to a baseline TDF participant's saving and investing habits, Vanguard employs the following expectations in its TDF methodology (see "Baseline TDF participant" table on the next page).

1 The VLCM is a utility-based framework that accounts for investor characteristics, preferences, and constraints and incorporates market return projections from the Vanguard Capital Markets Model® (VCMM). It seeks to find an optimal glide path from a pool of potentially thousands that best balances portfolio volatility due to market risk with maximizing the probability of achieving retirement spending and wealth goals over the investor's lifetime.

Baseline TDF participant:[2]

Assumptions	Expected outcomes
Begins saving and investing for retirement at age 25, contributing 8.8% of their compensation, and works uninterrupted until retirement at age 65 while gradually increasing their saving rate to 12.0%.	Accumulates approximately $1.54 million in median wealth by retirement at age 65.
Aims to replace 79% of their ending salary in retirement to maintain pre-retirement lifestyle.	Has a 92% probability of meeting or exceeding their 79% goal at age 95.

While numerous factors can influence a participant's retirement preparedness, we will focus on two common events that may occur during a participant's pre-retirement phase:

1. A delayed start to saving
2. A temporary employment disruption

To measure each event's impact, we can compare the change in median accumulated wealth at retirement and the participant's probability of spending sufficiency at age 95 with that of the baseline TDF investor. Then we can evaluate and propose two corrective measures, namely adjustments to either pre-retirement savings or post-retirement spending levels, that could be implemented to counteract each event's impact and help participants restore their probability of spending sufficiency to the 92% baseline expectation.

Each life event scenario and corrective measure is considered in isolation and independently for illustrative purposes. In reality, these life events can occur multiple times and, as with mitigating strategies, in combination with each other or with other events beyond what's discussed in this paper. For more complex circumstances, an advisor could provide a more comprehensive and tailored approach to better help participants achieve their retirement goals and desired outcomes.

"I'll get to it someday": Exploring the impact of delayed retirement savings

Consider a sobering fact: More than one-third of individuals ages 25 to 40 have little to no retirement savings (USAFacts, 2023). As alarming as this sounds, it is unlikely that anyone plans to be part of this statistic. Rather, there likely exist several reasons, including competing financial priorities such as debt repayments (for example, student loans), day-to-day living expenses, insufficient financial education about the significance of saving for retirement and the benefits of starting early, and even lack of access to employer-sponsored retirement plans, that could account for this situation. Unfortunately, for every year they delay saving for retirement, participants forgo contributions and the compounding returns on those contributions that are crucial to building a sufficient nest egg.

We can assess the impact of delayed savings for a participant who postpones saving by 5, 10, 15, and 20 years versus the baseline target-date participant by calculating how much the delay reduces the median wealth accumulated by retirement and how the delay changes the probability of meeting spending needs at age 95. In other words, although we assume that the participant begins employment at age 25, they delay starting to make retirement plan contributions until ages 30, 35, 40, or

WHAT IS PROBABILITY OF SPENDING SUFFICIENCY?

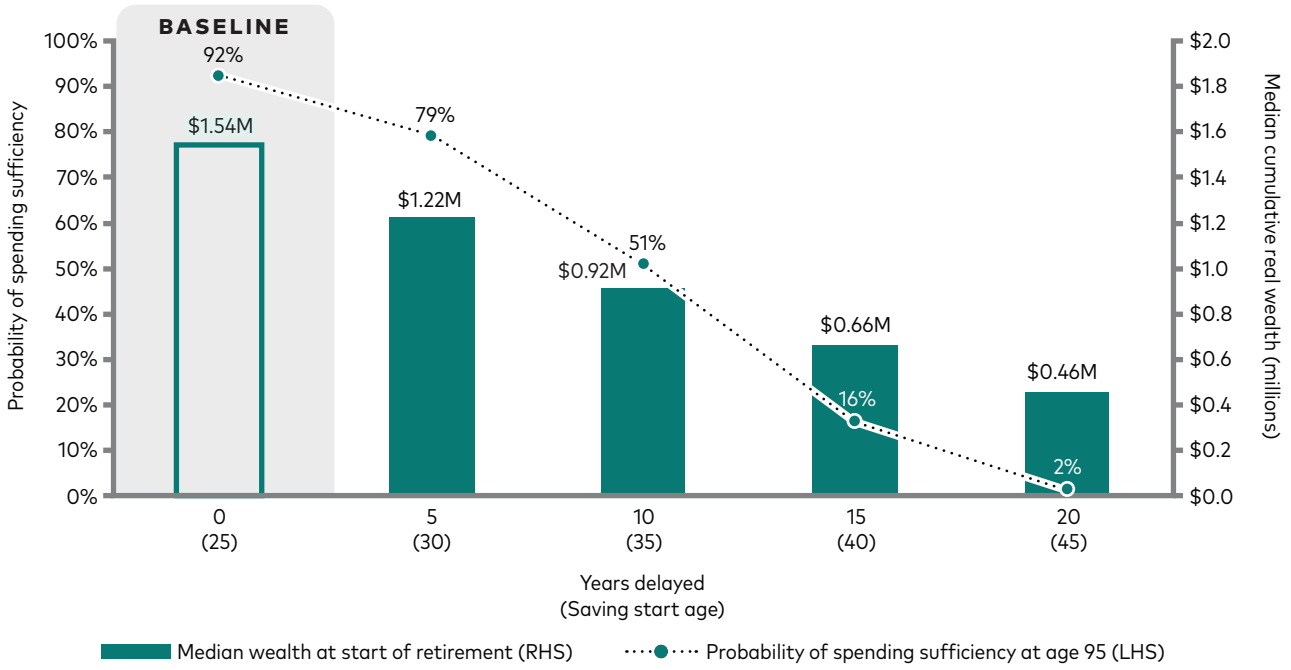
Probability of spending sufficiency is the likelihood of a participant meeting or exceeding their target spending goal. It is calculated as the total percentage of scenarios across 10,000 Monte Carlo simulation scenarios at any given age in retirement. It can also be thought of as the chances that the participant will still have a positive balance after covering their spending goal with inflation-adjusted income from the portfolio and all other sources.

