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The Road to Retirement: Bumpy or Smooth, Depends on Your Route

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Research Insight

The Road to Retirement

Bumpy or Smooth, Depends on Your Route

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Introduction

Defined Contribution (DC) plans are rapidly becoming the primary retirement investment vehicle for a majority of investors across the US and other markets. In the US, the enactment of the Pension Protection Act (PPA) (2006) has accelerated the adoption of Target Date Funds, permitting automatic enrollment of participants in 401(k) plans, which would be appropriate, since the PPA allows for 1) automatic enrollment, and 2) provides plan sponsors a safe harbor from asset value fluctuations in the market value of assets in funds with Qualified Default Investment Alternative (QDIA) status. In October 2007, the Department of Labor adopted Target Date Funds in the final list of products that were granted safe harbor protection. This has resulted in a dramatic rise in asset flows into Target Date Funds over the last three years with a majority of DC plans utilizing these as the default option.

Target Date Funds typically allocate assets based on the number of years the participant has until retirement. This approach to asset allocation (also referred to as the 'glide path design') is based on principles of balancing human capital and a broadly diversified portfolio of financial assets (comprising Equities, Fixed Income, TIPS, and Money Market Funds) aiming to balance the changing risk/return needs of the plan participants over the savings life-cycle. For younger participants, the typical allocation is growth-focused and dominated by equities. When the participant is closer to retirement, the allocation shifts away from risky assets and moves into protection assets and is dominated by fixed income investments. However, the recent poor performance of Target Date Funds during the financial crisis in 2008 has underscored the vulnerability of plan participants to market risk and its adverse impact on retirement income security. This has raised several questions about the asset allocation practices of these funds and also attracted increased regulatory scrutiny.

This paper analyzes two key interrelated aspects of DC plans, namely, the contribution and investment components, and their cumulative impact on retirement income adequacy. The rest of the paper is organized as follows:

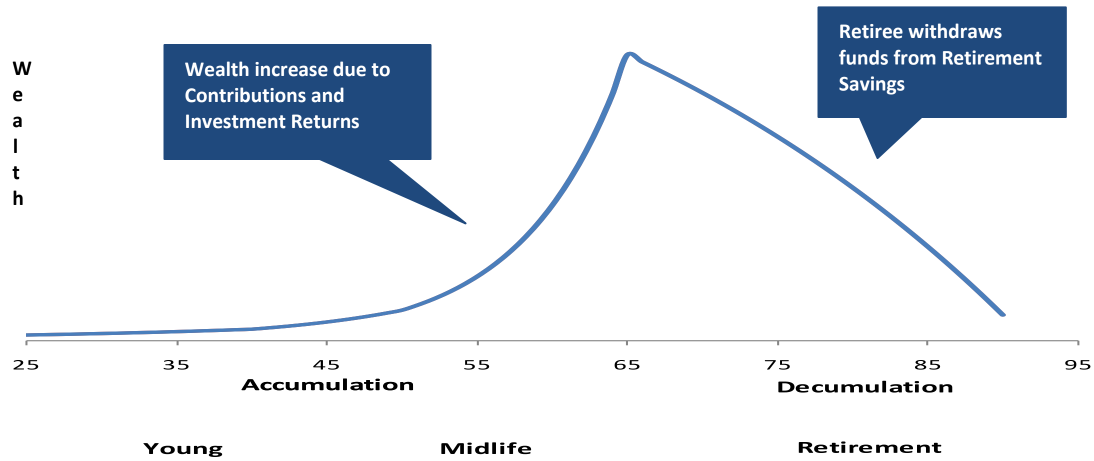
- In section 1, we highlight unique aspects of the investment problem of DC Plans and the impact of typical risks faced by retirement investors.
- In section 2, we revisit the performance of US Target Date Funds in the wake of the global financial crisis in 2008, highlighting the downside risks posed by higher equity allocations of these funds closer to retirement and its implications for participants and plan sponsors.
- In section 3, we discuss key considerations for asset allocation in DC plans and derive an alternative **Risk Focused** approach that provides for growth and downside protection.
- In section 4, we contrast the performance of the Risk Focused approach with other QDIA approved investment options, namely, the Balanced Fund and the average Target Date Fund. We also present sensitivity studies to understand the marginal impact of costs/fees longevity risks and investment returns on retirement outcomes, and consider countermeasures to augment retirement income adequacy.
- In section 5, we conclude with insights that could enhance the design of default investment options in DC Plans, and potentially deliver superior retirement outcomes for plan participants.

Readers familiar with the domain of retirement investing may find the following topics of particular interest: the Risk Focused approach to asset allocation discussed in section 3, and the comparative performance of QDIA investment options under different scenarios discussed in section 4.

Section 1: What is the DC Investment Problem?

The goal of a DC plan is to maximize the probability of attaining a threshold level of after-tax inflation-adjusted wealth that meets a participant's spending and lifestyle needs in retirement. The retirement investing problem is best understood with a lifecycle model in Exhibit 1. A young saver holds a large balance of human capital (the present value of future labor income), but the participant's retirement plan contributions are typically small. A mid-life saver has typically accumulated significant savings and makes larger plan contributions, and therefore strong investment returns in this phase can dramatically grow retirement wealth. However, a retiree has depleted human capital and must fund spending needs through retirement savings.

Exhibit 1: Typical Lifecycle of Retirement Investing



The retirement investment problem facing DC plans is unique because participants in these tax-qualified plans are faced with the following issues:

1. The responsibilities and risks for retirement saving are transferred from the employer to the plan participant.
2. The investment horizon is extremely long, typically spread over four to five decades.
3. The pattern of cash flows is dominated by inflows (with little need for liquidity) during the accumulation phase, and unpredictable outflows in the retirement phase.
4. Employees' future labor income (referred to as "Human Capital") typically resembles a risky annuity stream during the accumulation phase. This sequence of cash inflows is subject to unemployment risks, and the retirement investor needs to consider this factor, while seeking higher returns by investing in riskier growth assets.
5. DC plans are tax-deferred investment vehicles that enable compounding of savings on a tax-deferred basis. However, at retirement, all distributions (contributions plus capital gains) are taxed as ordinary income, whereas losses are not tax deductible. This creates an unusual payoff pattern where participants take risks to generate returns and have to share gains with the government, but any losses incurred are entirely borne by the participant.

Risks in Retirement Investing

The main risk in retirement investing is the failure to accumulate and retain sufficient wealth to support spending needs through retirement, referred to as **shortfall risk**. However, plan sponsors and savers need to be cognizant of other interrelated risks that add to the complexity of retirement investing, as shown in exhibit 2.

