

Defined Contribution Retirement Plans Should Look and Feel More Like Defined Benefit Plans

ANTTI ILMANEN, DAVID G. KABILLER, LAURENCE B. SIEGEL,
AND RODNEY N. SULLIVAN

ANTTI ILMANEN is a principal at AQR Capital Management in Greenwich, CT. antti.ilmanen@aqr.com

DAVID G. KABILLER is a co-founder of AQR Capital Management in Greenwich, CT. david.kabiller@aqr.com

LAURENCE B. SIEGEL is the Gary P. Brinson Director of Research at the CFA Institute Research Foundation in Charlottesville, VA. He lives and works in Wilmette, IL. lbsiegel@uchicago.edu

RODNEY N. SULLIVAN is a vice president at AQR Capital Management in Greenwich, CT. rodney.sullivan@aqr.com

Why have defined contribution (DC) retirement plans delivered such uneven—and, on average, inadequate—results? How can DC sponsors, who are charged with most of the responsibility for retirement security in the United States and elsewhere, do better—*much* better?¹ Can DC sponsors learn from defined benefit (DB) plans, which did achieve desirable outcomes in many cases? Can they hold on to the best features of DB plans while simultaneously taking advantage of DC plans' structural advantages, such as full portability and unambiguous ownership of the assets by the participant?²

These are challenging questions, each requiring detailed analysis. Our basic thesis is that in order to provide more satisfactory results, DC plans need to look and feel more like DB plans.

To figure out how to do this, we'll emphasize the essential similarities between DB and DC plans. Both are mechanisms for spreading the income from one's working life over one's whole life; both are forms of lifecycle investing. Moreover, neither kind of plan can, in the aggregate, pay out more than is paid into it (plus investment returns). DB and DC plans both must obey the basic ground rules of economics—including the existence of limits, the universality of trade-offs, the power of incentives, and the tyranny of accounting identities. The challenges

faced by the two types of plans are, therefore, similar in their economic content, although quite different in execution.

This article asks what we can learn from history on both the DC and DB sides and suggests possible ways to design much better DC plans. We do so by borrowing the best ideas from both DB and DC structures. We identify the three levers that influence DC outcomes: (1) portfolio construction and investment return, (2) the savings rate and length of the savings period, and (3) decumulation strategy and longevity pooling. We assess opportunities to improve upon current practice in each of these three areas. But first, we begin with a brief history of DC and DB plans and identify the challenges currently facing both types of plans.

LIFECYCLE INVESTING

The best way to understand a retirement plan is as a way of spreading the income from one's work life over one's entire life. This is inherently difficult because one's work life typically spans 35 or 40 years, whereas one's entire adult life can range up to 80 or more years. With such a ratio, it's tempting to conclude that the would-be retirees have to save half or more of their income, but positive real returns and lower spending during retirement reduce this number to a more manageable, but still high, level.

We know of two ways to spread one's work income over one's whole adult life, the chief difference being who is doing the spreading. When an employer or the government does it, the transaction often takes the form of a defined benefit or income continuation. This is the DB plan structure. (Note that employers and governments can do this because they have continuing cash flows, beyond the employee's tenure, with which to guarantee the pension benefit.³) When employees themselves do the spreading, however, the source of post-retirement income must be savings accumulated during work. This is the DC plan structure. Although the surface characteristics of the two structures are quite different, the underlying economics are very similar.

Thus, DC and DB plans have these key characteristics in common:

- What you get out, in aggregate across participants, cannot be more than what you put in (plus investment returns).
- There is an investment component, explicit or implied, to both strategies.⁴
- Positive real returns on invested capital help—a lot. Even low rates of compound interest add up to a lot of money over a working lifetime.⁵
- Longevity-risk pooling, in which those who die young subsidize those who live a long time, helps—a lot (although this is an underutilized aspect of DC plans today; more on this later).

There is a rich literature on lifecycle investing, dating back to the Nobel Prize-winning economists Franco Modigliani and Milton Friedman in the 1950s.⁶ Robert Merton, another Nobel laureate, contributed significantly in 1969; and Bodie, Merton, and Samuelson added more pieces of the puzzle in their landmark 1992 article.⁷ William Sharpe, the chief proponent of the CAPM and yet another Nobel winner, has been continuously involved in the evolution of lifecycle finance thinking.⁸ In addition, since the 1990s, the practitioner literature on the topic has been very rich. Rather than introduce a detailed literature survey at this point, we refer to key research as needed.

In a recent article, Siegel [2015] asked why there is still a retirement crisis when so much valuable knowledge on the topic has been produced over the last 70 years. The main reasons, he argued, are human nature and agency costs. Human nature pushes us to choose

immediate satisfaction over waiting for larger rewards, making it hard to save for the future. Agency costs are a way of saying that giving your money to other people for safekeeping does not always work out well, largely because agents and principals face different incentives. This article, consequently, focuses on behavioral issues and agency costs, as we reflect on how we arrived at a situation in which many find that the income available for them to retire is inadequate and poorly secured.

THE ECONOMIC AND ACTUARIAL EQUIVALENCE OF DC AND DB PLANS

All this *Sturm und Drang* about retirement reminds us of a line in the classic baseball movie *Bull Durham*: Baseball is “a simple game—you throw the ball, you hit the ball, you catch the ball.” Well, it's not that easy—and neither is lifecycle investing. You earn money, you save money, you invest the money, and you spend the money: This all sounds simple, but none of it is easy.

Yet, this formulation helps us clarify the economic similarity between DB and DC plans. The money has to come from somewhere: employer and/or employee contributions. There is an investment component, usually explicit but occasionally hidden (if the DB plan is a pay-as-you-go plan, like Social Security), and there is payout or spend-down.

Moreover, the actuarial and investment work done by the DC plan participant, perhaps with the help of software or employer-provided advice, is identical in spirit to the work done by or on behalf of DB plans. Participants must determine their liabilities (future spending needs), estimate the expected return on the various assets available in the market, and figure out how much to save. When DC participants have reached their “number,” that is equivalent to being fully funded in a DB plan.⁹ They can then retire. And payout or spending is another actuarial puzzle, involving estimates of life expectancy (and the size of the right tail, living longer than expected) as well as of future market returns. We believe that DC sponsors should play a greater role in providing the tools and education needed to ensure a comfortable retirement for participants.

The investment and actuarial work required of a DC participant is made harder by the fact that it mirrors the work needed for a *one-person* DB plan, which is much less predictable than a plan with many participants. Through the law of large numbers, a multiparticipant

DB sponsor needs to know and plan for only the average and variance of the participants' life expectancy (as well as other factors such as job tenure); a one-participant DB sponsor, or DC participant saving his or her own money, needs to know, and save for, the maximum possible life span, which is much longer than the statistical life expectancy of a large pool of people—or else find a way to engage in longevity-risk pooling, a topic we'll cover later.

The bottom line, then, is that a DC participant must successfully operate the economic equivalent of a one-participant DB plan—typically with only a little investment or actuarial skill and with no recourse to outside funds if he or she turns out to be bad at it. No wonder DC plans are frustrating and confusing to many participants!