2 See Appendix I and Daga et al. (2022) for additional details and information about the Vanguard Target Retirement participant profile.

45. When they eventually begin contributing, the saving rate at each respective start age is assumed to be equivalent to the age-25 starting saving rate of our baseline TDF investor. From there, the saving rate follows the baseline progression schedule up to retirement.

As noted previously, our baseline participant is assumed to save 8.8% of their salary (including both employee and employer contributions) starting at age 25, gradually increasing this rate in a linear fashion over their career to 12.0% by age 65. In contrast, the participant who postpones saving to age 30 would save nothing from ages 25 to 29, begin with an 8.8% saving rate at age 30, and eventually reach a peak of 11.6% by age 65. This truncated accumulation phase and lower overall savings resulting from the five-year delay reduces the participant's probability of spending sufficiency by 13 percentage points, from the baseline 92% sufficiency rate to 79%. Additionally, the expected median wealth at retirement is significantly lower with a five-year delay, resulting in an approximate $320,000 reduction in accumulated funds by age 65. As illustrated in Figure 1, delays beyond five years have increasingly more severe effects on the participant's prospects. A saving delay of 10 years almost halves their chances to just 51% while also reducing the baseline expected wealth by nearly 40%. In our most extreme example—a 20-year delay—the median wealth shortfall exceeds $1 million compared with the baseline, with a grim retirement outlook for the participant unless corrective measures are taken.

Figure 1. Impact of a delayed start to saving on retirement readiness and outcomes



Notes: Analysis results are based on the VLCM, using 10,000 steady-state simulations from the VCMM based on market data and other information available as of December 31, 2024. See Appendix II for the beginning and ending saving contributions assumed for each saving start age. Retirement spending sufficiency is based on a 79% replacement ratio of pre-retirement ending salary. Ending salary is assumed to be $75,000. Real wealth is 50th percentile of distribution of cumulative inflation-adjusted portfolio wealth across 10,000 simulations that accounts for portfolio returns, pre-retirement contributions, and post-retirement spending. Probability of retirement spending sufficiency is the total percentage of scenarios across 10,000 simulations where the retirement spending goal, based on the 79% replacement ratio, is met by inflation-adjusted income from the portfolio and all other sources.

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 VCMM are derived from 10,000 simulations for each modeled asset class. Simulations as of December 31, 2024. Results from the model may vary with each use and over time. For more information, see Appendix III.

Source: Vanguard.

Notably, the longer the participant puts off retirement saving, the larger the savings shortfall and less time available for their investments to bounce back from any market downturn. Figure 2a shows that a five-year delay in saving can be offset by increasing annual savings by 2 percentage points per year for the remainder of the participant's working years. Alternatively, reducing their retirement replacement ratio—their annual spending goal in retirement—by 8 percentage points can achieve the same effect (Figure 2b). Both adjustments by themselves are enough to bring the participant's likelihood of spending sufficiency back to baseline levels. Naturally, the longer the delay, the more substantial the adjustments needed. For instance, when savings are postponed until age 45 (a 20-year delay), the participant would need to either increase annual contributions by a significant 19 percentage points or cut their retirement spending goal by 28 percentage points (with now a greater reliance on Social Security income) to get back on track.