Exhibit 2: Risks in Retirement Investing

Risks	Impacting	Mitigated by
Market Risk	Volatility of Savings Journey	Protection Assets: Bonds, Bills, Cash
Shortfall Risk	Volatility of Retirement Outcomes	Growth Assets e.g. Equities
Longevity Risk	Retirement Income Adequacy	Growth Assets e.g. Equities
Inflation Risk	Purchasing Power in Retirement	Equities, Real Assets, TIPS
Sequence of Returns Risk	Volatility of Retirement Outcomes	Sound Asset Allocation

Market risk is volatility in the value of investments during the savings cycle that may potentially erode the participant's savings. **Shortfall risk** arises if investors do not save enough, or invest in a manner (either too conservatively or too aggressively) that leads to a nest egg that fails to meet retirement income adequacy. **Longevity risk** arises from the possibility of outliving the accumulated retirement wealth; this risk continues to rise with increasing life expectancies and a lack of commensurate growth in the retirement savings. In addition, retirement savers also need to address **inflation risk,** to protect the real purchasing power of the nest egg over the long run to maintain lifestyle needs. **Furthermore, given the long horizons involved, investors are also exposed to "sequence of returns" risk,** as reflected by the wide dispersion of 10- and 20-year returns of asset classes. **Exhibits 3 and 4** below show that the rolling returns of equities are more volatile than bonds, even at longer horizons; this risk is an un-diversifiable component of retirement investing (Nigel Lewis, 2008) and impacts the volatility of eventual retirement outcomes and contributes to shortfall risk.

*Exhibit 3: Rolling 10 Year Returns**

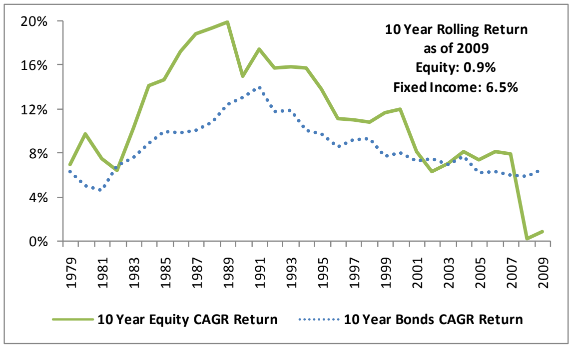
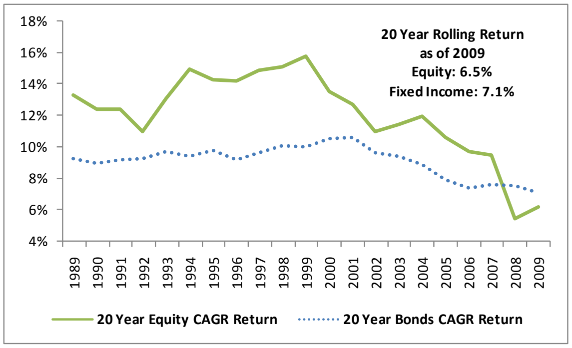


*Exhibit 4: Rolling 20 Year Returns**



* See Appendix 1 for details on asset class returns data.

In summary, a well-designed asset allocation for retirement investing needs to minimize the probability of shortfall while addressing other interrelated risks over the investment lifecycle.

Section 2: Why Now? Lessons from the Market Meltdown in 2008

The motivation for analyzing the asset allocation practices of DC plans stems from the recent poor performance of Target Date Funds during the financial crisis in 2008. The huge losses suffered by some of these funds, especially the 2010 Target Date Funds, has underscored the vulnerability of plan participants to market risk and its adverse impact on retirement income security. This has brought to sharp focus several questions around the asset allocation approaches of these funds and also attracted increased regulatory scrutiny.

Broadly, there are two categories of Target Date Fund glide paths, namely, “**Glide-To”** and **“Glide-Through.”**

“Glide-To” Target Date Funds terminate at the retirement date, whereas “Glide-Through” funds generally continue to vary their asset allocation well past the Target Date, typically stabilizing 10-20 years after the mentioned Target Date. “Glide-Through” Funds generally have higher equity allocations than “Glide-To” Funds at retirement, exposing participants to higher market risk, although they are typically designed to mitigate the impact of longevity risk. The attendant variation in equity allocation across various Target Date Funds has created a significant dispersion in the performance of different fund series, as evidenced during the 2008 market turmoil, which is illustrated in Exhibits 5 and 6.

In this paper, we examine the performance of different “Glide-To” Funds during the accumulation phase, with mandatory annuitization during the payout component of retirement. A comparative study of “Glide-To” and “Glide-Through” Funds and their performance in post-retirement is a subject of future research.

Exhibit 5: 2008 Performance of 2010 Target Date Funds

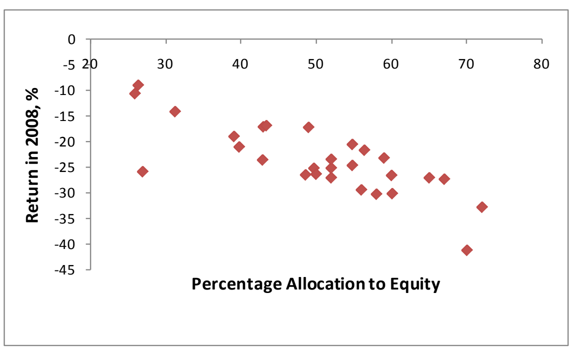
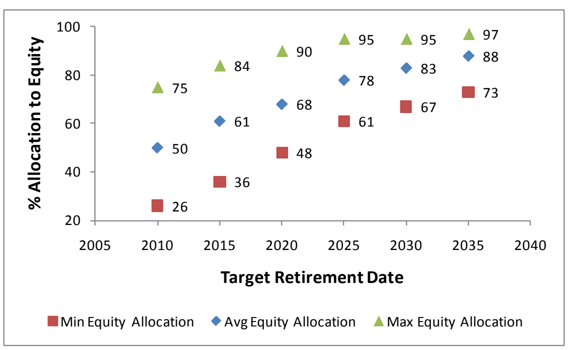


Exhibit 6: % Equity allocation in Target Date Funds



Source: Morningstar

As mentioned in Exhibit 2, the sequence of returns risk is a critical factor in the retirement investing process, especially closer to retirement. During this period, retirement-age savers typically have far more assets than younger savers, and they continue to make reasonably large contributions to the DC plan. This phenomenon, called the **portfolio size effect**, coupled with the actual **sequence of returns,** has a significant impact on eventual retirement wealth. In addition, investors approaching retirement also have lower “Human Capital” (i.e., fewer earnings years ahead) and have fewer years left to recoup any losses in the retirement portfolio. Thus, funds with a high equity allocation subject to a negative sequence of returns could destroy accumulated savings, as witnessed in 2008.

