Putnam Institute Retirement

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Toward more robust lifetime income: Integrating downside hedging into traditional lifecycle funds

W. Van Harlow, Ph.D., CFA
Director of Research

ABSTRACT

Downside hedging has been shown to be beneficial in protecting retirement savings from adverse negative returns once the retiree begins making withdrawals to fund living expenses. A natural extension of this prior research is to explore the role of downside hedging within the investment strategies of traditional lifecycle funds. In this paper, we show that this modification to the investment structure of these types of funds can offer significant improvements in terms of their retirement funding characteristics. Specifically, we show that for the same spending level, a downside-hedged lifecycle fund can reduce funding shortfall risk by as much as 50% over traditional lifecycle funds. Alternatively, for the same level of shortfall risk, downside hedging can offer as much as 50% more in initial and continuing retirement income as funds that do not employ these hedging strategies.

Introduction

One of the most salient trends among workplace savings plans in recent years has been the rapid increase in the use of lifecycle funds as both core plan offerings and as "default" choices for those participants who make no conscious investment choices. Both plan sponsors and participants find lifecycle strategies attractive because they provide an "automatic" pattern of lifelong asset allocation and rebalancing that extends over the whole accumulation phase, past some specific "target" retirement date, and on through an investor's whole "distribution" phase.

For participants just starting their working careers, lifecycle funds typically offer a relatively high allocation to stocks in order to capture equities' historically higher expected returns. As participants near retirement, lifecycle asset allocation shifts to a more conservative posture, generally fixed-income securities and cash. The aim is to curb the potential volatility of the accumulated savings pool as retirement approaches, and these assets then become a source to be drawn on for current income.

This "roll-down" or glide path from more to less aggressive allocations reflects the almost universally accepted notion that high volatility can have a powerfully negative impact on retirement success. Indeed, once an individual ceases working and saving and begins actually drawing income from assets, the single most immediate risk he or she faces is "sequence-of-returns" risk. This refers to the adverse impact that a sequence of sharply negative market returns in the early years of retirement can have on the long-term success of a retirement plan.

In a recent paper, we discussed sequence-of-returns risk in retirement and explored the role of downside hedging (DH) strategies within retirement portfolios.[1] DH-type funds, which have been familiar to institutional investors for many years, potentially offer investment risk and return characteristics that are attractive from the perspective of mitigating sequence-of-returns risk and extending the life of retirement savings.

This potential exists because DH strategies can use alternative securities and investment strategies — such as derivatives and short selling — which are not available to traditional, long-only mutual fund managers. The net effect of DH strategies is to narrow the future downside distribution of a portfolio's investment returns. Said differently, the extreme negative "tails" of the potential distribution are reduced through specific investment tactics or securities selection. Well-managed DH funds, therefore, have at least the potential of lowering volatility in down markets. This additional risk-control feature is particularly attractive if it can be successfully applied to retirement portfolios. Indeed, our research showed that the use of DH strategies can significantly lower the risk of an unsuccessful retirement outcome.

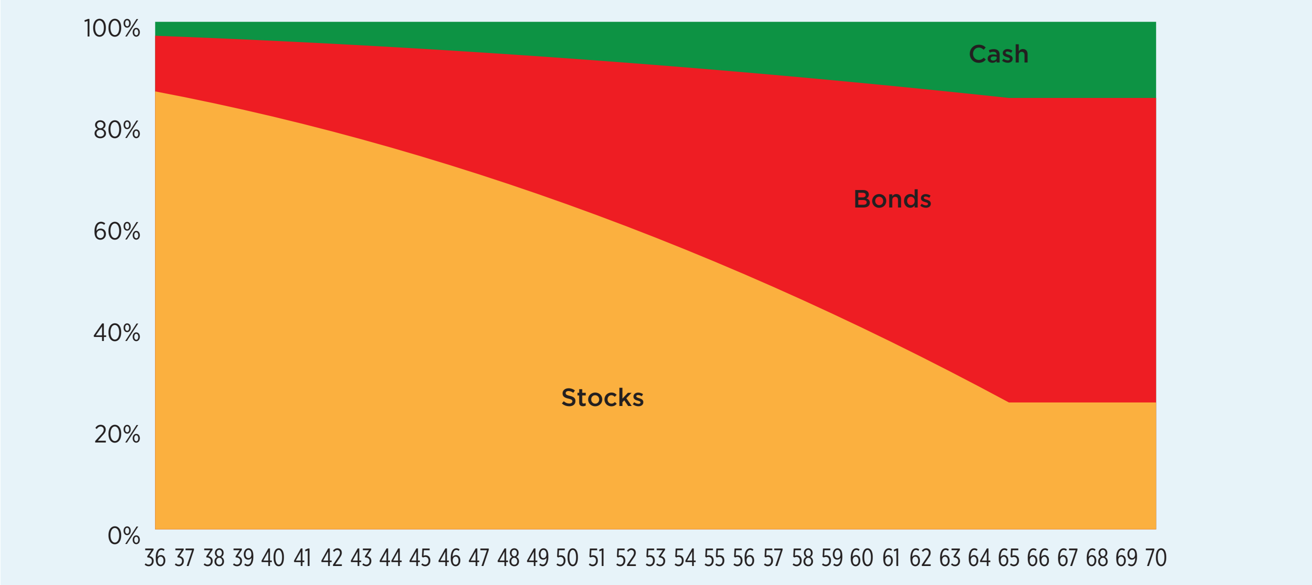
A natural extension of this prior research is to explore the potential utility of DH strategies within retirement lifecycle funds. Accordingly, in this paper we look at integrating DH strategies into traditional lifecycle "roll-down" or glide paths. We evaluate the impact this has on a fund's ability to reliably deliver income and avoid depletion by using the retirement present value (RPV) approach. This is a very powerful form of Monte Carlo-based analysis that integrates both mortality risk and investment uncertainty over an individual's whole savings accumulation and retirement drawdown. We focus on the most relevant measure of how severe a portfolio's depletion risk is — namely the average "shortfall" of all negative results the portfolio may produce. And we note the trade-off between lowered depletion risk, lower shortfalls, and smaller potential bequests to heirs.