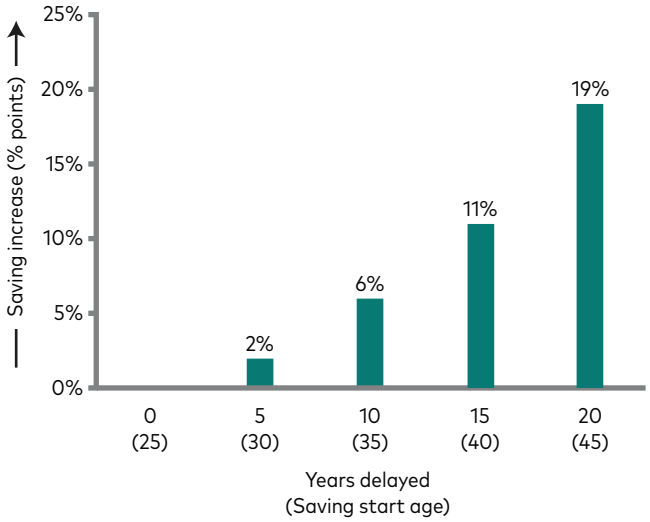
Career and employment interruptions: Timing and duration matter but can be managed

At various stages in their careers, many individuals find themselves taking breaks from work. These breaks may be involuntary, resulting from a job layoff or termination, or voluntary, such as when a parent decides to take leave to care for a newborn. In the following scenarios, we evaluate how career interruptions of different durations and starting ages can affect retirement outcomes.

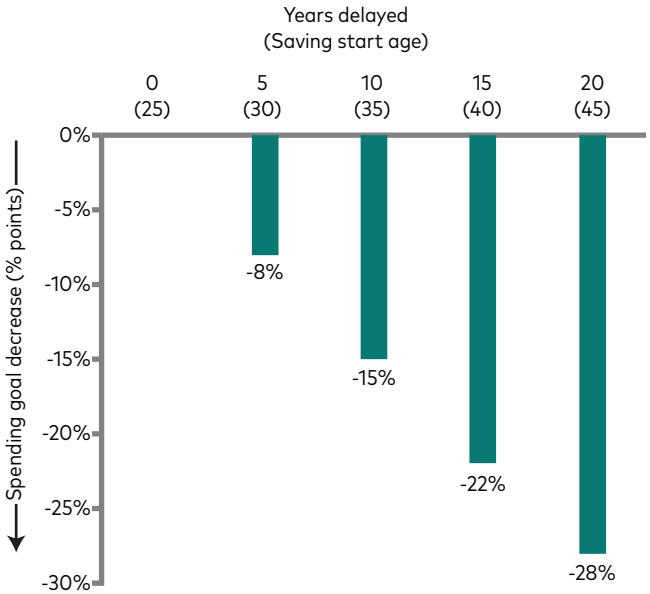
While the nature of employment interruptions and eventual return-to-work circumstances can vary widely, it becomes necessary to set a few operating assumptions that are conducive to our analysis. For example, we assume that during the employment break, the participant has no salary and does not contribute to retirement savings. At the conclusion of each break, the participant is assumed to return to a position with a salary level comparable to what they earned before the break. Further, we assume the participant closes the resulting wage gap with their peers within a few years of reemployment. Finally, given observed trends in job switchers' saving behavior (Grieg et al., 2024), we assume the participant resets their saving rate to the lower baseline starting rate of 8.8% upon reemployment and resumes annual savings increases at the baseline linear progression rate until retirement.

Figures 2a, 2b. Saving or spending goal adjustment after delayed start to saving

2a. Saving increase needed to reach baseline retirement sufficiency



2b. Spending goal* decrease needed to reach baseline retirement sufficiency



* The replacement ratio, measured as a percentage of ending salary.

Notes: Analysis results are based on the VLCM, using 10,000 steady-state VCMM simulations based on market data and other information available as of December 31, 2024. The saving increase is the percentage-point difference between the baseline and adjusted beginning and ending saving contributions. Retirement spending sufficiency at age 95 is based on a 79% replacement ratio of pre-retirement ending salary. See Appendix II for the adjusted beginning and ending saving contribution needed to achieve a baseline retirement spending sufficiency for each saving start age. Alternatively, the spending goal decrease is the percentage-point difference between the baseline and adjusted replacement ratios. The beginning and ending saving contributions are assumed to be 8.8% and 12.0%, respectively. See Appendix II for the adjusted replacement ratios of pre-retirement ending salary needed to achieve the baseline equivalent retirement spending sufficiency at age 95. Ending salary is assumed to be $75,000.