Section 3: Asset Allocation Considerations for DC Plans

The overarching goal of a well-governed DC plan is to facilitate superior retirement outcomes for plan participants. As Target Date Funds become a dominant part of the DC landscape, implementing the best asset allocation for the default option has become both critical and challenging. With various alternatives at hand, plan sponsors need to establish clear objectives to design and monitor the effectiveness of asset allocation for the default option.

The utility function of a retirement saver is to **maximize the probability of attaining a threshold level of after-tax inflation-adjusted wealth to meet spending needs in retirement, subject to the** constraints dictated by the investor's risk tolerance. A well-designed DC asset allocation should be able to meet three specific goals:

1. Maximize the probability of attaining a threshold level of real wealth
2. Minimize the volatility of terminal retirement wealth outcomes
3. Moderate the short- term volatility of the investment journey

Most Target Date Funds employ an age-based approach to asset allocation that varies with the number of years until retirement[1]. Such an approach to asset allocation is based on principles of balancing human capital and financial capital over the participant's lifetime, but does not explicitly account for the risk tolerance of a plan participant, nor the impact of short-term market risks or the volatility of the savings journey, all important investment objectives.

Short-term losses not only have a damaging impact on long-term returns, but also have a strong psychological impact on plan participants. According to a behavioral finance study by Nobel Laureate economists Kahneman and Tversky, investors dislike losses nearly 2.0 to 2.5 times as much as they like gains.

Exhibit 7: The Asymmetry in Losses and Gains

Investment Loss (%)	Gain Needed to Recover Loss (%)
10	11
20	25
30	43
40	67
50	100

As seen in Exhibit 7, the greater the magnitude of a loss, a disproportionate gain is required to recoup the lost value. Earning returns of such magnitude may be difficult, especially closer to retirement when investment horizons are typically short.

Key Considerations in Glide path Design:

Well-diversified retirement portfolios typically include major asset classes, such as:

1. Equities: to participate in long-term growth and inflation hedging.
2. Bonds: for diversification, lowering portfolio volatility, and deflation hedging.
3. Real Assets: such as REITS and TIPS for inflation hedging.

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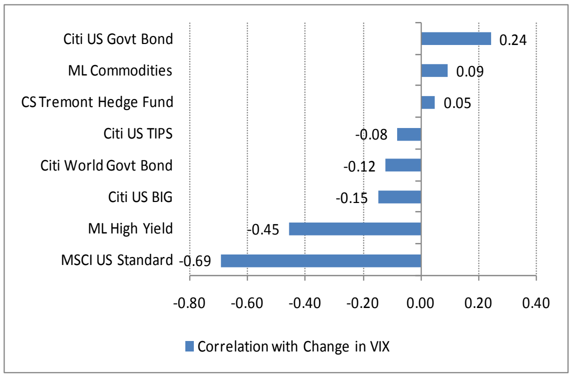
1 Traditional approach to asset allocation uses some variant of the rule: "Equity Allocation = 100% – Participant Age."

However, as seen with many Target Date Funds, seemingly well-diversified portfolios are subject to market risk of individual asset classes, accounting for a large part of the portfolio volatility. We can identify risk concentration at a portfolio level by examining the marginal and total contribution to risk[2] of individual assets. As seen in an illustrative example in Exhibit 8, stocks contribute disproportionately to the total risk in a stock-bond portfolio. For a 50/50 balanced allocation, nearly 85% of the portfolio risk is attributed to the stocks alone. Thus, portfolios considered well-diversified in a traditional sense may carry concentrated risk exposures and could potentially impact retirement savers adversely.

Exhibit 8: Asset Allocation and Risk Concentration[3]

Allocation		% Contribution to Risk		Portfolio Risk
Stock	Bond	Stock	Bond	
100%	0%	100%	0%	18.9%
80%	20%	98%	2%	15.4%
60%	40%	92%	8%	12.0%
50%	**50%**	**85%**	**15%**	**10.5%**
40%	60%	74%	26%	9.1%
20%	80%	34%	66%	7.1%
0%	100%	0%	100%	6.9%

Exhibit 9: Correlation of Returns with change in CBOE VIX[4]



These portfolios are exposed to spikes in correlations in periods of crises (when the diversification benefits vanish) since most asset classes have a negative correlation with change in equity market volatility (CBOE VIX). This negative correlation of returns for major asset classes with a change in CBOE VIX, seen in Exhibit 9, is also referred to as a **short volatility bias**.

An Alternative Approach to Asset Allocation – Risk Focused Glide Path

The allocation to risky asset classes must be closely monitored, especially closer to retirement, when larger asset balances are coupled with depleted levels of human capital. An ideal asset allocation would provide a minimum reasonable return, with a high probability of gain, and downside protection in adverse markets closer to retirement. Thus traditional asset allocation for a default investment option could be enhanced by combining the ideas of an age-based approach with a risk-based allocation.

In traditional asset allocation, investors use unconditional expected return assumptions that are based on long-term risk and return characteristics of asset classes. Recent asset allocation research incorporates adaptive approaches and extends the traditional framework. In their pioneering work, Campbell and Viceira (2005) highlight that risk could be measured as conditional on the investment horizon and its relevance to the design of policy portfolios. Campbell and Viceira highlight that stocks have much higher volatility at shorter horizons (1 year) compared to longer horizons, where their volatility is much lower. This effect is attributed to mean reversion of stock returns at longer horizons (refer to Exhibit 10 below). In addition, the correlation of stocks and bonds is lower at both short (1

2 Risk is defined as the standard deviation of annual returns over the period of 40 years (1969-2009) as shown in exhibit 17 in Appendix 1.

3Marginal contribution to risk measures the marginal change in portfolio risk with a marginal change in asset weight. Contribution to Risk highlights the asset weights that contribute most to overall portfolio risk. Please refer Appendix 2 for further details.

4 Based on monthly returns data from Jan 2001 – Jun 2010.

year) and very long horizons (25 years and longer), but it is higher at intermediate horizons of 5-15 years (refer to Exhibit 24 of Appendix 1). The key implication is that the term structure of risk and return of asset classes should be incorporated when determining portfolio asset allocation across different time horizons.

