Refocusing on Retirement Income Risk

The Retirement Driven Investing (RDI) Approach to Fixed Income in DC Plans

Fixed income allocations in defined contribution plans, while perceived as low risk, may actually expose participants to substantial volatility in retirement income. To reduce this risk, sponsors can apply duration-matching techniques when designing target date funds or managed accounts. This offers participants stability in their retirement income expectations and customization to better reflect plan demographics.

This paper is part of our series on retirement driven investing for defined contribution plans, available at *www.nisa.com/rdi*.

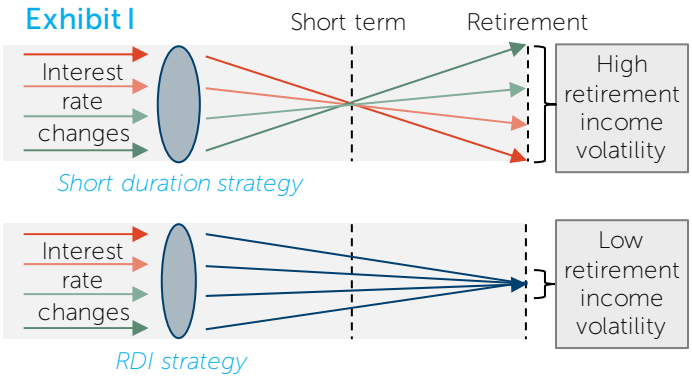
With the rise in popularity of the defined contribution plan and the steady waning of its defined benefit counterpart, workers increasingly view their 401(k) as a primary source of retirement savings and the foundation for their retirement spending.

But while pension plan structures have changed with the shift from DB to DC, the desire to have a predictable source of income during retirement has remained. Accordingly, there is a growing trend to measure the success of a defined contribution account by its ability to generate income during retirement. A variety of stakeholders are reaching similar conclusions. For example, the Department of Labor is exploring how retirement income estimates can be reflected on participant statements, in addition to the account balance.[1]

As natural as this heightened emphasis on retirement income may seem, the implications from an investment strategy and risk management perspective are profound. Typically, risk in a DC plan is dimensioned in terms of the volatility of the account balance. However, this definition overlooks the fact that interest rates play a central role in transforming current account balances into future retirement income. In fact, short duration bond portfolios intended to stabilize account balance fluctuations are, ironically, generating volatility in retirement income as interest rates change.

Given the long-dated nature of typical retirement income needs, fixed income portfolios must choose to focus either on stable account balance or stable retirement income. Just as a camera focused on the foreground creates blurry objects in the distance, a fixed income strategy focused on short-term volatility creates "blurry" long-term outcomes – i.e., volatility at retirement. Exhibit I illustrates this dynamic.

Exhibit I



In this paper, we explore this short-term/long-term volatility tradeoff and characterize the DC participant's retirement income objective. We then introduce an investment framework around this objective, designed to stabilize retirement income. We call this framework RDI, or Retirement Driven Investing. This approach explicitly recognizes the age of the participant and the interest rate sensitivity of their retirement income goals when structuring bond portfolios.

[1] *http://www.dol.gov/ebsa/newsroom/fsanprm.html*

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April 2014

The Red Herring of Account Balance Stability

Imagine a 60-year-old female worker who is planning to retire in five years. Let's assume she estimates $25,000 a year[2] – half of her current salary – to be the minimum amount of retirement income she will need from her 401(k), and does not want to risk falling below that level. Her goal of $25,000 a year may be viewed as a "pension promise made to herself",[3] in essence representing the DC version of a DB pension liability.