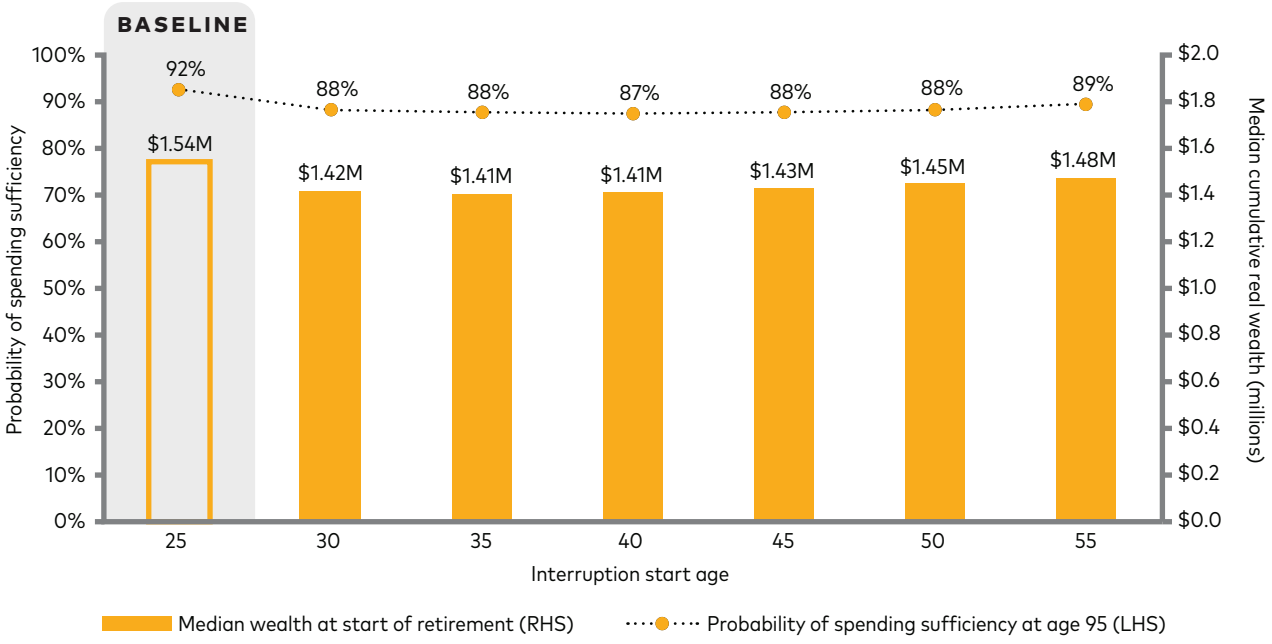
Source: Vanguard.

A short-term career interruption due to unemployment

Many workers will endure a period of unemployment during their career, with the typical average unemployment duration lasting less than one year (U.S. Bureau of Labor Statistics, 2025). In this first career interruption scenario, we examine the effects of a one-year employment break at different points of a participant's career, in five-year increments from ages 25 to 55. As with the previous life event analyzed (delaying saving start), we measure the impact in terms of changes to the participant's median expected wealth at retirement and the probability of spending sufficiency at age 95.

Figure 3 illustrates that, fortunately, a one-year break in employment is likely to have a limited impact on a participant's retirement outcome, regardless of whether the break occurs early in their career or closer to retirement. An early-career interruption leads to the largest retirement wealth shortfall compared with the base case—approximately $130,000—resulting from the year of missed savings and longer-term impact on compounded returns. The probability of the participant meeting their spending goal at age 95 remains high throughout as well, ranging from 87% to 89%, which is only a few percentage points less than the 92% baseline sufficiency rate.

Figure 3. Impact of a short career interruption on retirement readiness and outcomes



Notes: Analysis results are based on the VLCM, using 10,000 steady-state simulations from the VCMM based on market data and other information available as of December 31, 2024. See Appendix II for the beginning, pre-interruption ending, post-interruption starting and ending saving contributions assumed for each interruption start age. Retirement spending sufficiency is based on a 79% replacement ratio of pre-retirement ending salary. Ending salary is assumed to be $75,000. Real wealth is 50th percentile of distribution of cumulative inflation-adjusted portfolio wealth across 10,000 simulations that accounts for portfolio returns, pre-retirement contributions, and post-retirement spending. Probability of retirement spending sufficiency is the total percentage of scenarios across 10,000 simulations where the retirement spending goal, based on the 79% replacement ratio, is met by inflation-adjusted income from the portfolio and all other sources.

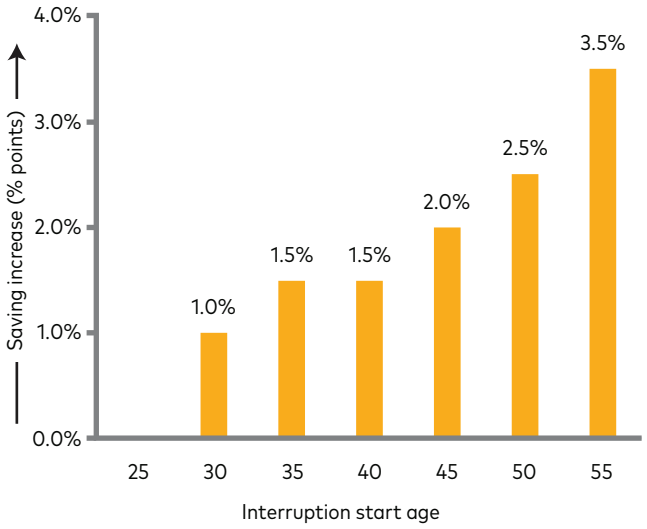
Source: Vanguard.