We now propose an illustrative approach to build a "**Risk Focused**" glide path by combining the term structure of risk, return, and covariance of asset classes, and by explicitly evaluating a risk budget to determine asset allocation at different time horizons. We take into account three key variables in determining asset allocation at different investment horizons:

1. Time Horizon (derived from Time to Retirement).
2. Time-varying risk / return / covariance of asset classes.
3. Explicit risk budget based on the total expected volatility of the portfolio.

The risk budget is a control measure that sets a permissible range for the total expected volatility of the portfolio at different time horizons, consistent with the investor's risk tolerance. We calibrate the risk budget to a narrow band of 4%-7% at different horizons; this attempts to minimize the probability of large losses while maintaining a reasonable exposure to growth assets. A risk budget of 7% at the 1-year horizon is consistent with the average annualized volatility of a well-diversified bond index, based on data over the last 40 years (1969-2009).

Exhibit 10: Term Structure of Risk of Asset Classes

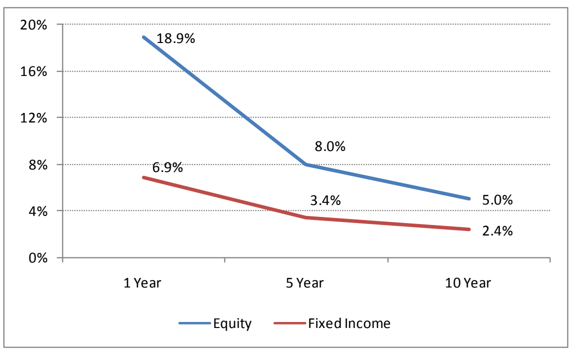
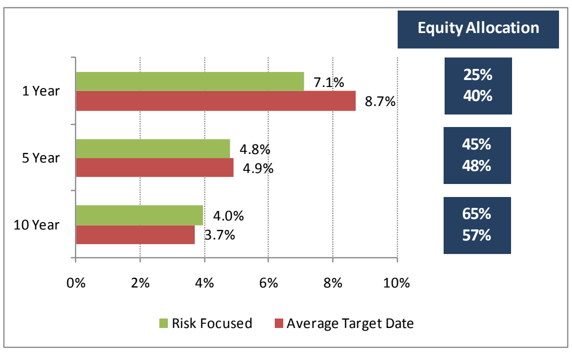


Exhibit 11: Horizon Risk with Years to Retirement



We then create anchor portfolios at different horizons (at 1, 10 and 10+ years prior to retirement) and derive asset class weights using standard mean variance optimization based on historical risk / return /covariance of asset classes, at different horizons, subject to the risk budget (please refer to Appendix 4 for further details). The intermediate weights between the anchor dates are obtained by linear interpolation.

The allocation of most existing Target Date Funds seems to suggest that they do not utilize an explicit risk budget in asset allocation. **The unique Risk Focused approach explicitly constrains the overall portfolio volatility using a risk budget and derives asset weights based on optimization.** This approach allocates higher weights to equities at longer horizons (since they exhibit lower volatility at longer horizons). For portfolios closer to retirement, this approach is deemed conservative with its lower allocation to equities (thus minimizing short horizon volatility).

Exhibit 12: Asset Allocation of the Risk Focused Glide Path

Age	25	35	45	55	56	57	58	59	60	61	62	63	64	65
Equity (%)	65	65	65	65	61	57	53	49	45	41	37	33	29	25
Core Fixed Income (%)	35	35	35	35	38	41	44	47	50	53	56	59	62	65
TIPS (%)	0	0	0	0	1	2	3	4	5	6	7	8	9	10

Section 4: Evaluation of Qualified Default Investment Alternative (QDIA) Investment Options

In this section, we evaluate the relative effectiveness of typical QDIA options to provide retirement income adequacy, while balancing market risk, shortfall risk, and longevity risk. Specifically, we contrast two categories of QDIA options: (1) Target Date and (2) Balanced Fund, using the Risk Focused approach as described in section 3 above. The various glide paths evaluated are listed below:

1. All Equity: This investment strategy is 100% in Equity and is not QDIA compliant, but will serve as a benchmark for the other QDIA-compliant glide path strategies.
2. Average Target Date Fund : Average Equity and Fixed Income allocation.
3. Balanced Fund: 60% Equity and 40% Fixed Income.
4. Risk Focused Approach: 65% Equity and 35% Fixed Income till the age of 55; allocation changes linearly to reach 25% Equity, 65% Bonds, and 10% TIPS at retirement.

Asset allocation of an average Target Date glide path is illustrated in Exhibit 25 in Appendix 1.

Simulation Methodology and Assumptions

1. The simulation approach is based on portfolios comprising Stocks, Bonds, TIPS, and Cash, using asset class returns from 1969-2009.
2. The simulation methodology uses bootstrapping of annual asset class returns. About 5,000 bootstrapped simulations are performed.
3. The portfolios are rebalanced annually to bring the asset allocation in line with that suggested by the glide paths.
4. Refer to Appendix 3 for assumptions on Salary, Salary Growth, and the schedule of retirement contributions.

Income Replacement Factor (IRF) and Target Retirement Wealth

1. Income Replacement Factor (IRF) is the fraction of the last drawn salary that the retiree needs in the first year of retirement.
    a. This is based on a participant's income level at retirement and social security coverage.
    b. We assume that an IRF of 50% is needed for a participant having a last-drawn salary of USD 99,000.
2. The Target Retirement Wealth required at retirement (as shown in Exhibit 14) is computed as the present value of the inflation indexed life annuity stream, where :
    a. The first annuity payment is the Target Income Replacement Factor multiplied by the last drawn salary.

b. The annuity payments grow annually indexed to inflation (3% annually), attempting to account for the fact that experimental CPI for older Americans (CPI-E) is greater than CPI for the Urban Population (CPI-U)[5].
c. The present value of annuity payments derived from step (b) is discounted at a conservative rate of 4% per annum.
d. The annuity period is based on longevity assumptions.