We also look at this data from another perspective — that of a portfolio's risk-adjusted income potential. Given equal risk, we contrast the level of income that could potentially be produced by traditional lifecycle funds to that available from lifecycle funds that integrate a substantial share of DH strategies in their overall allocation.

The potential benefits of integrating DH strategies in lifecycle funds appear very compelling. To begin with, we show that *a DH lifecycle strategy can provide significant improvements over traditional lifecycle funds in terms of both reducing depletion risk and lowering the more relevant shortfall hazard by as much as 50%.* Such strategies can substantially extend the long-term viability of retirement plans — provided that withdrawal rates are held at reasonable and sustainable levels.

1 See "Improving the outlook for a successful retirement: A case for downside hedging strategies," Putnam Institute, June 2011.

Figure 1. Traditional lifecycle roll-down schedule



Perhaps most strikingly, we show that *lifecycle portfolios that include DH strategies can enable retirees to draw substantially more income throughout their retirements than from a traditional lifecycle fund — without increasing their risk of depletion.* Indeed, in conditions of high volatility, lifecycle funds that include a DH component can produce as much as 50% more initial and continuing income — at the same level of risk — as lifecycle funds that do not employ DH elements.

Modeling downside-hedged lifecycle funds

To analyze the impact of incorporating DH strategies in a lifecycle glide path, we need to move through two sets of assumptions. First, we need to establish a baseline asset allocation "roll-down" schedule (as in any lifecycle fund) and then weave into it an element of DH strategies. Second, we need to define an economically legitimate way to model the return distribution of DH strategies within the portfolio.

To that end, Figure 1 offers an example of a traditional lifecycle asset class roll-down for an individual beginning at age 35 to age 70. The allocation begins with the vast majority of assets (approximately 86%) dedicated to stocks — with the rest in bonds and cash. As the individual nears his or her retirement age of 65, this notional portfolio reaches its most-conservative allocation of 25% to stocks, with most of the rest invested in bonds. This "terminal" allocation then remains fixed throughout the retirement period. This is the base from which we assume retirement income will be drawn. We define this asset allocation glide path as "traditional" and use it as our unhedged base case.

We then compare it with a precisely similar roll-down template (shown in Figure 2) with the key difference that we apply DH strategies to a portion of the portfolio's equity and bond elements.

In this example, we are using two types of DH funds — a stock-based and a bond-based DH. The overall stock, bond, and cash allocations remain the same as the traditional roll-down model in Figure 1. Here, though, a portion of the overall stock allocation is dedicated to a stock-based DH strategy, and similarly, a portion of the bond allocation is shifted into a bond-based DH strategy.

You will notice here that the use of DH funds is maximized at the retirement age of 65. This is meant to use the increased downside hedging that DH strategies can provide to hedge the portfolio against sequence-of-returns risk in the critical years around retirement when withdrawals begin.

Another view of this DH roll-down schedule is provided in Figure 3. In this graph, the stock- and bond-based DH funds are combined to illustrate the overall use of DH-type strategies in this lifecycle example. Keep in mind, however, that the stock, bond, and cash allocations in this DH example are the same as that in the traditional example. We are just applying downside hedging strategies to a portion of the holdings in each asset class.

Having established the baseline traditional strategy and a model for applying DH strategies within it, let's now explain how we might legitimately model the risk and return characteristics of DH strategies.

For purposes of this analysis, we base our calculations on the "put option approach." In this strategy, a fund manager hedges the downside risk of a DH holding by buying put options with a rolling 12-month maturity that provides the right to sell those assets at a fixed price slightly below current value. The cost of the put is deducted from the portfolio each year. This proxy for a DH hedging strategy is employed separately for the stock and bond elements in the lifecycle portfolio with the appropriate put options reflecting their different volatilities. It is used wherever DH-type funds are incorporated into the asset allocation from accumulation on through the withdrawal phase.

Now that we have determined a framework and a set of assumptions for our analysis, let us turn to the way we will evaluate and compare the performance of a traditionally allocated unhedged lifecycle strategy with one that includes DH elements. The most holistic way to make this comparison is to look at the retirement present value of each strategy.