A participant entering retirement with less wealth due to a period of unemployment may consider reducing their spending goal or increasing their saving rate to maintain the higher 92% baseline spending sufficiency rate. As shown in Figure 4b, the participant can slow wealth depletion and improve their retirement outlook with a modest 2- to 3-percentage-point reduction in their replacement ratio. Alternatively, if they can increase savings immediately upon returning to work, they could achieve a similar outcome.

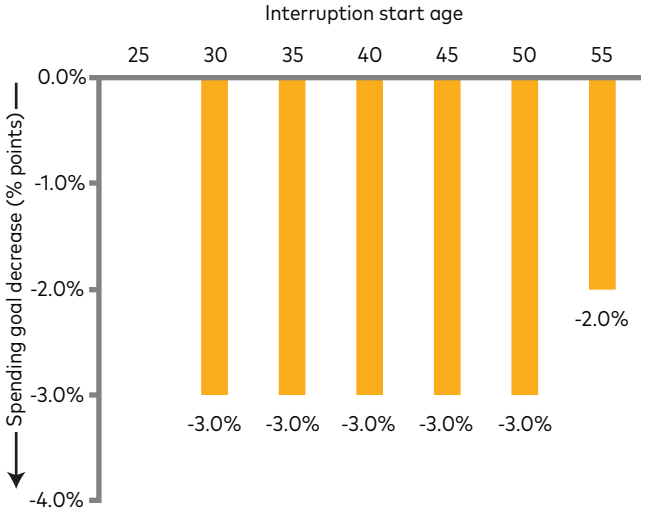
Although an earlier employment interruption results in a larger expected wealth shortfall, the participant also has a longer adjustment period and greater opportunity to benefit from compound growth. For example, if the interruption occurs at age 30, a 1-percentage-point boost in annual contributions is enough to bring the participant back to baseline (Figure 4a). Conversely, job interruptions that occur later in their career provide less time to contribute and grow wealth, necessitating greater additional savings to make up a smaller shortfall.

Figures 4a, 4b. Saving or spending goal adjustment after a short career interruption

4a. Saving increase needed to achieve baseline retirement sufficiency



4b. Spending goal decrease needed to achieve baseline retirement sufficiency



Notes: Analysis results are based on the VLCM, using 10,000 steady-state VCMM simulations based on market data and other information available as of December 31, 2024. The saving increase is the percentage-point difference between the pre-adjusted and adjusted post-interruption beginning and ending saving contributions. Retirement spending sufficiency at age 95 is based on a 79% replacement ratio of pre-retirement ending salary. See Appendix II for the adjusted saving contribution needed to achieve a baseline retirement spending sufficiency for each interruption start age. Alternatively, the spending goal decrease is the percentage-point difference between the baseline and adjusted replacement ratios. The beginning and ending saving contributions are assumed to be 8.8% and 12.0%, respectively. See Appendix II for the adjusted replacement ratios of pre-retirement ending salary needed to achieve the baseline equivalent retirement spending sufficiency at age 95. Ending salary is assumed to be $75,000.

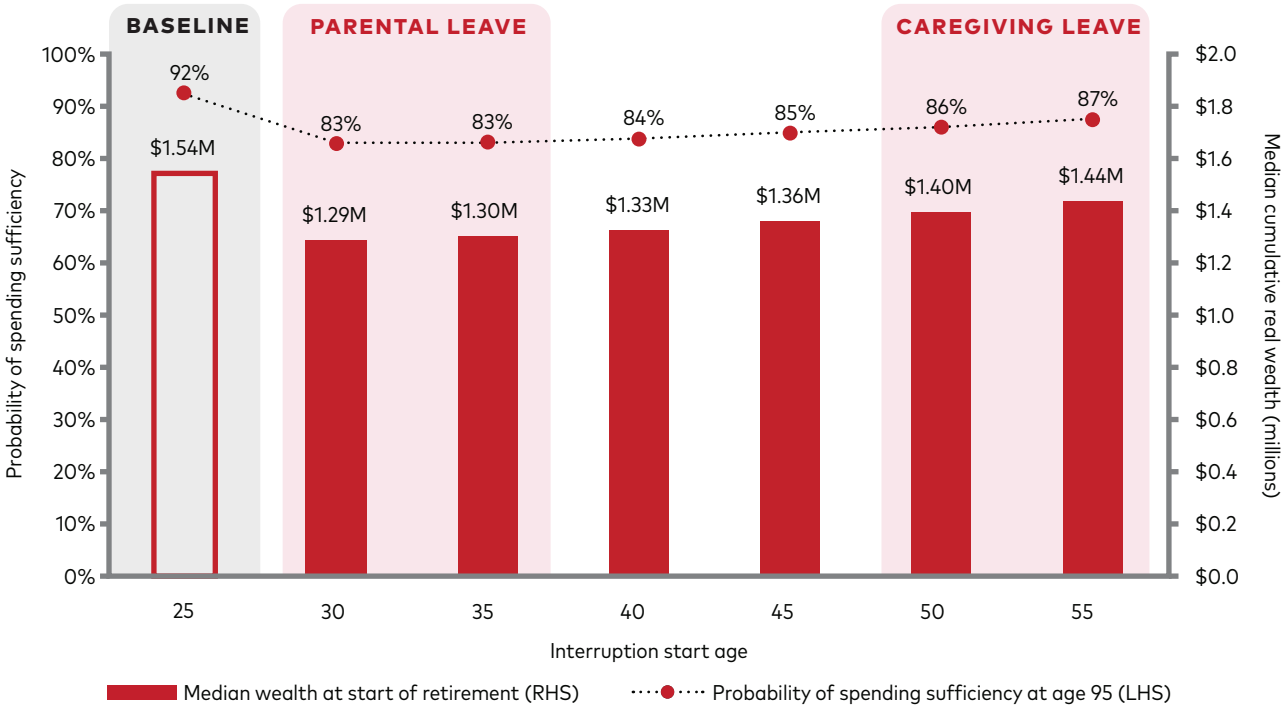
Source: Vanguard.