Performance Evaluation Criteria

The various bootstrapped Monte Carlo simulations **generate a distribution of terminal wealth** for different glide paths. Then the investment performance of these glide paths is based on the following evaluation criteria:

1. **Probability of Success at a Target Income Replacement Factor:** Expresses the odds of attaining the target retirement wealth from the given investment option. For example, if the probability of success is 70% at the Target Retirement Wealth of USD 500,000, this means that the terminal retirement wealth attained was more than USD 500,000 in 70% of simulation trials.
2. **Distribution of Terminal Retirement Wealth:** Ceteris paribus, the investment strategy that generates the highest terminal retirement wealth (in both median and worst case scenarios) is generally preferred (see comparisons in Exhibits 15 and 16).
3. **Journey Volatility:** Although the time horizon for retirement investing is very long, managing the short-term volatility is an important objective. Extreme volatility has the potential to adversely impact the savings behavior of participants, sometimes causing them to discontinue their contributions during their savings journey (see charts Exhibits 17 through 20).

Simulation Case Studies

Exhibit 13 below details the various simulations performed by sequentially introducing the impact of annual investment costs of 75 bps (per ICI 401(k) Plan Fee Study, 2009), increased longevity (25 years versus 18 years in the Base Case), and interruptions to contributions at the age of 33 and 51. We also incorporate mitigating measures such as saving more and working longer that a retirement saver could adopt to augment retirement outcomes. DC plans in the US permit participants who are age 50 or older to make additional contributions, popularly known as catch-up contributions. These additional contributions are not subject to the general limits that apply to 401(k) plans. In addition, most employees earn their highest salaries during the final years of their career and a few additional years of employment may have a beneficial impact on retirement outcomes[6].

5 From Dec 1982 to Dec 2007, the experimental CPI-E rose 126.5 percent, compared with increases of 115.2 percent for the CPI-U and 110.0 percent for the CPI-W. That translates into average annual increases of 3.3 percent, 3.1 percent, and 3.0 percent for the CPI-E, CPI-U, and CPI-W, respectively. This was because prices of medical care and shelter are weighted more heavily in the CPI-E and increased more rapidly than overall inflation during the same period.

6 For higher income participants, a similar Sensitivity Analysis has been performed and shown in Appendix 5.

Exhibit 13: Case Studies for Sensitivity Analysis and Mitigating Measures

S. No	Simulations	Contributions	Post-retirement Longevity (years)	Annual Fees, bps
1	Base Case	Regular contributions	18	0
Sensitivity Analysis and Stress Testing				
2	Impact of Cost	Regular contributions	18	75
3	Impact of Cost and Irregular Savings	Regular contributions	18	75
4	Impact of Cost, Irregular Savings and Longevity Risk	1. At age 33, participant borrows $5,000 from the DC plan and stops contributing for 2 more years 2. At age 51, participant borrows $10,000 from the DC plan and stops contributing for 2 more years	25	75
Mitigating Measures				
5	Impact of Cost, Irregular Savings, Longevity Risk and 3% Catch Up Savings	1. Irregular Savings as in simulation 4 2. 3% additional catch up contributions by the participant after the age 50	25	75
6	Impact of Cost, Longevity Risk, Irregular Savings, 3% Catch Up Savings and Working Longer till age 67	1. Irregular Savings as in simulation 4 2. 3% additional catch up contributions by the participant after the age 50	25	75
7	Impact of Cost, Longevity Risk, Irregular Savings, 3% Catch Up Savings, Working Longer till age 67 and Lifestyle Adjustments (40% IRF)	1. Irregular Savings as in simulation 4 2. 3% additional catch up contributions by the participant after the age 50	25	75

Exhibit 14: Probability of Success[7]

S.No	Simulations	Required Wealth USD	All Equity	Average Target Date	Balanced Fund	Risk Focused
1	Base Case	790,027	100%	100%	100%	100%
Sensitivity Analysis and Stress Testing						
2	Impact of Cost	790,027	99%	100%	100%	100%
3	Impact of Cost and Irregular Savings	790,027	92%	100%	98%	99%
4	Impact of Cost, Irregular Savings and Longevity Risk	1,062,016	66%	63%	66%	63%
Mitigating Measures						
5	Impact of Cost, Longevity Risk, Irregular Savings and 3% Catch Up Savings	1,062,016	73%	80%	77%	77%
6	Impact of Cost, Longevity Risk, Irregular Savings, 3% Catch Up Savings and Working Longer till age 67	1,062,016	95%	99%	97%	95%
7	Impact of Cost, Longevity Risk, Irregular Savings, 3% Catch Up Savings, Working Longer till age 67 and Lifestyle Adjustments (40% IRF)	849,612	100%	100%	100%	100%

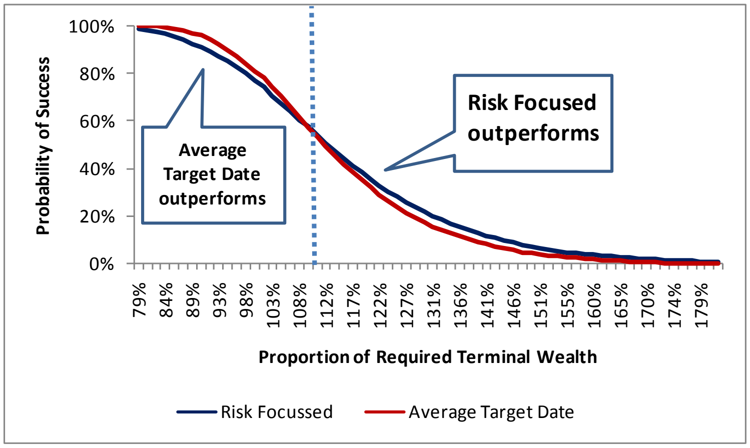
In exhibit 14, we find that across simulation settings, the Risk Focused glide path achieves comparable Probability of Success, a key investment objective. To gain a deeper understanding of distribution of retirement wealth, we consider the results from simulation 5, as it captures a realistic scenario with annual investment costs of 75 bps, disruptions to contributions, post retirement stressed longevity of 25 years, and 3% catch up contributions.

7 The Target Retirement Wealth for the participant having last-drawn salary of USD 99,000 and needing an IRF of 50% from DC Plan is computed as USD 790,027 and USD 1,061,062 for post retirement life expectancy of 18 and 25 years, respectively implying a lifespan of 83 and 90 years respectively for the individual.

Exhibit 15: Distribution of Terminal Retirement Wealth (USD)

Target Retirement Wealth = USD 1,062,016	**All Equity**	**Average Target Date**	**Balanced Fund**	**Risk Focused**
5th Percentile (Worst Case)	793,748	967,648	909,654	919,546
25th Percentile	1,036,570	1,089,223	1,077,304	1,072,059
50th Percentile (Median)	1,289,633	1,192,188	1,226,319	1,197,423
75th Percentile	1,616,700	1,320,609	1,402,919	1,351,634
95th Percentile (Best Case)	2,297,083	1,569,747	1,717,083	1,635,380

Exhibit 16: Probability of Success and Terminal Wealth



From exhibits 15 and 16, we find that median terminal wealth of the Risk Focused allocation is better than that of the Average Target Date glide path, while worst case terminal wealth of the Risk Focused allocation is only marginally lower. In addition, the Risk Focused allocation outperforms the Average Target Date glide path across all but the bottom quartile.