RPV analysis considers a retirement plan from a variety of perspectives, incorporating cash flows, changes in asset values, and a person's own mortality risk or likely length of life. Each plan is represented by a collection of current and future assets and liabilities. Savings contributions are assets and are flows into the portfolio. The value of these assets also fluctuates with variable and uncertain investment returns over time. Retirement expenses, conversely, are both current and future liabilities, and are outflows from the portfolio. Of course, the duration of the plan or portfolio varies because of the uncertainty of how long one will live. But RPV analysis captures all of these dynamic components, integrates them, and then discounts them into a positive or negative value expressed in today's dollars. Rather than simulating returns to project the future value of a retirement portfolio (e.g., at age 85), the simulated returns are used as discount factors to compute the present value of future retirement cash flows. Mortality risk is captured by weighting these cash flows by the probability of being alive at any point in the future.[2] A positive RPV indicates the likelihood of having some assets left over at the end of life. A negative RPV implies the depletion of all retirement assets well before death.

2 In the analyses presented in this paper, retirement plan cash flows and simulated returns are estimated from the individual's current age out to age 110. The probability of living beyond 110 is essentially zero based on the Gompertz-Makeham model used to estimate mortality.

Figure 2. Integrating downside hedging in a lifecycle roll-down strategy

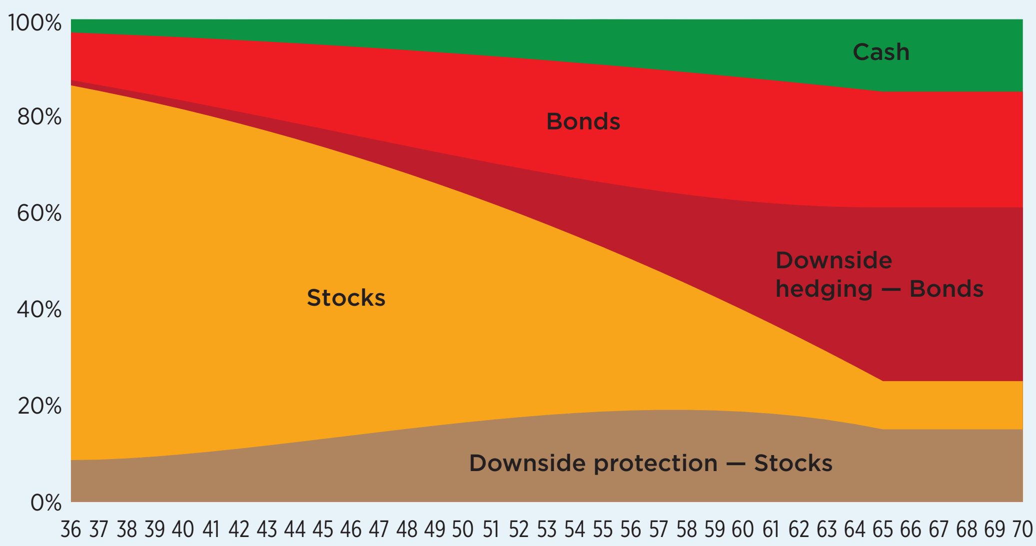
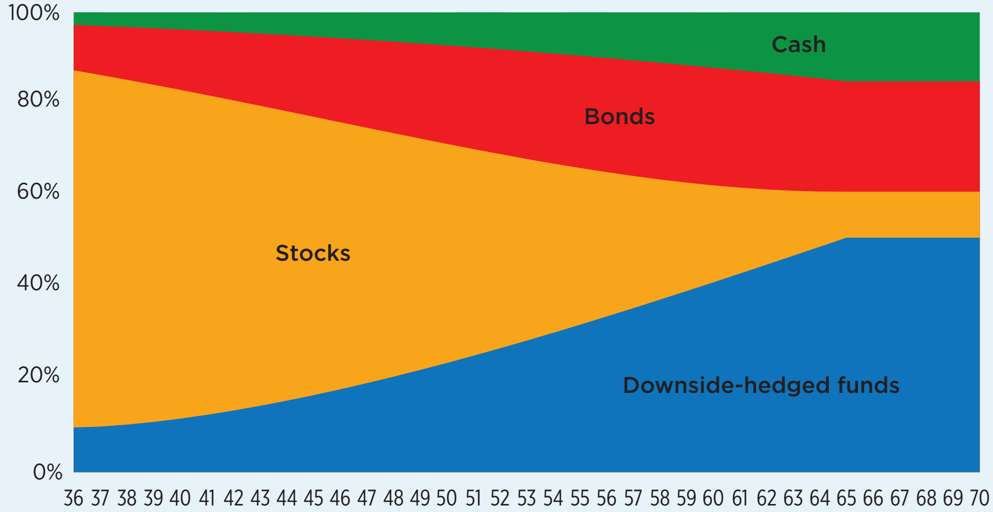


Figure 3. A downside-hedged roll-down strategy by fund type



The reason that there is not a single value but rather a distribution of present values is because of the uncertainty that exists around future investment returns as well as the uncertainty of how long the individual will live. If the distribution of RPV results is completely positive (or nearly so), then we would expect a successful retirement outcome with a high degree of confidence. Conversely, a highly negative RPV distribution suggests a situation in which an individual is likely to outlive his or her retirement resources.