Why DB Plans Are, in Principle, the Best Retirement Vehicles—And How DC Plans Can Emulate Them

As the investing luminary Charles Ellis recently stated, “The DB pension system approach produced the best financial service for individuals there's ever been” (Ilmanen and Sullivan [2015a, p. 9]). We agree. When broadly applied and competently managed, with full funding of the economic (not actuarial) liability so that benefits are in effect prepaid and there is no possibility of default, DB plans are a great system for providing retirement income. Among the advantages of DB plans are the following:

- skilled actuarial work and portfolio construction—plan sponsor and its advisors figure out how much to save and how to invest the assets
- funding—usually mandatory, with the employer doing the saving for the employee
- institutional-quality asset management, including management of “time risk” (the risks associated with saving over the very long term)
- decumulation—a check every month—with longevity-risk pooling (so that the short-lived subsidize the long-lived, making adequate benefit levels affordable).

The plan sponsor takes care of essential functions that an individual on his or her own cannot replicate without great difficulty and expense. Retirees with no

DB plan struggle to figure out how much to spend, and many live in fear of an impoverished old age.

The DB system was very good for individuals who could get into the plans and whose coverage was not impaired by inflation or vesting requirements (which we'll get to in a moment). But today, many employees have little chance of ever being covered by pensions with these characteristics. The reason is that DB plans present a number of structural challenges that have caused some to close down or become underfunded.

If we can't all have DB plans—other than in a few occupations—we need to see which of their features a plan operating within the DC ecosystem can emulate. In other words, we need to ask how DC plans can be made to look and feel more like DB plans from the participant's perspective. To the extent that this can be accomplished, DC outcomes can be improved tremendously.

To find out ways the DB financial arrangement can be emulated, we first review the DB system. Naturally, the economic principles that emerge from this story are valid everywhere that DB pensions exist, but the United States is the “laboratory” where much of today's pension technology was first developed.¹⁰

Although pensions paid to specific individuals have an ancient history, the idea of a pension plan as an employee benefit—a part of one's pay—appears to have started with American Express in 1875, which provided the benefit to workers who had been “injured or worn out” (Tackett [1989]).¹¹ The list of beneficiaries was gradually expanded to include all of the company's retirees. Pensions became wildly popular during the era of rapid industrialization before and after World War II, and by the end of that period, DB plans covered a majority of full-time employees in large corporations.

But the DB structure, in which the plan's liabilities are considered the sponsor's liabilities for accounting and reporting purposes, resulted in sometimes overburdened sponsor balance sheets.¹² These liabilities grew from negligible size in the 1950s to vast amounts in the 2010s. This situation evolved both in corporate plans—where pension liabilities occasionally even exceeded all corporate assets for companies with shrinking businesses and aging workforces—and in public plans, where the willingness or ability to tax often fell short of the benefits promised to employees. The consequent underfunding of most plans, both corporate and public, augurs poorly for beneficiaries being able to rely fully on the pension promises made to them.

A pension manager who wishes to minimize risk tries to match the assets to the liabilities both in quantity and in risk exposures. However, there can be a mismatch. For instance, the economic “surplus” (assets minus liabilities) may actually be negative—a deficit—if an excessively high discount rate is used to calculate the present value of future liabilities. In addition, assets may be poorly hedged to the liabilities, with, for example, a lot of equity market risk but not enough duration risk. Thus, when interest rates fall, as we’ve observed over a three-decade period, the market value of the liability rises more than the assets.

Inflation, too, has potentially significant consequences. Fixed nominal pension payments may be fine—or almost fine—in today’s low-inflation environment, but in the Great Inflation that started in the 1940s and culminated in the 1970s, recipients of fixed nominal payments were ruined. Although some DB plan benefits are indexed to inflation, someone unlucky enough to retire at age 65 in 1947 with a fixed nominal benefit would have seen each benefit dollar depreciate to \$0.23 by the time he or she turned 100 in 1982—while experiencing none of the robust economic growth that occurred in this period.

Pension benefits may also be subject to vesting requirements. DB plan benefit formulae usually require that employees stay in a job long enough to vest, and often weight benefits toward the last years of service. And, even though the employee’s own contribution to a DC plan is fully portable, such plans sometimes have “cliff vesting” for the employer’s part of the contribution.¹³ In either case, job-hoppers may receive little benefit from employer contributions, even when the benefits from all the different jobs are aggregated. Finally, many small-business employees, part-time workers, and others are not covered at all.^{14,15}

Three Macro Events That Impacted the DB System

As we argued earlier, the DB pension system was one of the most elegantly engineered financial arrangements in history.¹⁶ The establishment of a pension fund—instead of pay-as-you-go—was supposed to cover bankruptcy risk of the sponsor. The truing up of asset balances, through extra contributions (or contribution holidays if the balance was more than adequate), was intended to cover market fluctuations. The DB system

can be summarized as follows: Buy (labor) now, pay later (similar to any other debt).

As it turned out, however, three major changes in the macroeconomic environment impacted the DB system:

1. Interest rates declining to historic lows, raising the present value of pension liabilities
2. Longer lifespans
3. Lower expectations for returns following the great bull market of 1982–2000.

The first two changes are well known and are covered in the context of corporate DB plans in Leibowitz and Ilmanen [2016], so we don’t need to go into detail on them here. It suffices to say that long-term Treasury yields fell from over 15% in 1981 to around 2% in 2015; and that U.S. life expectancies have been on the rise.¹⁷ We’ll discuss the lowered expectations for future returns in the next section.

Reflecting on the list of three macro events above, we note that DC participants, in managing their one-person retirement plans, face exactly the same challenges from these events as DB sponsors. They—individual savers—have to prepay their consumption liabilities (spending plans) at very low interest rates, they have to plan for longer lives, and they cannot buy equities cheaply. So the impact of the macro events is not specific to the DB world—far from it. But individual savers in DC plans can benefit by reacting in different ways to the same stimuli. For example, they can cut spending to account for the possibility of living longer. DB plans typically cannot cut their payouts without the sponsor going through a bankruptcy.

WHAT MARKET RETURNS CAN DB AND DC INVESTORS EXPECT IN THE FUTURE?

We’ve experienced an unusual series of events in the capital markets. A generation ago, it was a widespread practice to extrapolate historical equity returns forward indefinitely into the future (after adjustment for changes in interest rates), based on the logic that the stock market offers a reasonably stable return premium over bonds.

But from 1982 to 1999, equity returns were so high that they pushed historical-average returns up to levels that could not persist indefinitely. From 1926 to the 1999–2000 peak, the arithmetic mean of annual

nominal total returns on large-cap U.S. equities was a very strong 12.7%.¹⁸ Projecting this rate forward created truly heroic assumptions about future equity values—assumptions that would not be realized so far in the 21st century.

It makes sense that the high equity prices of 1999–2000 would be followed by low equity returns because current equity earnings yields (E/P) at any given time are linked to forward-looking returns. Elevated market prices mean lower yields, which suggest lower returns going forward. When applied to today’s market conditions, the current low levels of market yields on both stocks and bonds suggest that returns on both stocks and bonds will continue to be lower than their historical averages.

Exhibit 1 shows the real expected return (real yield) of a 60/40 portfolio of U.S. equities and bonds since 1900, calculated using a dividend and earnings discount model for equities and an inflation adjustment to the nominal yield for bonds at each point in time.¹⁹ We expect a real return of 4.0% on equities and 0.5% on bonds, which combine to a 2.6% real return on a 60/40 portfolio.²⁰ This is one of the lowest expected returns on a stock/bond portfolio over the 115-year history shown in the exhibit.