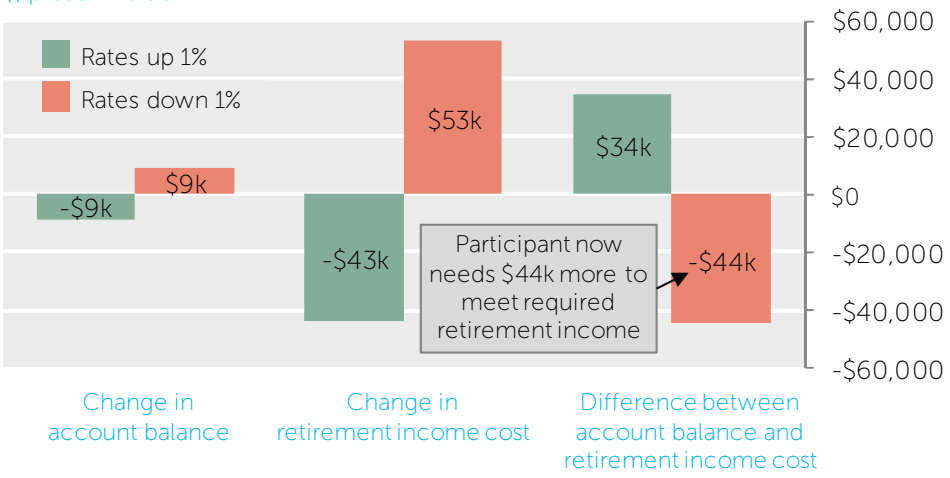
How much does she need today to lock in her future spending needs? By taking these required future cash flows, weighting them by the appropriate mortality probability, and discounting them to today's dollar terms using risk-free interest rates, we can calculate the current cost of her retirement income (i.e., the value of her "liability") to be $313,000.[4] Let's further assume our participant has this amount in her account already, the result of years of diligent savings and investment returns. She takes $313,000 to invest in an "income generation" portfolio designed to meet her required retirement income needs and invests any remaining amount and future contributions in a separate equity "growth" portfolio.[5]

A key question remains: *how to invest the assets?* How would a plan sponsor or other advisor suggest she invest the $313,000 to lock in the required retirement income with as little market risk as possible? Until recently, the answer may have simply been "bonds". And since low volatility in account balance has been associated with low risk, more than likely the chosen portfolio would be a bond, stable value, or money market fund of short or intermediate duration.

However, changes in account balance are a misleading indicator of progress towards her retirement goals. Exhibit II illustrates the consequences of investing the $313,000 in a "low volatility" bond portfolio with a 3-year duration. It highlights the effect of changing interest rates on both current account balance and, more importantly, on our participant's ability to meet her retirement income goals relying solely on her income generation portfolio.

Exhibit II[6]

$, present value



Source: NISA calculations. Mortality rates based on data from the Society of Actuaries

[2] *While we assume a constant $25,000, various circumstances may argue for a retirement income stream that is not level. Please see the* RDI Portfolio Implementation *and* Characterizing the DC Liability *sections for more discussion on this topic.*
[3] *Stephen C. Sexauer and Laurence B. Siegel, "A Pension Promise to Oneself",* Financial Analysts Journal*, November/December 2013*
[4] *See the* Characterizing the DC Liability *section for more details on this calculation.*
[5] *The objective of the growth portfolio may be to meet non-essential retirement spending goals, for example.*
[6] *Readers may notice that the change in retirement income cost is not of equal size in the up and down rate cases. This asymmetric sensitivity to interest rate changes is a characteristic of long maturity cash flows known to fixed income analysts as convexity.*

Seven years of her savings have effectively been wiped out by the 1% drop in interest rates.

Before the interest rate change, our participant's $313,000 was sufficient to meet her retirement income goal. After the change, the story is very different. We see that if interest rates fall, her account balance is slightly higher, but the amount needed to meet her future retirement income goal has increased much more. She now falls $44,000 short of the amount needed today to fund her minimum annual $25,000 target. She can now purchase only $22,000 of annual retirement income, 12% less than she had planned. If we assume she is currently saving ten percent of her salary, this drop in interest rates has effectively wiped out the last *seven years* of her savings.[7]

The key insight from this illustration is that an employee's retirement income is not only influenced by the size of the account balance, but by interest rates that are the link between that account balance and future retirement income. It is intuitive that, all else equal, employees will have more retirement income if they grow their balance through additional savings and through investment returns. What is less intuitive is the central role that interest rates play in determining how much retirement income a given account balance will be worth in the future. This intuition difference may explain why most decisions about interest rate exposure (i.e., portfolio duration) are generally an attempt to stabilize account balance, not stabilize a projected retirement income level. However, holding shorter maturity bonds to meet longer maturity spending needs exposes the participant – unnecessarily – to the risk of adverse changes in interest rates, with consequences that can have a substantial dollar value and lifestyle impact.