Leaving aside the issue of providing a bequest to heirs, the "perfect" retirement plan would be one in which the RPV would be exactly zero. In that unique case, a person would have precisely the right amount of retirement funds to spend before dying. In reality, of course, retirement plans have a distribution of possible outcomes, ranging from outliving your resources to dying early and leaving a sizeable inheritance unspent.

For planning purposes, one reasonable goal would be to lower the possibility of a negative RPV (i.e., the "probability of ruin" or failure). An even more relevant goal might be to minimize the expected "shortfall" of a portfolio — which measures the relative severity of the risks represented by the possible negative RPVs to which a portfolio is subject. The shortfall, therefore, captures the worst-case results that one would most want to avoid — rapid, catastrophic exhaustion of retirement assets long before a person's death.

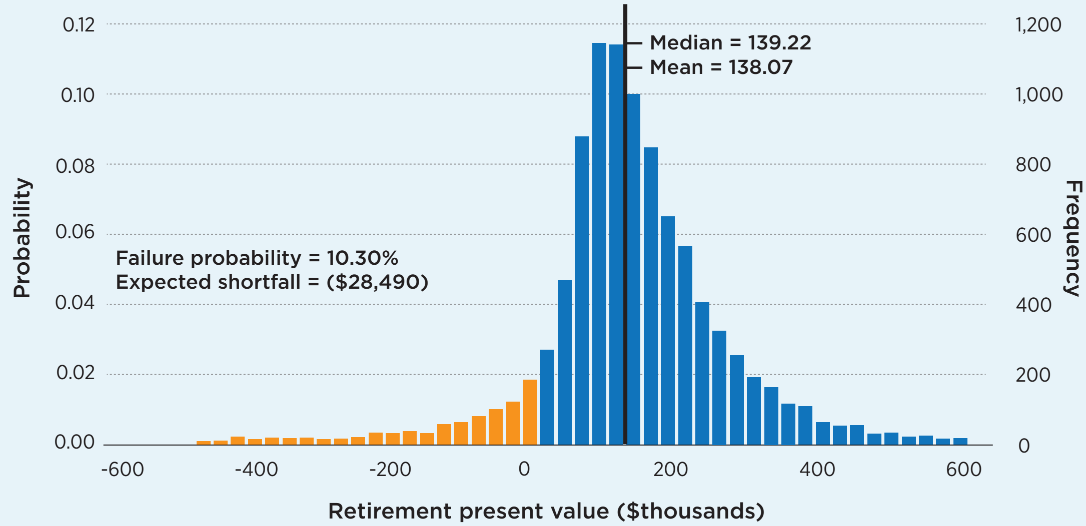
To set a base for comparison, Figure 4 provides the RPV distribution of an example retirement plan employing a traditional lifecycle strategy. In this case, a 35-year-old has no current retirement savings but is planning on saving $20,000 per year, adjusted for inflation. At age 65, the individual will retire and begin spending $60,000 per year in real terms. Throughout the accumulation and retirement period, we assume that the retirement savings are invested in a traditional unhedged lifecycle fund whose asset allocation was previously reflected in Figure 1. We also make the adverse assumption that markets are extremely volatile, with bonds and stocks having volatilities of 15% and 30%, respectively.[3] Real returns for bonds are assumed to be 3.5%, and for stocks, 6.0%.

The RPV analysis for this base case shows a wide distribution of possible outcomes. On average, the retirement plan has a value of $138,070 (median value of $139,220). Thus, in today's dollars, this is the amount that our retiree can expect to leave to heirs. But as you can see, there is also a range of negative RPVs that represent unsuccessful retirement outcomes, i.e., total asset depletion. In fact, 10.3% of the outcomes have a negative present value. This represents a one-in-ten chance of exhausting the portfolio's assets well short of mortality.

A more important statistic gleaned from this RPV analysis is the expected retirement shortfall of negative

3 During 2008, the volatility of the U.S. equity market as measured by the VIX Index averaged 31.6%.

Figure 4. RPV analysis of a traditional lifecycle fund



Note: The analysis assumes the individual begins saving $20,000 per year at age 35 and retires at age 65, spending $60,000 per year, adjusted for inflation. The analysis ignores taxes and transaction costs. Mortality is modeled with a Gompertz-Makeham fit to the unisex RP2000 table.

$28,490. This represents the average of the negative RPVs weighted by the probability of them occurring. This is a more valuable assessment of the severity of the downside risk than pure depletion, because it captures the severity of the unsuccessful outcomes, some of which could be devastating. For example, some outcomes shown in Figure 4 indicate adverse results as high as a negative $600,000 — suggesting there are combinations of market and mortality events that would have actually required $600,000 in initial savings at age 35 plus the $20,000 per year in contributions to completely fund a successful retirement at $60,000 per year. These outlying cases could be the result of a combination of poor market returns early in the retirement (sequence-of-returns risk) and a very long retirement period due to extraordinary longevity. However unlikely, they mark an extreme that many investors would seriously consider insuring against.