An extended career interruption due to parental or caregiver leave

Many workers, particularly women, may face longer employment interruptions at different stages in their careers. Starting around age 30, a third of women leave work for a median of three years to care for children, and nearly 10% of women take a median break of two years around age 50 to provide caregiving for elderly family members.[3] As with the shorter-term employment interruption above, we analyze the effects of longer-term employment breaks—specifically those lasting three years—on retirement outcomes at various career stages, from early to late career.

As illustrated in Figure 5, those taking parental leave around age 30 face a tangible decrease of roughly $250,000 less saved for retirement compared with the baseline, as well as a 9-point drop in their probability of spending sufficiency at age 95, from 92% to 83%. In addition to the years of missed savings, the participant also loses compounded returns on those savings and wages during a crucial career-growth phase. A participant taking an extended break from work later in their career—for example, someone responsible for family caregiving around age 50—would likewise experience a reduction in their accumulated retirement wealth and overall probability of spending sufficiency. However, because the interruption occurs later in this participant's career, they will have already amassed a significant portion of their pre-retirement wealth by this point. Consequently, their median expected wealth shortfall is smaller ($140,000), and their projected spending sufficiency rate is higher (86%).

Figure 5. Impact of an extended career interruption on retirement readiness and outcomes



Notes: Analysis results are based on the VLCM, using 10,000 steady-state simulations from the VCMM based on market data and other information available as of December 31, 2024. See Appendix II for the beginning, pre-interruption ending, post-interruption starting and ending saving contributions assumed for each interruption start age. Retirement spending sufficiency is based on a 79% replacement ratio of pre-retirement ending salary. Ending salary is assumed to be $75,000. Real wealth is 50th percentile of distribution of cumulative inflation-adjusted portfolio wealth across 10,000 simulations that accounts for portfolio returns, pre-retirement contributions, and post-retirement spending. Probability of retirement spending sufficiency is the total percentage of scenarios across 10,000 simulations where the retirement spending goal, based on the 79% replacement ratio, is met by inflation-adjusted income from the portfolio and all other sources.

Source: Vanguard.

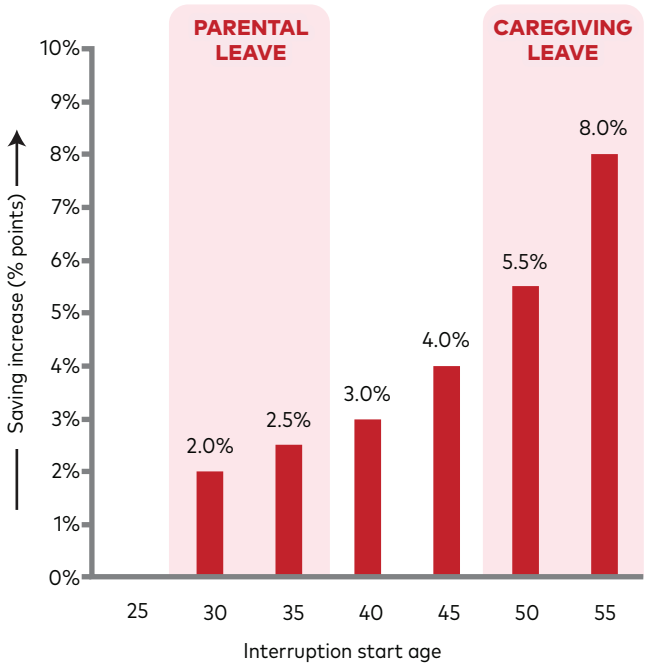
3 For the age-30 data point, see Osterman et al. (2024); for the data points around the third and nearly 10% of women, see Kavanaugh-Smith (2024); and for the age-50 data point, see AARP and National Alliance for Caregiving (2020).