We now compare the short-term risk characteristics, or journey volatility, of these glide paths, the last of the three stated investment objectives. We propose average standard deviation of annual portfolio returns of 5,000 simulation trials as the first measure of journey volatility.

Exhibit 17: Journey Volatility – 40 Years

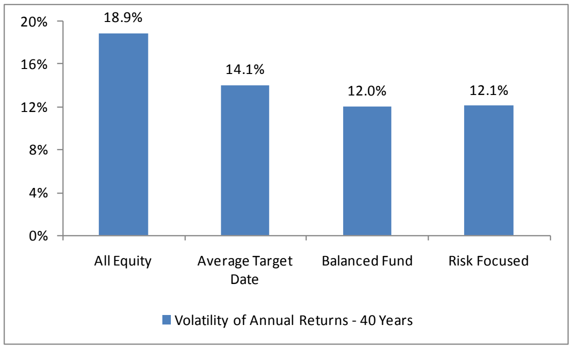
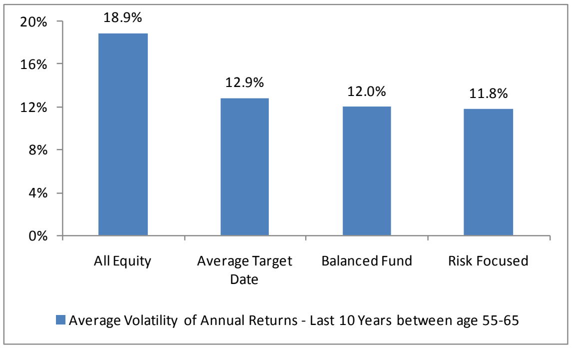


Exhibit 18: Journey Volatility – Age 55 to 65 (10 years)



Comparing the journey volatility of different options in exhibits 17 and 18, we find that the 40-year journey volatility of the Average Target Date Fund (14.1%) is much higher than that of the Risk Focused glide path (12.1%). In the last 10 years prior to retirement, a Risk Focused glide path has lowest risk (11.8%), while the Average Target Date Fund is much riskier (12.9%).

*Exhibit 19: 1 Year Expected Shortfall Risk with Age**

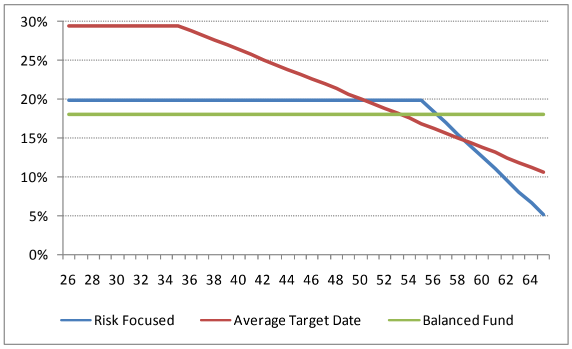
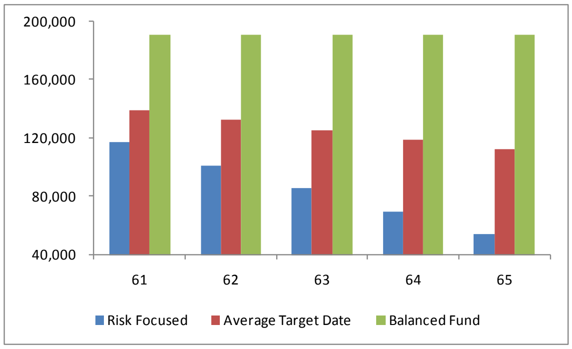


Exhibit 20: 1 Year Dollar Expected Shortfall Risk



* 1 year Expected Shortfall risk estimate is calculated as the average of worst 1 year returns below the 5th percentile.

** 1 year Dollar Expected Shortfall risk estimate is calculated on USD 1,062,016.

The journey volatility can also be quantified with the one-year Expected Shortfall Risk (ES) estimate. **At the start of the savings cycle, the Risk Focused allocation has a lower ES risk than the Average Target Date Fund, and hence provides a better downside protection as seen in exhibit 19**. In addition, Risk Focused allocation sharply reduces the allocation to a risky asset class (i.e., equities) in the last 10 years to manage the "sequence of returns" risk. **The emphasis of the Risk Focused glide path on managing the journey volatility and sequence of returns risk is intensified further in the last 5 years, as seen from the declining levels of 1 Year Dollar ES Risk estimate for a hypothetical portfolio of USD 1,062,016, given in exhibit 20.**

By incorporating a risk budget at different horizons, the Risk Focused glide path attempts to minimize the probability of suffering large losses over the savings cycle and lowers the probability of the average participant suspending their contributions towards the plan.

Section 5: Conclusion

Asset allocation for DC plans has to strike a balance between growth and protection assets over the savings lifecycle to address the cumulative impact of shortfall, longevity, and market risks while protecting the long-term purchasing power of the nest egg. With various alternatives at hand, implementing the right asset allocation for the default investment option has become both critical and challenging for DC plans. A well-designed asset allocation for DC plans should ideally meet three key goals:

1. Maximize the probability of attaining a threshold of retirement wealth.
2. Minimize the volatility of terminal retirement wealth outcomes.
3. Moderate the short-term volatility of the investment journey.

In this paper, we present a unique **Risk Focused** approach to glide path design, taking into account the term structure of risk and return characteristics of asset classes, in conjunction with an explicit risk budget that strikes a balance between long-term growth and downside protection, while addressing journey volatility.

The following table compares the relative effectiveness of this approach with other QDIA investment options, such as a balanced fund and an average Target Date Fund.

*Exhibit 21: Summary of Success Metrics**

	Average Target Date	Balanced Fund	Risk Focused
Target Retirement Wealth (USD)	<----------------------------1,062,016---------------------------->		
Retirement Wealth Achieved (USD)			
5th Percentile (Worst Case)	967,648	909,654	919,546
50th Percentile (Median)	1,192,188	1,226,319	1,197,423
95th Percentile (Best Case)	1,569,747	1,717,083	1,635,380
Probability of Success	80%	77%	77%
1 Year Dollar Shortfall Risk (for USD 1,062,016 Portfolio)			
3 Years to Retirement	125,950	191,471	85,764
1 Year to Retirement	112,607	191,471	54,314

*Results for the scenario with annual investment costs of 75 bps, disruptions to contributions, post-retirement stressed longevity of 25 years, and 3% catch-up contribution.