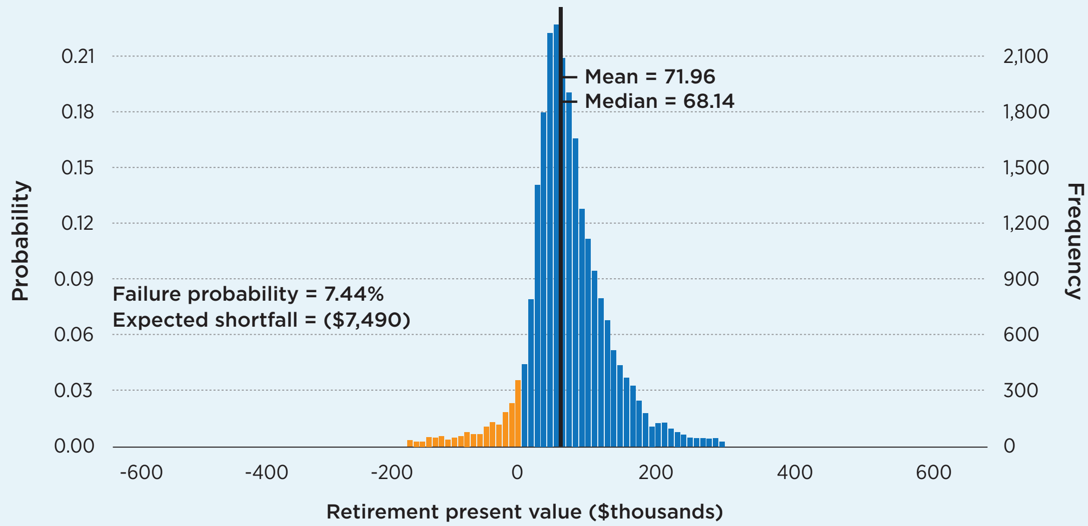
Now let us do the same evaluation of this lifecycle retirement portfolio but with DH strategies integrated into it as in Figures 2 and 3. We will assume that put options with a strike price of 0.95 are purchased for the stock and bond components employing a DH strategy, and the cost of these options will be deducted each year from the value of the portfolio. The resulting RPV distribution for this analysis is shown in Figure 5.

The first thing to notice about the impact of incorporating DH strategies is that the distribution of RPVs is much narrower. In fact, the average RPV of the plan is $71,960, which is approximately half of that using the traditional lifecycle fund ($138,070). The overall probability of failure is also reduced from roughly one chance in 10 to one in 13 (7.44%). More important, the use of DH strategies dramatically lowers the expected "shortfall" of the plan. The negative shortfall of $7,490 is only about one quarter of that of the traditional fund (negative $28,490). The extreme negative outcomes of up to $600,000 that we saw in the traditional base case are eliminated, and the risk of early, massive failure is more than cut in half.

Obviously, there is a trade-off made here. A retiree or advisor can improve the overall health of a retirement plan by employing the DH strategy. The "cost" of this improvement, however, is a lower potential bequest to heirs — reflected in the lower mean and median RPVs we see in Figure 5.

To get a better sense of these trade-offs and the risk reduction from using DH lifecycle strategies, Tables 1 and 2 provide the relevant RPV statistics for a variety of examples using different volatility assumptions and different spending rates in retirement. The panels illustrating "normal" volatility conditions assume that bonds fluctuate by 10% a year, and stocks by 20%. The "high volatility" tables assume that bonds and stocks fluctuate up or down by 15% and 30% per year, respectively.

Figure 5. RPV analysis of a downside-hedged lifecycle fund



Note: The analysis assumes the assets are hedged with the purchase of 12-month put options on the equity and fixed-income components of the lifecycle portfolio. The options have a strike price of 0.95 and the cost of the options is deducted from the portfolio each year. The individual begins saving $20,000 per year at age 35 and retires at age 65, spending $60,000 per year, adjusted for inflation. The analysis ignores taxes and transaction costs. Mortality is modeled with a Gompertz-Makeham fit to the unisex RP2000 table.

Looking first at measures of retirement risk, the results shown in Table 1 parallel our earlier examples. Compared with the traditional lifecycle approach, lifecycle portfolios that include DH strategies reduce both the probability of failure and the expected shortfall of any given retirement plan. While the DH approach cuts the probability of failure only marginally, it significantly lowers the expected shortfall. Depending on various volatility and spending levels, reductions to this more relevant retirement risk measure range from one twelfth

Table 1. Risk comparisons of traditional and downside-hedged lifecycle funds for different volatilities and spending levels in retirement

	Traditional strategy		Downside protection strategy			
Retirement withdrawal	Mean bequest	Median bequest	Mean bequest	Median bequest	Mean difference	Median difference
Panel A. Normal volatility						
$30,000	$229,580	$209,240	$152,260	$139,630	$77,320	$69,610
$40,000	$198,550	$183,480	$132,300	$122,890	$66,250	$60,590
$50,000	$168,660	$159,400	$112,850	$106,370	$55,810	$53,030
$60,000	$138,430	$137,300	$93,190	$91,460	$45,240	$45,840
$70,000	$107,820	$117,070	$72,900	$77,550	$34,920	$39,520
$80,000	$76,610	$97,270	$52,100	$63,920	$24,510	$33,350
$90,000	$47,270	$78,050	$32,160	$50,400	$15,110	$27,650
Panel B. High volatility						
$30,000	$254,660	$206,470	$119,220	$98,900	$135,440	$107,570
$40,000	$217,240	$180,900	$104,560	$87,660	$112,680	$93,240
$50,000	$177,860	$158,910	$88,570	$77,470	$89,290	$81,440
$60,000	$130,410	$135,050	$69,470	$66,220	$60,940	$68,830
$70,000	$101,510	$119,650	$56,350	$58,860	$45,160	$60,790
$80,000	$62,600	$104,300	$39,380	$51,430	$23,220	$52,870
$90,000	$21,070	$90,320	$22,140	$44,200	($1,070)	$46,120