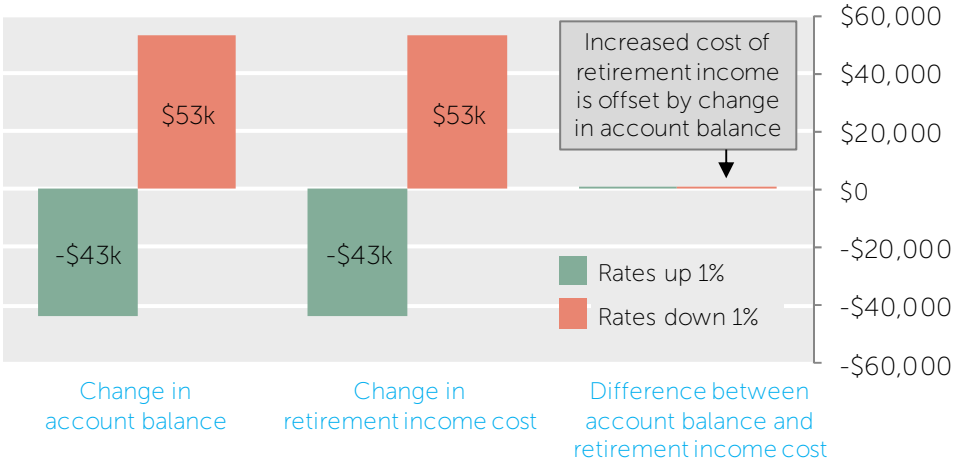
The RDI Portfolio

The good news for our participant is that bond portfolios can easily be designed to reduce retirement income volatility. Fixed income allocations that are intended primarily to generate future income and "hedge" a participant's liability do so by targeting the interest rate sensitivity of those flows.

In our example, the current value of our 60-year-old participant's retirement income stream has a sensitivity to changing interest rates – i.e., a duration – of 15 years.[8] This indicates that a one-percent drop in interest rates makes that future income stream roughly 15% more costly to buy today, and a rise in rates makes it about 15% cheaper. As substantial as this volatility is, its impact to the participant can effectively be eliminated by simply matching the duration of the bond portfolio to that of the liability. Exhibit III shows the result of investing in an RDI portfolio with a matching 15-year duration.

Exhibit III

$, present value



Source: NISA calculations. Mortality rates based on data from the Society of Actuaries

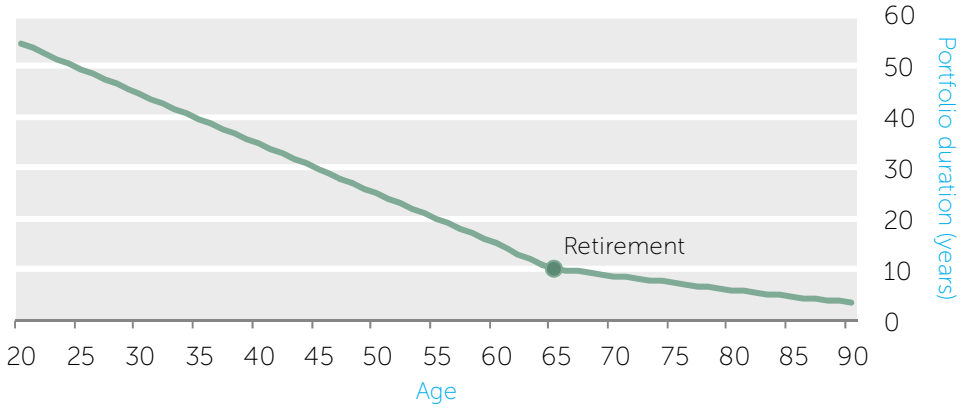
[7] *Calculation based on a 4% interest rate assumption.*
[8] *See* Characterizing the DC Liability *section for the details of the duration calculation.*