Further, Figures 6a and 6b illustrate how the participant can adjust either saving or retirement spending to help mitigate the reduction in their sufficiency rate. The larger shortfall resulting from the earlier break (age 30) necessitates a 6-percentage-point reduction to the baseline replacement ratio to maintain a similar probability of spending sufficiency (Figure 6b). Alternatively, the participant could compensate for the shortfall by boosting annual savings upon returning to work. Given the relatively young age at the time of their break, they have more time to recover, so a 2-percentage-point annual savings increase is enough to close the gap (Figure 6a).

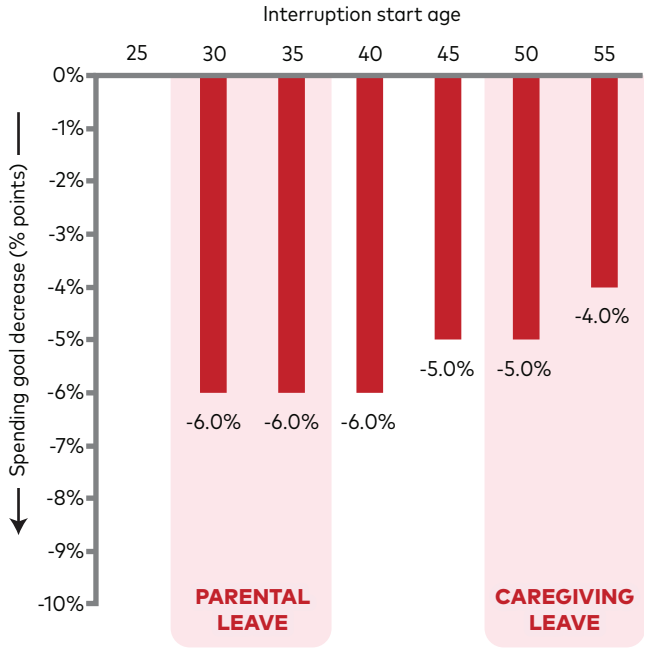
In contrast, the participant taking leave at age 50 has a smaller wealth shortfall, and reducing their spending goal by 5 percentage points can achieve the baseline sufficiency rate (Figure 6b). At the same time, with fewer years remaining until retirement, modifying the saving rate after the employment break for this older participant would require more than twice the increase to the annual saving rate compared with the younger participant, with the increase amounting to almost 6 percentage points (Figure 6a).

Figures 6a, 6b. Saving or spending goal adjustment after an extended career interruption

6a. Saving increase needed to achieve baseline retirement sufficiency



6b. Spending goal decrease needed to achieve baseline retirement sufficiency



Notes: Analysis results are based on the VLCM, using 10,000 steady-state VCMM simulations based on market data and other information available as of December 31, 2024. The saving increase is the percentage-point difference between the baseline and adjusted beginning and ending saving contributions. Retirement spending sufficiency at age 95 is based on a 79% replacement ratio of pre-retirement ending salary. See Appendix II for the adjusted beginning and ending saving contribution needed to achieve a baseline retirement spending sufficiency for each saving start age. Alternatively, the spending goal decrease is the percentage-point difference between the baseline and adjusted replacement ratios. The beginning and ending saving contributions are assumed to be 8.8% and 12.0%, respectively. See Appendix II for the adjusted replacement ratios of pre-retirement ending salary needed to achieve the baseline equivalent retirement spending sufficiency at age 95. Ending salary is assumed to be $75,000.

Source: Vanguard.

Solutions exist to help participants navigate life's uncertainties

Generally, life events that occur earlier and last longer will have the greatest impact on one's retirement outcomes. However, barring extreme scenarios where saving is substantially delayed, employment is interrupted for exceptionally long periods, or both, TDFs remain an enduring and viable vehicle to support participants as they strive for retirement readiness. Of course, participant readiness will require a disciplined approach to saving—by starting to save, or resuming saving, as early as possible and saving consistently, with appropriate saving and spending adjustments as needed.

Participants face a wide array of competing priorities amid an ever-changing financial landscape, where personal circumstances evolve even as retirement readiness remains a constant goal. Providing reliable and actionable answers to the questions posed at the beginning of this paper—along with many others—continues to be the goal for investment providers and investment professionals dedicated to improving outcomes for the millions of investors who put their trust in that guidance.

One of the central premises of this paper is that a participant's world is often filled with disruption and uncertainty. Indeed, it may be more the exception than the rule that a person's career and retirement journey adhere closely to a set of prescribed circumstances. Yet, as demonstrated throughout this research, it should be encouraging to participants and plan sponsors who rely on target-date funds as core investment solutions that several of life's events that can derail investors from their retirement path can, with quick and purposeful action, be managed and addressed with appropriate countermeasures.