Note: The analysis assumes the assets are hedged with the purchase of 12-month put options on the equity and fixed-income components of the lifecycle portfolio. The options have a strike price of 0.95 and the cost of the options is deducted from the portfolio each year. The individual begins saving $20,000 per year at age 35 and retires at age 65, spending the indicated amounts each year, adjusted for inflation. The analysis ignores taxes and transaction costs. Mortality is modeled with a Gompertz-Makeham fit to the unisex RP2000 table.

to one half compared with the traditional lifecycle strategy. For ranges of failure risk that most individuals would find tolerable — roughly 10% or less — the risk reduction can be as high as 50% to 75%. That is a very dramatic improvement in the overall health of a retirement plan. There are, of course, trade-offs, measured in terms of reduced potential bequests to heirs and shown in the panels of Table 2.

Table 2 shows that the improvements in the viability of the plans that can be achieved by using DH strategies come at the cost of a reduced average RPV. This means a reduced value in the estate or bequest likely to be available to a retiree's heirs. This reduction, however, is considerably smaller in percentage terms than the overall reduction in failure or shortfall risk. For example, looking at the normal-volatility case and a $60,000-per-year retirement withdrawal, the reduction in shortfall risk is 56% ($2,879/$6,597), while for bequest it is 33% ($93,190/$138,430). For the high-volatility case with a $60,000 withdrawal rate, the reduction in risk is 74%, and for bequest, 53%.

For most people, securing funding for a successful retirement is foremost in their minds. Any reduction in expected bequest is a secondary consideration to reducing retirement risk — a trade-off that many retirees may find worth making. This type of analysis, then, allows a retiree or financial advisor to make a much better-informed decision about these trade-offs between likely retirement success and a potentially lower bequest.

The value of the downside-hedged lifecycle strategy

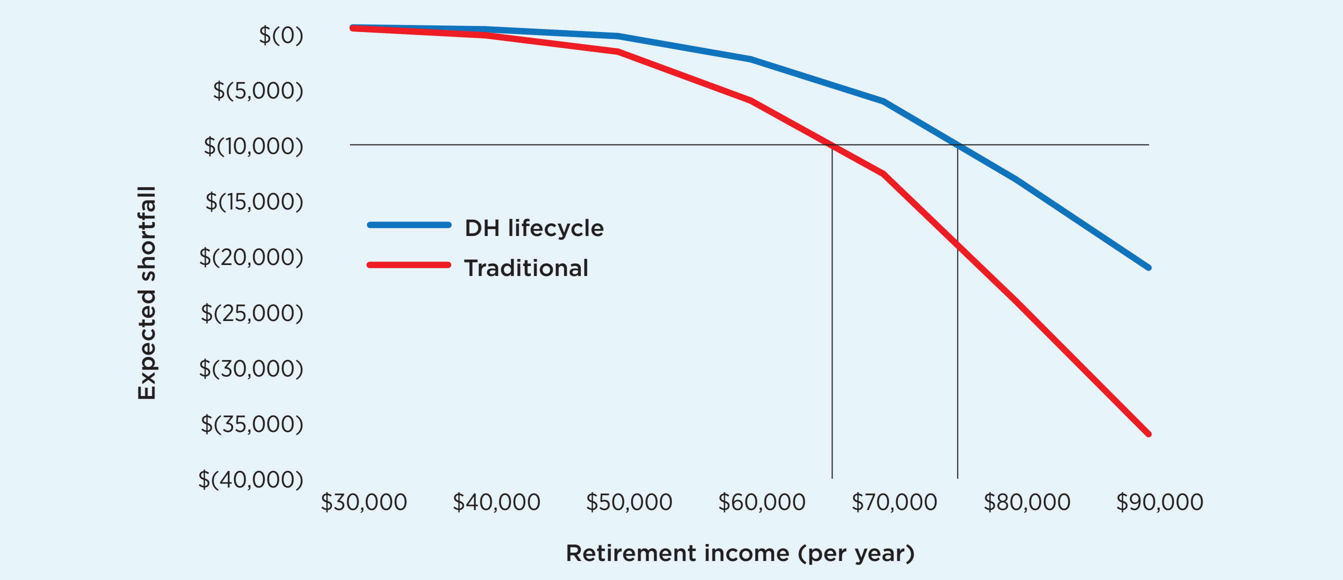
Having seen that DH strategies can lower retirement risk — by narrowing the range of results and sharply reducing the frequency and depth of negative outcomes — a natural follow-up question is: What difference could this make in terms of potential income in retirement? Holding risk levels equal, how much more cash income could a person reliably draw from a DH-enhanced lifecycle portfolio — compared with a traditional model?