We certainly don’t welcome such a somber outlook for traditional investment returns, but that’s the unfortunate reality we now face. But, while investors cannot do much about low real expected returns for traditional asset classes, they can plan or budget for a

lower-return environment. This means saving more in the years leading up to retirement and spending less in retirement. (Longer lifespans also mean more savings and less spending.) When faced with low returns, the DC investor’s problem mirrors the DB sponsor’s problem exactly, although different terminology is used. Investors can also try to enhance returns by diversifying with additional market risk premia and adding alpha, strategies that we’ll come back to later.

THE GROWTH OF DC PLANS

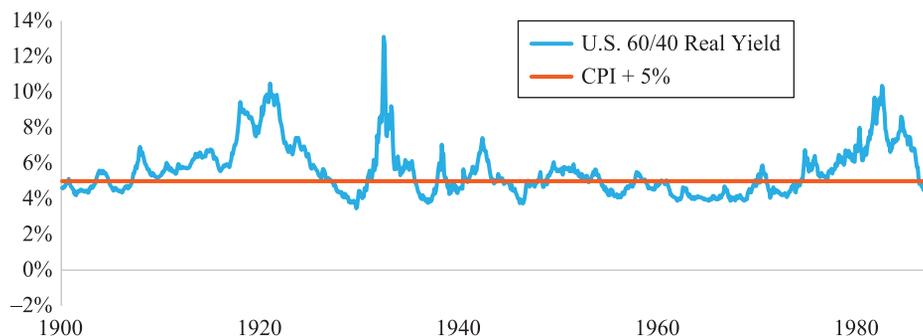
Origins of DC Plans

The idea of a DC plan is rooted in the age-old tradition of individual saving and investing. The individuals—who, in the special case of a DC plan, may receive aid from their employer through matching contributions and account and fund structure—buy assets and later consume out of the income from holding them and the proceeds from selling them. DC plans are no more (and no less) than a way of making individual investing more convenient, affordable, and tax-advantaged.

But it is important to note that DC plans in the United States—at least in their current form as 401(k), 403(b), and similar plans—began as supplements to DB plans, not as substitutes for them (Fetini [2008]).²¹ There is little evidence that corporate or public plan sponsors ever seriously thought, until quite recently, that DC plans alone could meet the needs of their employees.

EXHIBIT 1

Expected Real Return of U.S. 60/40 Stock/Bond Portfolio, January 1900–December 2015: *Expected Investment Returns Are Low*



Sources: AQR, Bloomberg, Robert Shiller’s Data Library, Ibbotson SBBI data from Morningstar Direct (also reproduced in Ibbotson SBBI 2015 Classic Yearbook [2015]), Kozicki and Tinsley [2006], Federal Reserve Bank of Philadelphia, Blue Chip Economic Indicators, Consensus Economics. See endnote 19 for methodology.

In 1986, Congress replaced a generous DB plan for Federal workers with a less-generous DB plan plus a 401(k), kicking off the DB-to-DC transition (but still treating DC benefits as supplemental).

A Pennsylvania benefits consultant named Ted Benna is credited with bringing the 401(k) into private enterprise in the early 1980s.²² He noted that an obscure provision in the Revenue Act of 1978, called section 401(k), enabled employees to legally defer compensation. He added the employer match—an early “nudge” that gave thrifty employees a raise that others did not receive—and the movement toward a DC world began, at first slowly but then gaining momentum like wildfire.

Given DC’s origins in individual (“retail”) investing, it is perhaps unsurprising that Fidelity Investments, a retail market leader, saw an opportunity around 1987 to sell its mutual funds to employers for use in their newly established DC plans. It took a while for the institutional market leaders to catch on, but by the mid to late 1990s, many investment management firms had entered the DC market. Exhibit 2 shows the growth of DC plans since 1980. After stalling during the first few years of the new millennium, participation in DC plans has since been gradually on the rise once again—perhaps a result of the 2006 Pension Protection Act, which allowed for auto-enrollment among other important “automatics” such as qualified default investment alternatives (QDIA), which are typically diversified portfolios, and periodic auto-escalation of worker contributions.²³ Interestingly, the percentage of workers with no pension plan coverage has remained unsatisfactorily high at roughly 55% since 1989.

DC AND DB PLANS COMPARED

The Roles of Income and Assets in a Retirement Strategy

It is worthwhile recalling that DC plans originated as a supplement to DB, not a substitute for it. DC plans thus created a potential *four-legged stool* of retirement security: Social Security, DB plans, DC plans, and private saving. The first two are independent streams of guaranteed lifetime income and the last two are independent (but typically correlated) asset pools. Of course, few retirees ever enjoyed four-legged retirement security, but it is a good model for thinking about the future.

With DC plans supplanting DB plans, however, retirees are going to have to make the more conventional three-legged stool (Social Security, DC, private savings) work. This design is dominated by asset accumulation, rather than by earning the rights to lifetime income. Many thinkers have argued that income, not assets, is what retirees want and need.²⁴ Thus, successful retirement plan design should include ways that would-be retirees can accumulate income rights in the first place.

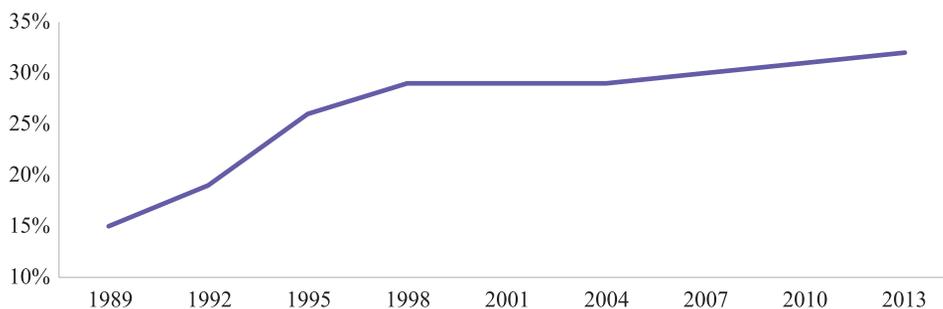
Significant Differences Between DC and DB Plans

Though we’ve emphasized the economic similarities between DC and DB plans, the differences are substantial, and go beyond the fact that one involves asset accumulation while the other involves income provision.²⁵

Perhaps the most important difference, which argues in favor of DB plans, relates to oversight of the

EXHIBIT 2

Percentage of Private and Public Sector Workers with DC Plan Coverage, 1989–2013: *Rising Significance of DC Plans*



Source: Center for Retirement Research, cr.bc.edu/wp-content/uploads/1012/01/Pension-coverage1.pdf.

fund investments. With DB plans, investment professionals oversee the investments on behalf of the beneficiaries and have accountability for fund performance. However, the DC plan structure shifts the retirement liability from the employer to the individual. As we stated earlier, it is unreasonable to expect most DC participants, with little investment experience or actuarial skill, to successfully serve as CIO of their own retirement plan. We believe a better way forward is sorely needed. This change seems especially important now, given the forthcoming demographic shift facing so many developed economies and the anticipated increase in required pension payments. Given this backdrop, the DC pillar of the three-legged stool will become increasingly important.