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Appendix I

Life-cycle assumptions for Vanguard Target Retirement Funds

Input	Assumption	Notes
Starting age	25	—
Horizon age	111	—
Retirement age	65	—
Social Security withdrawal age	65	—
Risk aversion	Moderately conservative	—
Saving rate (as % of salary)	8.8%–12.0%	Saving rate increases over time because of the expectation of savings escalation for retirement plan enrollees as the investor approaches their retirement date
Starting real salary	$52,000	For investor in the workforce at age 25
Ending real salary	$75,000	For investor starting at age 25 and retiring at age 65. We add productivity growth and inflation to this over time
Wage scale	Social Security Administration Average Wage Index	—
Total replacement ratio	79%	For ending salary of $75,000 and saving rate of 15%. Single earner – replacement ratio = 79%*
Social Security replacement ratio	37%	Based on real monthly Social Security benefit estimates for ending salary of about $75,000 and saving rate of 15%. Single earner – Social Security replacement ratio = 37%
Defined benefit replacement ratio	None (0%)	—
TDF replacement ratio	42%	Total replacement ratio – Social Security replacement ratio – defined benefit replacement ratio
Spending rule	Fixed real dollar with sustainability adjustment	Withdrawal amounts bounded on higher end by replacement ratio and on lower end by determining sustainable withdrawal amount given years of spending the portfolio is expected to support

*See Lobel, Jaconetti, and Cuff (2019).

Appendix II

Saving and spending assumptions:

	Years delayed (saving start age)				
Figure 1	**0 (25)**	**5 (30)**	**10 (35)**	**15 (40)**	**20 (45)**
Starting saving rate	8.8%	8.8%	8.8%	8.8%	8.8%
Ending saving rate	12.0%	11.6%	11.2%	10.8%	10.4%

	Years delayed (saving start age)				
Figures 2a, 2b	**0 (25)**	**5 (30)**	**10 (35)**	**15 (40)**	**20 (45)**
	ADJUSTED SAVING				
Starting saving rate	8.8%	10.8%	14.8%	19.8%	27.8%
Ending saving rate	12.0%	13.6%	17.2%	21.8%	29.4%
	ADJUSTED SPENDING				
Total replacement ratio	79%	71%	64%	57%	51%

	Interruption start age						
Figure 3	**25**	**30**	**35**	**40**	**45**	**50**	**55**
Starting saving rate	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%
Pre-interruption ending saving rate	—	9.1%	9.5%	9.9%	10.3%	10.7%	11.1%
Post-interruption starting saving rate	—	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%
Ending saving rate	12.0%	11.5%	11.1%	10.7%	10.3%	9.9%	9.5%

	Interruption start age						
Figures 4a, 4b	**25**	**30**	**35**	**40**	**45**	**50**	**55**
Starting saving rate	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%
Pre-interruption ending saving rate	—	9.1%	9.5%	9.9%	10.3%	10.7%	11.1%
	ADJUSTED SAVING						
Post-interruption starting saving rate	—	9.8%	10.3%	10.3%	10.8%	11.3%	12.3%
Ending saving rate	12.0%	12.5%	12.6%	12.2%	12.3%	12.4%	13.0%
	ADJUSTED SPENDING						
Total replacement ratio	79%	76%	76%	76%	76%	76%	77%

	Interruption start age						
Figure 5	**25**	**30**	**35**	**40**	**45**	**50**	**55**
Starting saving rate	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%
Pre-interruption ending saving rate	—	9.1%	9.5%	9.9%	10.3%	10.7%	11.1%
Post-interruption starting saving rate	—	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%
Ending saving rate	12.0%	11.4%	11.0%	10.6%	10.2%	9.8%	9.4%

	Interruption start age						
Figures 6a, 6b	**25**	**30**	**35**	**40**	**45**	**50**	**55**
Starting saving rate	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%
Pre-interruption ending saving rate	—	9.1%	9.5%	9.9%	10.3%	10.7%	11.1%
	ADJUSTED SAVING						
Post-interruption starting saving rate	—	10.8%	11.3%	11.8%	12.8%	14.3%	16.8%
Ending saving rate	12.0%	13.4%	13.5%	13.6%	14.2%	15.3%	17.4%
	ADJUSTED SPENDING						
Replacement ratio	79%	73%	73%	73%	74%	74%	75%

Appendix III

Asset returns: Vanguard Capital Markets Model®

IMPORTANT: The projections and other information generated by the Vanguard Capital Markets Model (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 important, 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 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 investors 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 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 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, saving 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.

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Important information

For more information about Vanguard funds, visit vanguard.com to obtain a prospectus or, if available, a summary prospectus. Investment objectives, risks, charges, expenses, and other important information are contained in the prospectus; read and consider it carefully before investing.

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

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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