The RDI portfolio's higher duration amplifies the effect of changing interest rates on current account balance. However, the same $25,000 of annual income can be purchased since that swing in account balance mirrors the swing in the cost of the future retirement income stream. This is the beauty of the duration-matching strategy. The immediate fall (or rise) in account balance is offset by higher (or lower) reinvestment rates, leaving her attainable level of future retirement income effectively unchanged. This illustration reinforces the point that not all volatility is bad. In fact, volatility in account balance is *desirable* when it is tracking a similar volatility in the cost of retirement spending objectives.

Calibrating the RDI Portfolio Based on Age

Since participant age is a key factor in determining how far in the future retirement spending is likely to occur, age is also a key determinant of the duration target for the fixed income hedging portfolio. This is a particularly useful observation because it means that RDI portfolios can be easily incorporated into funds that already structure investments based on age, like target date funds (TDFs). In Exhibit IV, we show how the liability duration for an illustrative female participant would look at various ages.

Exhibit IV



Source: NISA calculations. Mortality rates based on data from the Society of Actuaries

The shape of the line is fairly intuitive. Leading up to retirement, each additional year in age corresponds to about a year less of duration as the target cash flows move a year closer. The kink in the line is the point where retirement begins. Afterwards, duration falls less rapidly as disbursements are taken and the shortest duration cash flows are removed each year. Also, the durations reflect the updated longevity probabilities that are warranted as the participant actually reaches older ages. The likelihood of reaching age 90 is much higher once someone has reached 89 than it was at 65, and portfolio duration should be adjusted accordingly.

A typical "core" portfolio may fall significantly short of the required duration for hedging retirement income objectives.

One notable takeaway from Exhibit IV is that for any age less than about 80, the target duration is greater than five years, and is much greater for any working-age participant. This suggests the typical "core" or broad market duration allocations within DC plans may fall significantly short of the duration required to hedge retirement income objectives. Furthermore, to the extent a participant's RDI hedging portfolio holds less in dollar value than the current cost of their retirement income liability (i.e., if they are "underfunded"), an even longer duration may be desirable.

Some readers may note that the current marketplace does not offer bonds long enough to match the duration targets for those younger employees who still have several decades until retirement. As target duration approaches 30 years, either leverage (e.g., a derivative instrument) is required or a mismatch versus the ideal duration target will exist. As a practical matter, for those younger employees with smaller account balances and higher allocations to equity, the impact of a duration mismatch is less meaningful given that most of their retirement wealth has yet to be earned and given the lower effective volatility of very long-dated interest rates. Nonetheless, any fixed income that younger

employees do hold would likely be better allocated to strategies with longer durations than those currently offered in most DC plans.

RDI Portfolio Implementation

We anticipate the RDI approach will most likely be adopted by sponsors, advisors, and consultants for use in target date funds or managed accounts, although some may choose to offer RDI to participants in the core investment option lineup. In either case, we believe that RDI provides a new tool in the toolkit for those decision-makers seeking to customize the plan's investment options and manage risks related to retirement income.

A key component of the RDI approach is duration – specifically, targeting the duration of mortality-weighted retirement income projections. Beyond duration, this framework can be implemented in different ways depending on the specific goals, circumstances, and demographics of each plan and its participants. Here we highlight a few of these choices and other considerations.

- Real vs. nominal retirement income: Up to this point, we have not made an explicit assumption about whether retirement income is being measured in real or nominal terms. Economics tells us that retirement savers should seek real income, representing consumption power that is not diluted by inflation. However, to the extent retirement income is intended to meet spending needs that are nominal (e.g., fixed mortgage payments), nominal income may be desirable.