Exhibit 21 highlights that the **Risk Focused** approach delivers retirement outcomes comparable to a conventional Target Date Fund, as seen from the median retirement wealth (USD 1,197,423) and the probability of success achieved (77%). **The Risk Focused approach attains all three aforementioned goals of retirement investing, with much lower journey volatility, as underscored by the 1-year Dollar Shortfall Risk**. In contrast, the balanced fund and the average Target Date Fund typically have higher portfolio volatility (as seen from the much higher Dollar Shortfall Risk estimates); this risk exposes participants to sequence-of-returns risk and could lead to adverse outcomes in volatile market conditions, especially closer to retirement, as witnessed in 2008. Prudence suggests that investors preferring more reliable terminal wealth outcomes should moderate their exposures to risky assets as they approach retirement.

To improve the odds of attaining superior retirement outcomes, participants and plan sponsors may consider several mitigating measures, including lowering investment costs, minimizing contribution disruptions, saving more, and working longer. Our analysis shows that annual investment fees of 75 bps reduces the median retirement wealth by approximately USD 210,000, which is more than twice the participant's last drawn salary. All else failing, the participants would be forced to compromise their lifestyle with reduced payouts in retirement. A similar analysis for higher income retirement participants is presented in Appendix 5.

The unique Risk Focused allocation presented in this paper aims to address the shortcomings of conventional Target Date Funds experienced during the financial crisis of 2008. The Risk Focused allocation potentially delivers comparable retirement wealth outcomes with enhanced downside protection and attempts to facilitate a smoother journey on the road to retirement.

Appendix 1

Exhibit 22: Annual Asset Class Returns and Risk (based on 40 years of data from 1969 -2009)

	CAGR Returns	Average Returns	Min. Return	Max. Return	Risk (stdev)
Equity	9.7%	11.4%	-42%	43%	18.9%
Core Fixed Income	8.2%	8.4%	-3%	32%	6.9%
Cash/T-Bills	5.8%	5.9%	0%	15%	3.1%
TIPS	7.3%	7.5%	-8%	22%	7.1%

Exhibit 23: Asset Class Annual Arithmetic Returns and Risk (based on data from 1969 -2009)

		Equity	Fixed Income	TIPS	Cash
1 Year	**Return**	11.4%	8.4%	7.5%	5.9%
	Risk (stdev)	18.9%	6.9%	7.1%	3.1%
5 Year	**Return**	10.6%	8.2%	7.6%	6.1%
	Risk (stdev)	8.0%	3.4%	3.4%	2.6%
10 Year	**Return**	11.3%	8.6%	8.2%	6.4%
	Risk (stdev)	5.0%	2.4%	2.3%	2.2%

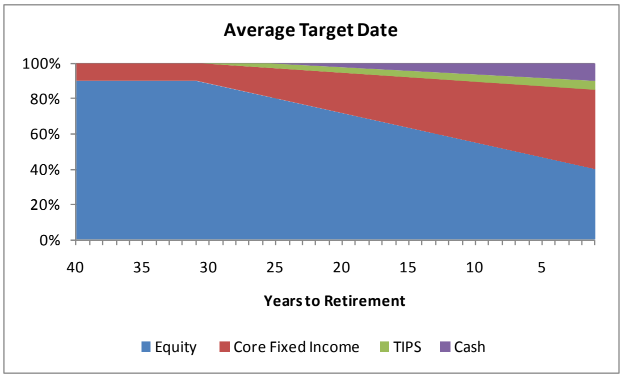
Exhibit 24: Asset Class Correlations at different horizons (based on data from 1969 – 2009)

1 Year	**Equity**	**Fixed Income**	**TIPS**	**Cash**
Equity	1.00	0.13	0.36	-0.01
Fixed Income	0.13	1.00	0.02	0.23
TIPS	0.36	0.02	1.00	0.07
Cash	-0.01	0.23	0.07	1.00

5 Year	**Equity**	**Fixed Income**	**TIPS**	**Cash**
Equity	1.00	0.47	0.52	0.43
Fixed Income	0.47	1.00	0.57	0.46
TIPS	0.52	0.57	1.00	0.45
Cash	0.43	0.46	0.45	1.00

10 Year	**Equity**	**Fixed Income**	**TIPS**	**Cash**
Equity	1.00	0.82	0.91	0.72
Fixed Income	0.82	1.00	0.87	0.53
TIPS	0.91	0.87	1.00	0.57
Cash	0.72	0.53	0.57	1.00

Exhibit 25: Average Target Date Glide Path



Appendix 2: Marginal Contribution to Risk

The aim of calculating a Marginal Contribution to Total Risk (MCTR) is to understand the impact of a change in the weight of one asset on the total volatility of the portfolio. The question we want to answer is: what will happen to the volatility of the portfolio if the weight of this asset goes up or down?

Derivation of MCTR

As mentioned above, the MCTR of an asset is the first derivative of the risk of the portfolio (predicted standard deviation of the portfolio returns) with respect to the weight of the asset:

$$\sigma_p = (W_t^{'} V W_t)^{1/2}$$

The vector of MCTR is:

$$\frac{d\sigma_p}{dW} = \frac{1}{2} Var_p^{-1/2} * \frac{dVar_p}{dW} = \frac{1}{2}(W_t^{'} V W_t)^{-1/2} * (2VW) \quad \Rightarrow \quad \boxed{\text{Vector of } MCTRs = \frac{\delta\sigma_p}{\delta W} = \frac{VW}{\sigma_p}} \quad (1)$$

The MCTR of the first asset in the vector of MCTR is: $\dfrac{\sum_{i=1}^{n} Cov(asset_1, asset_i) w_i}{\sigma_p}$

Where w_i is the total weight of asset *i* in the portfolio.