This shifting of the retirement liability has a profound effect on retirement policy and strategy. With DB plans, the employer takes the responsibility for saving, bears the market risks, and guarantees the benefits; with DC plans, in contrast, investment risk is borne by the participant, saving is voluntary, the employer determines any matching contributions, and retirement benefits are not guaranteed (although portable). This makes achieving success in a DC world more challenging, but not impossible.

Consider Australia's superannuation arrangement, for instance, which involves compulsory fund contributions accompanied by voluntary savings and a benefit safety net for retirees. In the United States, such arrangements, or similar ones, would of course require a change in policy. But from where we sit, policy changes will be needed to achieve success in securing retirement income for most retirees in the coming decades.

Another key difference between DB and DC plans is portfolio efficiency. With DB plans come professionally managed, relatively efficient portfolios comprising a wide array of eligible asset classes ranging from liquid traditional and alternative asset classes and strategies to a variety of less-liquid alternatives. DC plans provide a much narrower investment set. As we'll see later, this difference has important implications for portfolio diversification, risk, and returns.

One important advantage of DC plans is that they are inherently portable because the employee unambiguously owns the assets.²⁶ As we noted earlier, this feature eased the DB-to-DC transition, especially for a younger generation of workers who expected to have several jobs in a lifetime (and some of whom were already familiar with mutual-fund investing). Given traditional DB

vesting rules, a worker who switches jobs frequently might never earn a pension; a DC plan is a necessity for such a person.

Moreover, DC plans are attractive to corporate managements and their accountants because they are always "fully funded" on the balance sheet; a DC plan has essentially no impact on the liabilities of the sponsor. (The desire to get DB plans and their unfunded liabilities off the balance sheet has made the DB-to-DC transition attractive to corporate managers.) But be careful! DC plans are rarely if ever fully funded relative to employee needs or expectations. Employers who want to attract and retain the workers of their choice at reasonable cost need to be mindful of the trepidation and confusion felt by many workers trying to save and invest for retirement. DC plans need to be improved.

ARE DC PLANS FAILING?

DC Plans Are Also Struggling to Provide Needed Benefits—Hence the Looming Retirement Crisis

It's important to understand that DC plans can fail, but they do so in subtle and gradual ways. DC participants often underperform DB plans and the market (we discuss this in a later section). A DC plan can be said to have failed a particular individual if the benefits provided are so meager that she can't retire on them without a radical decrease in her standard of living. DC plans and their participants, working together, can improve the participant experience on many fronts:

- Increase savings rates
- Work longer
- Construct portfolios more skillfully
 - Improve DC plan performance
 - Move portfolios onto the efficient frontier—risks need to be better diversified with better access to a wider array of risk premia beyond traditional asset classes to include alternative asset classes and strategies
 - Ensure fair fees and costs
- Reduce or eliminate early withdrawals
- Optimize decumulation practices
 - Increase discipline around how much to spend
 - Expand mortality pooling.

Although DC plans as an institution have not explicitly failed, it remains an open question whether in the coming decades participants will be able to successfully maintain the standard of living in retirement that they've come to expect. We believe that DC plans have not been tried in anything close to a sensible way yet. (How can a savings plan with a 3% savings rate succeed?) Although some have been able to secure a comfortable retirement under the DC flag, a majority of DC plan participants do not have enough savings accumulated.

A sensible approach to securing DC plan retirements means some combination of less consumption now (more saving during working years, working longer, or both) and in the future (spreading retirement wealth over a longer lifespan). To better understand how we can improve DC plans to fix this problem, let's examine them in more detail. We follow the outline from earlier.

Increase Savings Rates

At the heart of the problem of insufficient DC plan benefits is an inadequate savings rate (as represented by employer plus employee contributions to the plan). You can only get out what you put in, plus investment returns, minus costs. Unless investment returns are miraculous, a DC plan cannot provide needed benefits unless contribution rates are on the high side of 15% of salary, and some researchers argue for 20% or even 30%.²⁷

Exhibit 3 shows the distribution of retirement savings balances as reported by the U.S. Government Accountability Office. A disturbing 41% of households

age 55–64—the key age group for ascertaining retirement preparedness—have *no* retirement savings. For the 59% of households aged 55–64 with some retirement savings, the median amount saved is about \$104,000, which translates to an estimated inflation-indexed annuity of \$331 per month for a 60-year-old. While about 9% of all households have retirement savings amounts over \$500,000, 20% have retirement savings below \$50,000. A savings amount of \$50,000 translates to an estimated inflation-indexed annuity of \$159 per month for a 60-year-old—hardly a sufficient retirement plan.²⁸

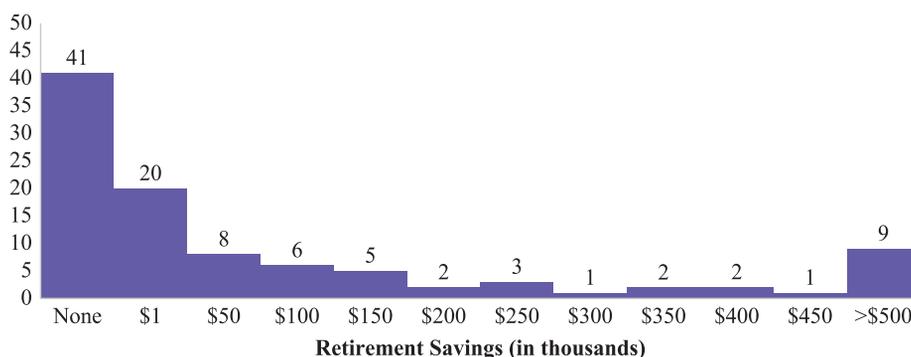
The situation is ameliorated by the fact that some of these households have DB plans and almost all will receive Social Security benefits.²⁹ However, these data show that retirement preparedness is generally poor and also very unevenly distributed.

Exhibit 4 shows the distribution of 401(k) plan participants' asset balances by age and job tenure, again at a point in time. Exhibits 3 and 4, together, begin to portray the low-savings problem. However, not everyone saves too little; the successes show that adequate savings are possible and provide clues on how to increase savings rates and asset balances for more participants.

While Exhibits 3 and 4 appear to be in conflict, with the latter showing a more favorable picture, there is no actual conflict—the two exhibits cover different populations. The data in Exhibit 3 represent all U.S. households age 55–64, while the data in Exhibit 4 represent people with DC plans (and jobs!). We'd expect the latter to be better prepared. And because Exhibit 4 shows

EXHIBIT 3

Distribution of Retirement Savings Amounts among Households Aged 55–64, 2013: Retirement Savings Levels in U.S. Are Disturbingly Low



Source: GAO analysis of 2013 Survey of Consumer Finances data: GAO 15-419.

that retirement balances rise sharply in the last years of one's work, it indicates that DC plans can help their participants at least partially accomplish their retirement goals, given a long enough period of time.

Yet, even the \$250,000 median balances achieved by older long-service employees are not enough. That amount, invested in a life annuity by a 60-year-old, produces only about a \$1,193 per month income—and that is not inflation protected.³⁰ Thus, much more work needs to be done on improving DC plans.

Why are contribution rates for DC plans seemingly so much higher than for DB plans, with savings requirements of 20% to 30% of salary instead of 5% to 15%, given that they are both (as we've emphasized) lifecycle savings vehicles attempting to provide the same level of post-retirement consumption? There are multiple reasons:

- The longevity-risk pooling inherent in DB plan benefit formulae helps some, but a more important reason is subsidies from those who change jobs (or die before retirement age). These subsidies or transfers do not exist in DC plans.
- Relative to modest expected contribution rates, DB plan promises are often generous and thus contingent on either very good capital market outcomes or subsidies from the plan sponsor and, in extreme, the taxpayer. It would have been more realistic to budget for larger contributions.