  If real retirement income is the objective, then long duration Treasury securities with payoffs linked to inflation (TIPS, or Treasury Inflation-Protected Securities) may be the preferred vehicle for hedging the retirement income goal, and an RDI portfolio can be designed accordingly. In cases where real income is the goal and suitable inflation-linked instruments are not available, an empirical analysis can be done to help determine the relative roles of TIPS and nominal instruments.

- Longevity risk: While an RDI portfolio does manage interest rate risk throughout retirement, on its own it does not provide any hedge of longevity risk. The implications of this are significant since if a retiree were to rely directly on disbursements from their portfolio through the retirement years, they bear the risk of outliving those assets, as our later *Characterizing the DC Liability* section discusses. However, since the calculations of liability size and duration are based on mortality probabilities assuming the participant survives until retirement, it implies that the participant is expected to have the capacity at that time to purchase an annuity product that does provide a lifetime income guarantee.[9] This purchase could occur outside the plan, or the plan could directly incorporate different insurance products alongside the RDI portfolio to provide various levels of longevity risk management (e.g., immediate annuities, longevity annuities, contingent deferred annuities).[10]

- Customization for participant demographics: We have already discussed how age is a central feature in the RDI portfolio's design, but a sponsor could further customize to incorporate other sources of participant retirement income, further refine mortality assumptions and duration based on demographics, and so on. Sponsors may find this particularly useful in light of the Department of Labor's recommendation that participant circumstances and demographics be considered when selecting investment options in TDFs.[11]

- Constant duration vs. target age duration: An RDI strategy could either be based on a menu of fixed income portfolios with constant durations, or on portfolios

[9] *So long as future mortality projections are not different from current projections, this will be the case.*
[10] *Note that if an annuity is actually purchased, consideration should be given to the various tax treatments of all the participant's assets. It may be more tax-efficient to purchase annuities with assets that do not receive the favorable tax-treatment of a 401(k).*
[11] *http://www.dol.gov/ebsa/pdf/fsTDF.pdf*

with durations that change over time. For example, a target date fund manager or managed account provider could allocate among component portfolios with different fixed durations (e.g., 10-years, 20-years) to maintain the appropriate duration for a particular fund. Alternatively, that fund could rely on a single portfolio designed to follow a path like the one illustrated in Exhibit IV and "age" automatically.

- **Total account volatility:** Plan sponsors may be wary of intentionally injecting volatility into account balances (and the prospect of explaining that to participants). In reality, this may not be an issue. When an equity allocation exists alongside an RDI portfolio, as may likely be the case, volatility at the combined account level may change very little given the material volatility of equity markets and typically low long-term correlation with long duration bonds. Depending on the circumstances, only a marginal increase in total account volatility may actually result from the switch to a longer duration bond portfolio. It is important to note that this does not somehow undermine the importance of the RDI strategy. The goal of the RDI portfolio is to stabilize its designated portion of retirement income spending, regardless of how the remaining assets are invested.

Conclusion

How well do we understand the risks that plan participants face as they invest for retirement? Thus far, investment strategy and risk management in DC plans have largely focused on growing account balances while minimizing their volatility in the short term.

However, if stable retirement income is the goal, then choosing bond portfolios for their low market value volatility may backfire on participants. While less volatile in account balance or market value terms, short duration bond portfolios leave the participant exposed to changes in long-term interest rates that are central to meeting retirement income goals. If this dynamic is overlooked, participants risk falling short of their goals and undermining years of accumulated savings as interest rates change. We believe this is a risk many participants do not realize they are taking, would not choose to take if they did, and would eliminate if they could.

Low volatility bond portfolios may backfire on participants if the goal is stable retirement income.

Since the role and prominence of DC plans in retirement planning has expanded and evolved, so too must the industry's definition of risk evolve from an "asset-only" to an "asset-liability" perspective. As another step in that evolution, we propose a broad framework called RDI – Retirement Driven Investing – that considers the retirement income objective in investment decision-making. In this paper, we have illustrated how the RDI approach can be applied to fixed income portfolios to mitigate the impact of unexpected interest rate changes on future retirement income.