The interesting point of formula (1) is that if you multiply the vector of MCTR with the vector of weights transposed, you obtain the risk of the portfolio.

$$W' \frac{\delta\sigma_p}{\delta W} = \frac{W'VW}{\sigma_p} = \sigma_p$$

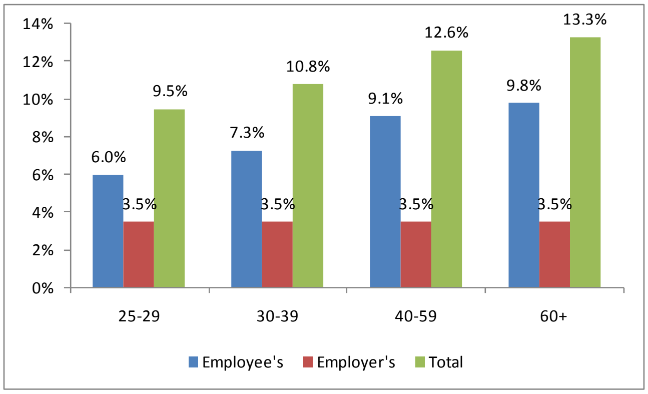
This implies that the weighted sum of the MCTRs is equal to the total risk of the portfolio. This is a very important point because it allows allocation of total risk to the different assets of a portfolio in a very intuitive way. The contribution of an asset to the total risk of portfolio (CTR) is the product of the MCTR of the asset and its weight in the portfolio.

Appendix 3: Simulation Assumptions

Assumptions on Salary, Salary Growth, and Contributions

1. The DC plan participant starts contributing at age 25 and retires at age 65.
2. Starting salary is USD 25,000 and annual nominal salary growth is 3.5%. This leads to a last drawn salary of USD 99,000 at retirement at age 65.
3. Contributions from participant and employer to DC plan are as shown in the Exhibit 26.
4. Simulations for a sample Higher Income participant are presented in the Appendix 5.

Exhibit 26: Average Contribution schedule of DC Plan by Age (% of Gross Salary)



Source: Hewitt Associates

Asset Classes in Simulations

1. **Equities:** MSCI World Index (1969 – 1988) and MSCI ACWI (1988 – 2009).
2. **Fixed Income:** Average of Long-term Corporate Bonds, Long-term Government Bonds and Intermediate-term Government Bonds from Ibbotson SBBI[8] (1969 – 1978) and Citigroup US BIG Index (1979 – 2009).
3. **TIPS:** Simulated TIPS returns (1969 – 1996) from data in the research paper by Kothari and Shanken (2004) and Citigroup US TIPS Index (1997 – 2009).
4. **Cash:** 3 Month T-Bill Returns from Ibbotson SBBI (1969 – 1977) and Citigroup US 3 Month T-Bill Index (1978 – 2009).

Appendix 4: Mean Variance Optimization

The formulation of the optimization problem at different time horizon is described below:

Maximize Portfolio Return: h' μ

s.t. constraints

$h_i > 0$ ………(Long only portfolio weights)

$\sum h_i = 1$ …….(budget constraint)

$h' V h < T$ …….(risk budget at different time horizons), where **h** is the vector of asset class weights, **μ** is vector of expected returns of asset classes at different horizons, **V** is the covariance matrix and **T** is the risk budget at the given time horizon. The asset allocation weights are derived using this approach and are presented in exhibit 10.

8 Source: 2010 Morningstar. All rights reserved. Used with permission.

Appendix 5: Sensitivity Analysis of Higher Income Participants

With rising income levels, income replacement from social security decreases, while total required income replacement increases in retirement. This implies that participants with a higher income would have to target a higher income replacement from the DC plan. Participants with a last drawn salary of USD 150,000 may require approximately 84% of total Income Replacement, of which 23% is available from Social Security, while the remaining 61% has to be delivered by the DC plan. In these simulations, we assume the participant starts with a salary of USD 40,000 that grows annually at a nominal rate of 3.5% to reach a **final annual income of USD 158,000 at age 65**. These simulations target an income replacement factor of 60% from the DC plan, versus 50% targeted earlier in case of participants having a last drawn salary of USD 99,000.

Exhibit 27: Impact for Higher Income Plan Participant and Increasing Income Replacement Factor

S.No	Simulations	Required Wealth	Evaluation Metric	All Equity	Average Target Date	Balanced Fund	Risk Focused
1	Base Case	1,516,851	Prob (Success)	99%	100%	100%	100%
			Wealth (Worst Case)	1,835,303	2,179,629	2,094,553	2,081,626
			Wealth (Median)	3,006,465	2,788,939	2,851,323	2,800,527
Sensitivity Analysis and Stress Testing							
2	Impact of Cost	1,516,851	Prob (Success)	95%	100%	99%	99%
			Wealth (Worst Case)	1,521,132	1,818,954	1,743,609	1,745,158
			Wealth (Median)	2,519,192	2,333,092	2,390,582	2,344,016
3	Impact of Cost and Irregular Savings	1,516,851	Prob (Success)	82%	93%	90%	89%
			Wealth (Worst Case)	1,252,328	1,489,174	1,425,859	1,418,989
			Wealth (Median)	2,016,923	1,863,052	1,919,715	1,885,217
4	Impact of Cost, Irregular Savings and Longevity Risk	2,039,070	Prob (Success)	49%	29%	39%	34%
			Wealth (Worst Case)	1,252,328	1,489,174	1,425,859	1,418,989
			Wealth (Median)	2,016,923	1,863,052	1,919,715	1,885,217
Mitigating Measures							
5	Impact of Cost, Longevity Risk, Irregular Savings and 6% Catch Up Savings	2,039,070	Prob (Success)	63%	58%	61%	57%
			Wealth (Worst Case)	1,410,135	1,701,075	1,603,082	1,619,114
			Wealth (Median)	2,267,343	2,101,893	2,154,934	2,112,629
6	Impact of Cost, Longevity Risk, Irregular Savings, 6% Catch Up Savings and Working Longer till age 67	2,039,070	Prob (Success)	90%	94%	91%	86%
			Wealth (Worst Case)	1,858,641	2,020,910	1,929,484	1,884,295
			Wealth (Median)	3,026,601	2,494,340	2,622,285	2,436,691
7	Impact of Cost, Longevity Risk, Irregular Savings, 3% Catch Up Savings, Working Longer till age 67 and Lifestyle Adjustments (40% IRF)	1,699,225	Prob (Success)	98%	100%	99%	99%
			Wealth (Worst Case)	1,858,641	2,020,910	1,929,484	1,884,295
			Wealth (Median)	3,026,601	2,494,340	2,622,285	2,436,691

These results presented in Exhibit 27 imply that plan participants with higher incomes need to consider making higher contributions and consider mitigating measures such as working longer or making lifestyle adjustments to address shortfall and longevity risks.

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