- More generally, prospective returns on all major asset classes have fallen in recent decades, most visibly in lower bond yields but also in other asset-class yields. This means that both DB and DC plans need higher saving rates—or else a more rewarding investment strategy; hopefully both—to reach any given benefit target. Because DC plans tend to be newer (and there is less hope of help from a fairy godmother), discussions of needed saving rates in DC plans are better anchored to the current reality while, in the DB context, historical experience from more rewarding markets drives expectations.

Work Longer

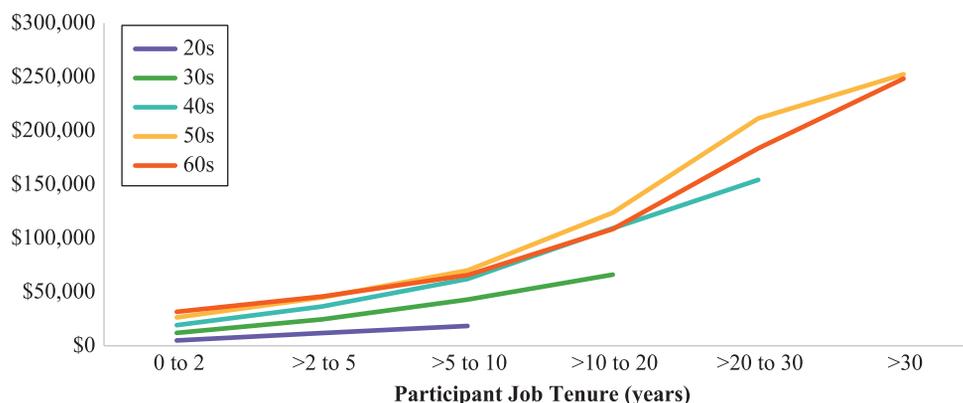
Possibly the most effective way to improve one's post-retirement standard of living is to work longer. Working longer means: (1) additional years' labor income out of which to save and invest; (2) additional years' investment return; (3) fewer years of post-retirement life to pay for, and (4) in the U.S., a larger Social Security benefit.

Regarding the last of these benefits, Charles Ellis (in Ilmanen and Sullivan [2015a]) says,

You can claim Social Security at any age from age 62 until age 70. If you defer and wait until age 70, the increase in your Social Security

EXHIBIT 4

401(k) Plan Balances by Participant Age Group and Job Tenure, 2013: Savings Balances Rise Rapidly with Age and Job Tenure, but Not Rapidly Enough



Source: Investment Company Institute, 2015 Investment Company Fact Book, http://www.icifactbook.org/fb_ch7.html.

annuity versus claiming benefits at 62 is extraordinary: approximately 76%. So you get 76% more every month for the rest of your life. It's also adjusted for inflation, so there's no risk of inflation. It's a fabulous real annuity.

We are not suggesting that everybody can work past age 62 (when Social Security benefits can first be collected) or 66 (currently the “full” Social Security retirement age). Nor are we suggesting that they have to work full time or maintain their current jobs or careers. What we are proposing is that people should come to understand the value of working longer, even if in a lesser capacity; a 76% increase in the monthly Social Security payment from working eight more years is a much bigger benefit than most people realize.

We want to help people understand that they are currently underfunded and that bringing them up to full funding is like solving a puzzle with many pieces. Working longer is not only a relatively easy strategy for many people but also very effective at solving the individual's retirement funding problem.

Construct Portfolios More Skillfully

Individuals are not trained investors. The idea that DC plans would “empower” employees by making them chief investment officers for their part of the retirement fund has been a disappointment.

Exhibit 5 compares DC and DB performance from 1990 to 2012 (asset-weighted median returns).

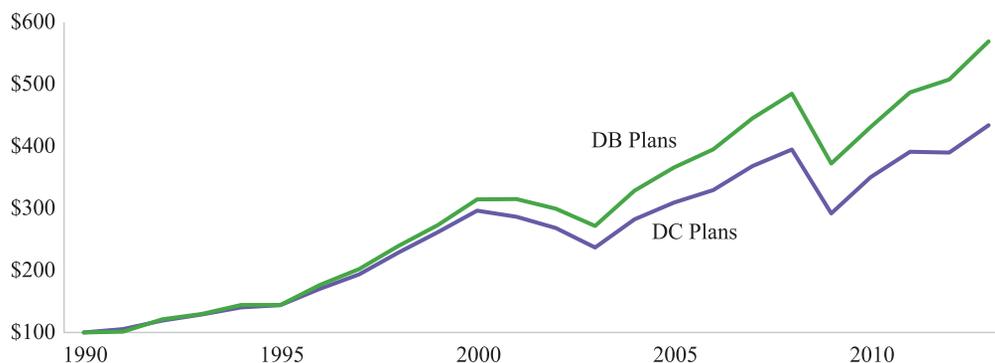
On average, DC plans underperformed by 0.9% per year over this period (Munnell, Aubry, and Crawford [2015, table 4, page 3]). This is a substantial number if compounded over the long life of a retirement portfolio, amounting to a 30% relative loss for DC plans over 30 years. When comparing plans by asset size, DC plans consistently underperform their DB counterparts for every asset size. This performance gap in part reflects the tendency of self-directed DC plan participants to buy high and sell low. As the legendary investor Jack Bogle has noted, “We have data that show the returns earned by shareholders in S&P 500 ETFs are some 250 basis points behind the returns that the S&P index delivers for the year” (Ilmanen and Sullivan [2015b, p. 22]). In addition, as Munnell et al. [2015] point out, some of the better performance of DB plans is due to the lower fees they are able to negotiate.

But there is more to the DC underperformance story than poor market timing. For both DB and DC plans, the larger the plan, the higher the returns. As mentioned earlier, larger plans have a wider array of eligible investments available at fair fees and so are able to push out the portfolio efficient frontier.³¹ As evidence, smaller DC plans underperform their larger DB counterparts by about 2% per year.³²

Not only has DC performance been subpar—risk-taking in the plans has been inconsistent, with only a minority of participants getting the risk decision approximately right. Exhibit 6 shows the range of equity allocations in DC plans by participant, for participants in their twenties and in their sixties.

EXHIBIT 5

Cumulative Total Returns on \$100 Invested at Beginning of Period, 1990–2012: DB Plans Outperform DC Plans



Note: Past performance is not a guarantee of future performance.

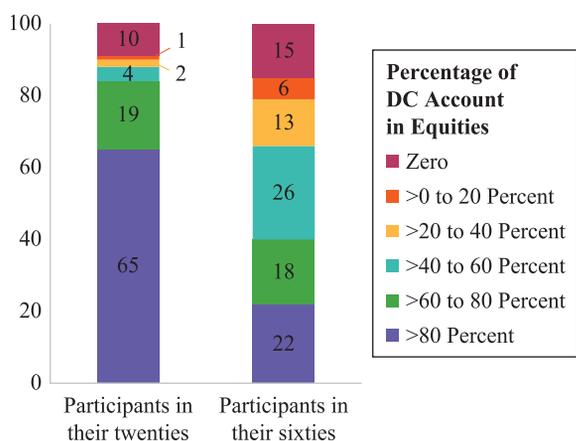
Source: Data from Munnell et al. [2015, Appendix A1] using asset-weighted median returns for all plan sizes, 1990–2012.