"What gets measured gets managed," the saying goes, and we expect that the growing focus on the retirement income metric will lead plan sponsors towards investment strategies that manage risk in terms of the stability of that retirement income. The increasing number of employees who plan to rely on their 401(k) in retirement will benefit from this approach for many years to come.

Institutional investors are invited to contact NISA to discuss customized RDI strategies:

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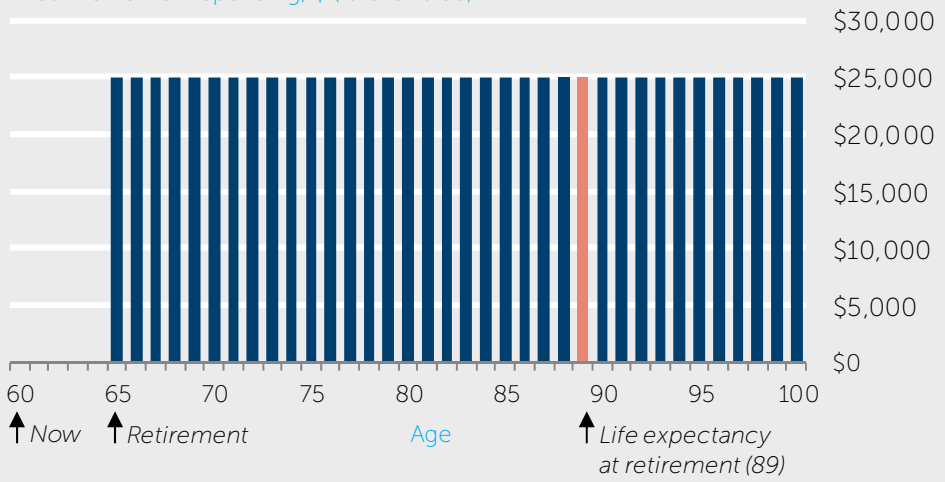
Characterizing the DC Liability

Defined contribution plans do not have payout obligations per se, so they do not have a well-defined liability in the traditional sense. However, any participant's retirement income objectives may be represented as a stream of future cash payouts, not unlike a defined benefit pension liability. Exhibit V depicts one possible consumption pattern for a hypothetical 60-year-old female planning to retire in five years.

Exhibit V

Annual Retirement Spending, $ (future value)



Source: NISA calculations. Mortality rates based on data from the Society of Actuaries

For simplicity, we assume the flows to be of equal size each year. However, the RDI approach could be applied to more customized consumption patterns as well as the flat pattern we've chosen here (see the *Alternative Liability Definitions* section for further discussion).

Perhaps the most important characteristic of these future cash flows is their long maturity, or more precisely their long duration, which implies that today's dollar value of these future flows is highly sensitive to changes in interest rates. Any strategy that seeks to track the cost of retirement spending will need to fine tune the duration of the investment portfolio accordingly.

We also know that each year brings some increasing probability of death that makes these consumption requirements less likely to occur the further we look into the future. Since this changing probability affects our target duration, we combine the flows in Exhibit V with current actuarial mortality tables.[12] The result is a set of probability-weighted cash flows based on the lifespan assumptions for the 60-year-old female, depicted in Exhibit VI.

[12] *We assume Society of Actuaries RP 2014 and Scale MP improvement rates, as they are current and readily accessible, but any mortality assumptions can be used. Survival probabilities are contingent upon living until retirement age.*

Exhibit VI

Expected Annual Retirement Spending, $ (future value)

Source: NISA calculations. Mortality rates based on data from the Society of Actuaries

These weighted cash flows can be thought of as the DC participant's "expected liability". To clarify why this may be the case, it's helpful to recognize that these weighted cash flows are equivalent to the expected payments an insurance company (or DB plan) would make to the participant if the constant retirement income in Exhibit V had been promised. Taking the present value of these expected payments can therefore be thought of as the amount a participant would need to buy this hypothetical retirement annuity from an insurance company today.[13] In our example, this amount is $313,000 based on the assumption of a 4% interest rate.