Table 2. Bequest comparisons of traditional and downside-hedged lifecycle funds for different volatilities and spending levels in retirement

	Traditional strategy		Downside protection strategy			
Retirement withdrawal	Probability of ruin	Expected shortfall	Probability of ruin	Expected shortfall	Probability difference	Expected shortfall difference
Panel A. Normal volatility						
$30,000	0.04%	($97)	0.02%	($16)	0.02%	($81)
$40,000	0.68%	($723)	0.30%	($185)	0.38%	($538)
$50,000	2.31%	($2,195)	1.49%	($794)	0.82%	($1,401)
$60,000	5.60%	($6,597)	4.60%	($2,879)	1.00%	($3,718)
$70,000	10.56%	($13,194)	9.45%	($6,662)	1.11%	($6,532)
$80,000	16.41%	($24,644)	15.61%	($13,688)	0.80%	($10,956)
$90,000	23.63%	($36,614)	23.13%	($21,637)	0.50%	($14,977)
Panel B. High volatility						
$30,000	0.85%	($1,956)	0.31%	($162)	0.54%	($1,794)
$40,000	3.03%	($7,200)	1.47%	($1,270)	1.56%	($5,930)
$50,000	5.85%	($16,584)	3.79%	($3,793)	2.06%	($12,791)
$60,000	10.91%	($32,218)	8.17%	($8,344)	2.74%	($23,874)
$70,000	14.72%	($44,502)	11.63%	($13,184)	3.09%	($31,318)
$80,000	19.24%	($64,070)	16.21%	($20,755)	3.03%	($43,315)
$90,000	24.64%	($89,547)	21.72%	($30,398)	2.92%	($59,149)

Note: The analysis assumes the assets are hedged with the purchase of 12-month put options on the equity and fixed-income components of the lifecycle portfolio. The options have a strike price of 0.95 and the cost of the options is deducted from the portfolio each year. The individual begins saving $20,000 per year at age 35 and retires at age 65, spending the indicated amounts each year, adjusted for inflation. The analysis ignores taxes and transaction costs. Mortality is modeled with a Gompertz-Makeham fit to the unisex RP2000 table.

Figure 6. Comparing traditional and DH-enhanced lifecycle funds for different spending levels with normal volatility



Note: The analysis assumes the assets are hedged with the purchase of 12-month put options on the equity and fixed-income components of the lifecycle portfolio. The options have a strike price of 0.95 and the cost of the options is deducted from the portfolio each year. The individual begins saving $20,000 per year at age 35 and retires at age 65, spending the indicated amounts each year, adjusted for inflation. The analysis ignores taxes and transaction costs. Mortality is modeled with a Gompertz-Makeham fit to the unisex RP2000 table.

To answer this key question, Figure 6 presents the risk and spending relationships that we saw in Table 1. But in this case, we graph the data to contrast varying income levels for lifecycle portfolios with and without the integration of DH strategies in their glide path.

Moving left to right, the chart tracks the impact of higher levels of spending. Moving from top to bottom, the chart tracks rising risks of asset depletion — as measured by the average RPV shortfall levels. The curved lines show that such risk rises as spending increases — whether the fund includes DH strategies (in blue) or is based on traditional lifecycle allocation (in red).

Clearly, the DH-enhanced portfolio's curve is both flatter and well above the traditional lifecycle fund. In other words, a DH-enhanced lifecycle strategy has lower risk at any given level of spending than a traditional lifecycle allocation. More interestingly, it also offers higher income potential at any given level of risk.

This is illustrated by the horizontal line drawn at an arbitrary shortfall level of $10,000 — which corresponds to a less than 10% probability of failure (depletion) for the retirement plan. At this level of risk, a retiree could draw approximately $66,000 per year from a traditional lifecycle portfolio. But if the same portfolio incorporated the share of DH strategies we outlined in Figures 2 and 3, the same retiree, with the same overall allocations between equities, bonds, and cash, could draw approximately $75,000 per year from the DH-enhanced portfolio — without increasing his or her risk one iota. That amounts to a risk-neutral increase of 14% in a retirement paycheck — with the only notable trade-off being a reduction in the potential bequest to heirs.

The advantage that DH strategies can provide is even more striking if we consider the impact they could have under conditions of high market volatility. To illustrate that, Figure 7 graphs the risk and spending data in the same framework, but using the higher-volatility assumptions from Table 2. Once again, the DH-enhanced fund's curve is higher and flatter than that of a traditional lifecycle fund.

In comparing potential income at the same level of risk, we assume in this example that the retiree is willing to take less than a 10% probability of failure as in the previous example. This corresponds to the horizontal line drawn at a shortfall of negative $20,000. The difference is staggering. At this level of risk, the traditional lifecycle portfolio can reliably generate approximately $53,000 per year. A DH-enhanced version of the same portfolio could throw off roughly $79,000 of income with no increased risk of running out (a 49% increase in income). DH strategies, in other words, have an even more potent impact on potential lifecycle income as market volatility rises.