Studies, such as this one, that look at the whole distribution of a variable (in this case equity allocations) are much more revealing than those that look at just the average; the average equity allocation for people in their sixties is around 50%, which on its surface may seem diversified. But when viewed from a risk perspective, even a 50/50 portfolio is still highly concentrated in equity market risk, with over 90% of the total portfolio risk coming from equities.³³ So, equity risk tends to dominate most DC plan allocations, even for those in their sixties.

These are problematic outcomes, in that taking too much risk close to retirement can devastate consumption levels if market outcomes are poor, while taking too little risk can make it difficult to keep up with inflation over a long retirement. The existence of a significant equity risk premium means it should likely constitute a key source of long-term returns, but arguably not the only one if other return sources can be identified. In the following, we'll discuss possible ways to improve portfolio performance over the long term.

First, we can draw on behavioral finance to help investors increase their savings rates, make better investment decisions, and otherwise improve their situation. Behavioral finance, and our experience in working with DC plans, has taught us that individual investors make a variety of costly mistakes. Here are a few things we can do to help them:

EXHIBIT 6 Percentage of 401(k) Account Balance Invested in Equities by Age: Equity Allocations for DC Plan Participants Vary Widely



Source: Investment Company Institute, 2015 Investment Company Fact Book, http://www.icifactbook.org/fb_ch7.html.

- Most do-it-yourselfers are well below the all-asset efficient frontier because they have an insufficient set of building blocks (or use an insufficient set even if the right building blocks are offered). Although the rise of target-date funds (TDFs) has helped investors get closer to the efficient frontier, such funds still basically blend two risks (equity and fixed income) and are dominated by one risk (equity). Related to this point, TDF glide paths are often too risky and fail to account for participants' limited ability to make up for investment disappointments after they retire.³⁴ We can do better by offering access to truly diversifying strategies instead of variations on equity risk.
- Fees and other costs charged to investors should be fair—that is, commensurate with the value delivered. Obviously, fees that are too high for the value delivered can detract from success. Most DC plans deliver index-fund-like returns at best; and if that is the performance they produce, they should come with an index fund fee. Again, we believe we can do better by improving access to diversifying strategies and risk premia that provide added value net of fees.
- The many fund offerings in typical DC plans make life harder, not easier, for investors, who have a well-documented tendency to make poor choices—such as the 1/n fallacy in which investors divide their funds evenly among the choices.³⁵ DC offerings need to be more straightforward so that participants can succeed in implementing the plan; the emergence of TDFs has helped, but participants still report feeling overwhelmed by the task of making their own investment decisions. DC sponsors can also help mitigate participant stress through investment education initiatives to enable participants to make improved choices.
- Though no single idea will likely solve these challenges, investors should consider an approach that emphasizes effective diversification across asset classes and strategies and, for the reasons discussed previously, less reliance on equity market risk. We believe this can be accomplished with three layers of return enhancement.³⁶ The bottom layer, as described by Asness and Imanen [2012], uses all the major asset-class return premia in the market—the equity risk premium, bond term premium, credit premium, and commodity premium. These are

typically held as long-only positions. The middle layer adds alternative style premia and alternative strategies. Such style premia include value (cheap outperforming expensive), momentum and trend (outperformers continuing to outperform and underperformers continuing to underperform), carry (high-yielding securities outperforming those with low yields), and defensive (low risk and high quality outperforming the opposite), implemented across a variety of asset groups.³⁷ It also includes classic hedge fund risk premia, including well-known strategies like merger and convertible arbitrage. The top layer is true, but often elusive, alpha—the portion of return that is derived from idiosyncratic investment processes, independent and over and above the return from the other two layers.

Through better diversification across viable asset classes and strategies, investors can improve their market risk and improve portfolio risk/return characteristics. This can help protect investors against mistakes such as capitulating near the bottom of a deep equity bear market, and it can also provide an overall investment experience that is closer to the efficient frontier. Taken together, we believe these ideas can help investors improve portfolios and retirement outcomes.

OPTIMIZE DECUMULATION OPPORTUNITIES AND PRACTICES

Finally, when the time comes for employees to retire and begin spending down their accumulated assets, the employers' message to participants has tended to be "goodbye and good luck." Employers, acting through investment management firms or consultants, usually supply some limited advice, but that is cold comfort to participants who'd strongly prefer a monthly check for the rest of their lives, as in a DB plan. Policy changes to remove certain legal obstacles may be needed to pave the way, but success further depends on employers diligently providing ongoing investment education programs and advice for participants, as well as the appropriate financial tools.

We believe that participants would also be aided by actuarial and investment analytics that improve the discipline of decumulation, helping to ensure an adequate retirement as they draw down the asset balance.

Though guarantees that they'll never run out of money are available in the marketplace through immediate and deferred life annuities and other products, it is difficult to evaluate the cost effectiveness and attendant risks of such guarantees (the guarantor may not stay solvent). It's also very hard for most DC plan participants to access any of these, much less to decide which are most beneficial or appropriately priced.

Moreover, decumulation advice is typically based on studies that assume "normal" capital market returns; the 4% Bengen rule (which says to initially withdraw 4% of peak capital and then increase that dollar amount at the inflation rate) was constructed that way.³⁸ Very low current real interest rates mean that investors need to lower their expectations for annual spending in retirement, relative to the past when "normal" real rates prevailed. If, however, investors can access longevity-risk pooling through an annuity strategy, they can *increase* annual spending relative to what it would be in the absence of such pooling.

Sophisticated planning knowledge is needed to disentangle all these issues and opportunities, and most DC plan participants don't have access to such knowledge. DC plan sponsors need to do better in this regard, by providing top-quality decumulation advice, analytics, and investment products.

TOWARD A BETTER DC FUTURE

The holy grail of reforming DC plans, then, is to make DC plans more like DB plans in terms of breadth of coverage, savings rates, investment rates of return at fair fees, and sensible decumulation using better actuarial tools and longevity pooling, while also achieving full portability. That's a grand menu, one from which we should be careful what we pick, lest we make the plan uneconomical or unwieldy. But it's helpful to know what we are aiming for.

CONCLUSION

The world is moving quickly toward a retirement landscape dominated by DC plans. DB plans provide a valuable benefit that's hard to replicate using the toolkit of individual investing—but that's exactly what we're going to have to do.

Making DC plans more effective is both a design and an economics problem. The economics are well

established: As we noted, you get out (collectively) what you put in, plus investment return and minus costs. In this article, we have identified the main ways in which DC plans may not provide adequate retirement for some participants and what aspects need to be changed in order that they succeed. We have also identified the major levers affecting DC outcomes and the power of each.

The savings rate is by far the most important lever. With a high-enough savings rate, it is much harder for a DC plan to go wrong. Longevity-risk pooling is the second most important lever. Short-lived beneficiaries must subsidize long-lived beneficiaries for benefits to be efficiently provided. The other major levers are the before-cost investment rate of return, investment costs, and the rules for withdrawals, including early withdrawals.

This is an ambitious menu. More research is needed to move us toward a better DC future. We hope that others will continue to contribute ideas on improving DC plan design using each of the levers enumerated here.