Given their long-dated nature, the current value of those expected cash flows – the "liability" value – will fluctuate as interest rates change, as would the dollar cost of an annuity obligation to deliver those future flows. In our example, the duration of the combined flows is 15 years, implying the annuity cost (i.e., liability value) will rise by approximately 15% for each 1% drop in rates, and vice-versa. The RDI strategy seeks to minimize the impact of unexpected interest rate changes on future retirement income by matching fixed income portfolio duration to the liability duration, as illustrated earlier in Exhibit III.

Alternative Liability Definitions

Most would agree that "retirement income" can be thought of as income that starts at retirement and lasts for the rest of one's life. In choosing to define our liability as equivalent to an annuity contract that pays a fixed nominal amount, we have perhaps chosen the simplest way to represent retirement income that satisfies that definition. However, many in both academic and practitioner circles have made observations on retirement income that may imply a different approach to defining the "liability". For example, is retirement spending likely to be equal in every year, or does it change over time? Should retirement income be defined in nominal terms or real (i.e., inflation-adjusted) terms? Should a participant's desire to leave some wealth to their heirs be incorporated into the retirement income objective? Will the participant want to bear the risk of outliving their assets, or offload that risk via an insurance product or through some other pooling mechanism?

[13] *Though importantly, this does not imply the participant must buy an annuity, as discussed below. Insurer profit margin or other annuity pricing considerations (e.g., administrative costs) are not considered here.*

The various answers to these questions have led to various ways to represent the retirement income objective. For example, some have suggested that retirement income be reflected as a set of inflation-linked payments for the first twenty years following retirement followed by a deferred annuity to best balance market and longevity risks given the investment options available in the marketplace.[14]

For our discussion about the duration of retirement income, the important point is that alternative characterizations of retirement income are likely to fit easily into the RDI framework. Regardless of how the retirement income liability is defined, it almost certainly has a long duration that argues for extending the duration of fixed income held in the income generation sleeve of the portfolio.

Does RDI Require an Annuity Purchase?

Since many have noted the various structural and behavioral factors leading to a seemingly low appetite for annuities,[15] it is natural to ask whether the annuity-replication liability definition we have chosen here implies an insurance contract is required. The answer is no. A participant need not intend to purchase an annuity to make this strategy relevant. To see why, we can break an annuity contract between a participant and an insurer into two distinct parts:

1. The cash flows: The purchase of a stream of cash payments for the remainder of their expected life.

2. The longevity hedge: Agreeing to forgo those payments if they die prior to their life expectancy in exchange for additional payments in the event they live longer than expected.

While these two components come packaged in an annuity, they can be thought of separately for both theoretical and practical purposes. A participant may choose to avoid an annuity, bear longevity risk, and take disbursements directly from their portfolio every year in an amount equivalent to what an annuity would have paid. If our hypothetical 60-year-old woman had taken this "self-annuitization" approach, she would have a 59% chance of running out of money, which by design is consistent with the probabilities an insurer would calculate to determine their break-even point (ignoring insurer profit margin, etc.).

We have chosen the annuity replication approach in part because we believe most participants do not want to bear longevity risk and would benefit from pooling that risk in some way. But our main purpose in this paper is to point out that the high interest rate sensitivity of the value of that stream of future payments (#1 above) argues for an investment strategy that reduces or eliminates that risk, regardless of whether longevity risk is borne by the participant or offloaded to an insurer.

[14] *Stephen C. Sexauer, Michael W. Peskin, and Daniel Cassidy, "Making Retirement Income Last a Lifetime"*, Financial Analysts Journal, *January/February 2012*
[15] *Shlomo Benartzi, Alessandro Previtero and Richard H. Thaler, "Annuitization Puzzles"*, Journal of Economic Perspectives, *2011*

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