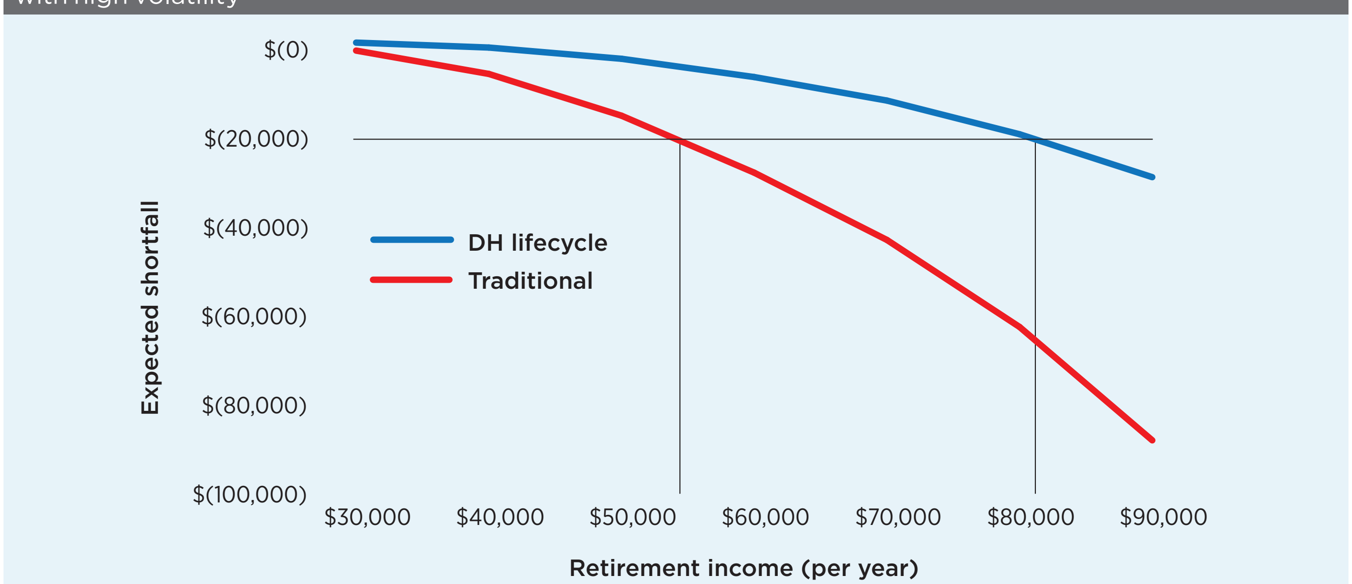
Of course, the income increases illustrated in Figures 6 and 7 are predicated on a reduction in the expected bequest to heirs. To the extent that the retiree puts the highest priority on ensuring his or her own retirement success and avoiding becoming a burden to his or her heirs or to society, DH lifecycle strategies clearly offer an attractive way to achieve that goal without needing to rely on other longevity-insurance strategies, such as annuities. The strength that DH strategies can add to a lifecycle portfolio becomes even more pronounced when securities markets are highly volatile, as they were in 2008.

Conclusions

Lifecycle funds have become one of the most central elements in American retirement savings, especially in workplace savings plans. They are popular because the ongoing asset allocation and rebalancing decisions required of a self-managed retirement portfolio are done by the investment firms that offer these products. Most valuably, lifecycle funds shift the asset allocation and risk characteristics of the portfolio over the lifetime of the investor — automatically — to reflect increasing sensitivity to volatility as total wealth grows and retirement nears.

In this paper, we fully recognize the value of this dynamic asset allocation concept. But we go one step further. We analyze the potential benefits of downside hedging strategies, which can offer lifecycle plan designers an added element of investment diversification and risk mitigation even without changing the basic asset allocations in a given lifecycle glide path. We focused on DH strategies since their objective of providing more downside risk hedging suggested that they may offer especially valuable hedging against sequence-of-returns risk once a retirement portfolio begins to be drawn on for current income.

Figure 7. Risk comparisons of traditional and downside-hedged lifecycle funds for different spending levels with high volatility



Note: The analysis assumes the assets are hedged with the purchase of 12-month put options on the equity and fixed-income components of the lifecycle portfolio. The options have a strike price of 0.95 and the cost of the options is deducted from the portfolio each year. The individual begins saving $20,000 per year at age 35 and retires at age 65, spending the indicated amounts each year, adjusted for inflation. The analysis ignores taxes and transaction costs. Mortality is modeled with a Gompertz-Makeham fit to the unisex RP2000 table.

We found that integrating DH strategies into a lifecycle portfolio can, in fact, produce significant improvements in its risk and return profile in retirement compared with a traditional, long-only lifecycle fund. Integrating DH strategies can reduce the most significant measure of a portfolio's risk — its expected "shortfall" as measured by retirement present value — by as much as 50% to 75% depending on spending levels and the volatility of markets.

Viewed through the most relevant lens of all, namely the impact on retirees' potential incomes, these findings suggest that the integration of DH strategies can enable a life-changing increase in a retiree's potential income compared with traditional lifecycle funds — without any increase in depletion risk.

The implications for lifecycle fund construction, for workplace plan design, and even for public policy in the retirement area are self-evident — and profound.

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Putnam Institute
One Post Office Square
Boston, MA 02109

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