With all these improvements in force, future DC plans should be able to provide a benefit on par with those provided by traditional DB plans, with the added advantages of full portability and unambiguous asset ownership by the retiree.

ENDNOTES

We thank Jeremy Getson, Michael Mendelson, Toby Moskowitz, and Chris Palazzolo for helpful comments, Taylor Horthy for analytical support, and we are especially grateful to Robert Capone for the many discussions and guidance in the writing of this paper.

¹This article focuses on the United States, but the principles expressed here apply globally.

²For summary information on why DC balances are expected to be insufficient for many participants, see McKinsey & Company [2009]. For a brief general discussion of the advantages of well-administered DB plans, see Ilmanen and Sullivan [2015a]. The literature on both topics is extensive; see also Ellis, Munnell, and Eschtruth [2014] and Mackenzie [2015].

³A DB plan could conceivably be operated successfully on a pay-as-you-go basis, with employers paying retirement benefits out of current revenues in the same way that they pay wages and salaries out of current revenues. But, for this to work, employees would have to trust their employers never to go out of business or to dishonor a promise. While working, employees can enforce the labor contract by not working if they are not paid; when retired, employees have no such

power. Thus, to reduce bankruptcy risk and time risk, a pension fund is established and benefits are paid out of the fund rather than out of current revenues. (Time risk is simply the fact that bad things happen, and more of them happen if you wait long enough. In the decades between when a benefit is earned and when it is supposed to be paid, there are many ways to make money disappear.)

⁴Even in a pay-as-you-go DB plan with no pension fund, the money becomes owed to the worker at the time the service is rendered and, if not put into a pension fund for safekeeping, is invested in the employer's other operations or paid out to shareholders or taxpayers.

⁵*The Economist* writes, "According to [the National Association of State Retirement Administrators], the total revenues—the money needed to pay benefits—of American public-sector pension funds have been \$5.9 trillion since 1984. Of this, employers have contributed \$1.5 trillion and employees \$730 billion. The vast bulk—\$3.7 trillion—came from investment returns." ("Many Unhappy Returns" [2015]). As we will show later, we cannot rely on the contribution from investment returns being anywhere near as large in the future as it was over the benign period from 1984 to the present.

⁶See Modigliani and Brumberg [1954] and Friedman [1957].

⁷See Merton [1969] and Bodie, Merton, and Samuelson [1992].

⁸We recommend Professor Sharpe's blogs, www.lifetimefinance.blogspot.com and www.retirementincomescenarios.blogspot.com.

⁹More precisely, it is equivalent to being economically fully funded in a one-participant DB plan at the time of the participant's intended retirement.

¹⁰Source: Pension Benefit Guaranty Corporation, "History of PBGC," www.pbgc.gov/about/who-we-are/pg/history-of-pbgc.html.

¹¹Source: Pension Benefit Guaranty Corporation, "History of PBGC," www.pbgc.gov/about/who-we-are/pg/history-of-pbgc.html. British Navy pensions substantially predate this, with the first paid to wounded officers in 1590 and with coverage extended to all officers in 1672; see www.pensionsarchive.org.uk/52.

¹²We only summarize the challenges facing DB plans here; for a more detailed exploration of these issues, please see Leibowitz and Ilmanen [2016].

¹³That is, the employer's contribution does not become the unambiguous property of the employee until the vesting period has passed.

¹⁴Sexauer and Siegel [2013] and Ilmanen, Rauseo, and Truax [2016] have estimated the savings rate needed to provide a replacement ratio (pension benefit as a percentage of final pay) of 70% to 75%. Ilmanen, Rauseo, and Truax [2016] show that, at the low returns they currently expect,

a 15% savings rate is needed to achieve a 75% replacement ratio, assuming Social Security benefits have been separately paid for; this is almost double the savings rate (8%) needed if one can boost the investment return by 200 basis points relative to the base case. (For a one-in-five worst-case market scenario, the needed savings rate rises to 20%.) Sexauer and Siegel [2013] target a 70% replacement ratio and find that with a zero expected real return (because the authors assume a risk-minimizing strategy of investing only in TIPS), needed savings rates for a middle-income worker range as high as 26.7%, again assuming that Social Security benefits are also available. At a 2% real return on investments, this rate falls to 19.3%.

¹⁵DB was not as good a deal as it may have superficially appeared, because many participants with short service periods (“job hoppers”) did not get the benefit that DB seemed to promise. There were enough “losers” from this perspective—especially as labor mobility increased and long service periods became less common—to make workers, especially younger ones, more open to a transition to DC. This phenomenon is analogous to the “lapse rate” in the insurance industry; affordability depends to some extent on customers who pay premiums for a while and then stop, ceding their rights to benefits to those who continue paying.

¹⁶This is also discussed in Ilmanen and Sullivan [2015a].

¹⁷Life expectancies at birth rose from 47.3 years at the beginning of the last century to 78.7 recently (in 2011). Data are for all races and origins, both sexes, and are from the U.S. Centers for Disease Control, www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64_11.pdf, p. 45.

¹⁸Source: Morningstar, Inc. Total return for the S&P 500 Index (including dividends) before fees, transaction costs, or taxes. One cannot invest directly in an index.

¹⁹Although the nominal yields on bonds can be directly observed in the market, the nominal expected returns on stocks must be estimated using a model; and expected inflation is always an estimate (unless TIPS spreads are used over the recent 1997–2015 period; in these exhibits, they were not). Thus, the data in Exhibit 1 are AQR’s estimates. The real equity yield is a simple average of two proxies: (1) the Shiller earnings yield (using 10-year historical averages of real earnings) multiplied by 1.075 (to correct for the staleness of past-decade earnings, embedding an annual real earnings per share growth, G , of 1.5%) and (2) the dividend yield plus 1.5% (that is, assuming 1.5% G or the long-run real growth of dividends- and earnings-per-share in the Gordon dividend discount model’s $D/P + G$). The universe of stocks represented is the S&P 500 since 1957, and the S&P 90 and other indices prior. The real bond yield is the yield on long-term U.S. Treasury bonds minus long-term expected inflation based on Blue Chip Economic Indicators, Consensus Economics, and the Federal Reserve Bank of Philadelphia.

Before survey data became available in 1978, expected long-term inflation data are based on statistical estimates and on one-year-ahead Livingston inflation forecasts.

²⁰See AQR [2016]. We note that Grinold, Kroner, and Siegel [2011] arrive at a very similar number.

²¹See www.ebri.org/pdf/publications/facts/0205fact.a.pdf for a detailed history.

²²An interview with Benna telling this story in greater detail is at www.marketplace.org/topics/sustainability/consumed/father-modern-401k-says-it-fails-many-americans.

²³See www.dol.gov/EBSA/pensionreform.html.

²⁴The literature on lifecycle investing is anchored by Yaari [1965], who used restrictive assumptions to show that a life annuity is the riskless asset for individual investors. Merton [2014] built on this theme, calling for investment managers to provide assets-to-income solutions. Ibbotson et al. [2007] provide a very good overview of the issues involved in securing lifetime income from an asset pool.

²⁵For a more detailed discussion, we point the interested reader to Yang [2005].

²⁶An exception is sometimes made for employer contributions, which can be subject to vesting requirements.

²⁷Ambachtsheer [2016] says 17% is needed at a zero real rate of return. Of course, as alluded to earlier, investment returns can also be negative, necessitating an even higher savings rate.

²⁸Annuity analysis conducted using the calculator tool on <https://www.immediateannuities.com/> on June 9, 2016. The following assumptions are used in obtaining the annuity income values: immediate annuity, male, age 60, no secondary beneficiary. We use Illinois as the state of issue, but other states yield same or similar results. The amount to invest is divided by 1.5 (so \$104,000 becomes \$69,333) to account for the estimated additional cost of an inflation-indexed immediate annuity. Results provided by the calculator tool are estimates only.

²⁹According to the Cooperative Extension Service, a government web site, “The major exceptions are most civilian federal government employees hired before 1984 and about 25% of state and local government employees with a pension plan.” For example, California teachers covered by the CALSTRS pension plan are not subject to Social Security tax and will not receive Social Security benefits, but most other California state employees are covered by Social Security. See <http://articles.extension.org/pages/43284/who-is-exempt-from-paying-the-fica-tax-in-the-united-states>.

³⁰Annuity analysis conducted using the calculator tool on <https://www.immediateannuities.com/> on June 9, 2016. Please see endnote 28 for assumption details.

³¹As noted by Elton, Gruber, and Blake [2006], DC plans can improve performance by including additional, more sophisticated, investment choices that enable participants to

move closer to the investment frontier. The authors find a strong correlation between the number of choices a plan offers and size of the plan and that larger plans are more likely to use more sophisticated strategies that may lead to better results as measured by improved Sharpe ratios.

³²Munnell et al. [2015] table 4, page 3. Period is 1990–2012. Smaller plans are those with less than \$100 million in assets.

³³See Dhillon, Ilmanen, and Liew [2016].

³⁴See Dhillon, Ilmanen, and Liew [2016].

³⁵See Benartzi and Thaler [1995].

³⁶Dhillon, Ilmanen, and Liew [2016] focus on addressing this challenge in detail.

³⁷These additional premia, and ways of investing in them, are detailed in Ilmanen [2011], Hurst, Ooi, and Pedersen [2014], and Asness, Ilmanen, Israel, and Moskowitz [2015].

³⁸See Bengen [1994]. In addition, Collins et al. [2015] have compiled a very thorough literature review on asset decumulation, bringing the discussion of the many competing spending rules up to date.

REFERENCES

- Ambachtsheer, K.P. *The Future of Pension Management*. Hoboken, NJ: John Wiley & Sons, 2016.
- AQR Capital Management. “2016 Capital Market Assumptions for Major Asset Classes.” *Alternative Thinking*, February 5, 2016, <https://www.aqr.com/library/aqr-publications/alternative-thinking-2016-capital-market-assumptions-for-major-asset-classes>.
- Asness, C.S., and A. Ilmanen. “The 5 Percent Solution.” *Institutional Investor*, May 2012.
- Asness, C., A. Ilmanen, R. Israel, and T. Moskowitz. “Investing with Style.” *Journal of Investment Management*, Vol. 13, No. 1 (2015), pp. 27–63.
- Benartzi, S., and R. Thaler. “Myopic Loss Aversion and the Equity Premium Puzzle.” *Quarterly Journal of Economics*, Vol. 10, No. 1 (1995), pp. 73–92.
- Bengen, W. “Determining Withdrawal Rates Using Historical Data.” *Journal of Financial Planning*, Vol. 7, No. 4 (1994), pp. 171–180.
- Bodie, Z., R.C. Merton, and W. Samuelson. “Labor Supply Flexibility and Portfolio Choice in a Life Cycle Model.” *Journal of Economic Dynamics and Control*, Vol. 16, Nos. 3–4 (1992), pp. 427–449, www.people.hbs.edu/rmerton/laborsupplyflexibility.pdf.
- Collins, P., H. Lam, and J. Stampfli. *Longevity Risk and Retirement Income Planning*. Research Foundation Literature Reviews, CFA Institute, 2015, www.cfapubs.org/loi/rflr.
- Dhillon, J., A. Ilmanen, and J. Liew. “Balancing on the Life Cycle: Target Date Funds Need Better Diversification.” *The Journal of Portfolio Management*, Vol. 42, No. 4 (2016), pp. 12–27.
- Ellis, C., A. Munnell, and A. Eschtruth. *Falling Short: The Coming Retirement Crisis and What to Do About It*. New York, NY: Oxford University Press, 2014.
- Elton, E., M. Gruber, and C. Blake. “The Adequacy of Investment Choices Offered by 401K Plans.” *Journal of Public Economics*, 90 (August 2006), pp. 1299–1314.
- Fetini, A. “A Brief History of the 401(k).” *Time*, October 16, 2008.
- Friedman, M.A. *Theory of the Consumption Function*. Princeton, NJ: Princeton University Press, 1957.
- Grinold, R., K. Kroner, and L. Siegel. “A Supply Model of the Equity Premium.” In *Rethinking the Equity Risk Premium*, edited by B. Hammond, M. Leibowitz, and L. Siegel. Charlottesville, VA: CFA Institute Research Foundation, 2011.
- Hurst, B., Y. Ooi, and L. Pedersen. “A Century of Evidence on Trend-Following Investing.” AQR Capital Management, 2014.
- Ibbotson S&P 500 2015 Classic Yearbook*. Chicago, IL: Morningstar Inc., 2015.
- Ibbotson, R., M. Milevsky, P. Chen, and K. Zhu. *Lifetime Financial Advice: Human Capital, Asset Allocation and Insurance*. Charlottesville, VA: CFA Institute Research Foundation, 2007.
- Ilmanen, A. *Expected Returns: An Investor’s Guide to Harvesting Market Rewards*. Hoboken, NJ: John Wiley & Sons, 2011.
- Ilmanen, A., M. Rauseo, and L. Truax. “How Much Should DC Savers Worry about Expected Returns?” *The Journal of Retirement*, Vol. 4, No. 2 (2016), pp. 44–53.
- Ilmanen, A., and R. Sullivan. “Charles Ellis on Confronting Investing Challenges.” AQR *Words from the Wise*, June 5, 2015a, <https://www.aqr.com/library/words-from-the-wise/words-from-the-wise-ellis-executive-summary>.
- . “Jack Bogle on Building a Better Investment Industry.” AQR *Words from the Wise*, December 11, 2015b,

<https://www.aqr.com/library/words-from-the-wise/words-from-the-wise-bogle-executive-summary>.

Kozicki, S., and P. Tinsley. "Survey-Based Estimates of the Term Structure of Expected U.S. Inflation." Working paper, Bank of Canada, December 2006.

Leibowitz, M.L., and A. Ilmanen. "U.S. Corporate DB Pension Plans — Today's Challenges." *The Journal of Retirement*, Vol. 3, No. 4 (2016), pp. 34-46.

Mackenzie, G. *The Decline of the Traditional Pension: A Comparative Study of Threats to Retirement Security*. Cambridge, UK: Cambridge University Press, 2015.

"Many Unhappy Returns: Pension Funds and Endowments Are Too Optimistic." *The Economist*, November 21, 2015.

McKinsey & Company. "Restoring Americans' Retirement Security: A Shared Responsibility." McKinsey & Company, Inc., October 2009, www.retirementmadesimpler.org/Library/Retirement_Security.pdf.

Merton, R.C. "Lifetime Portfolio Selection under Uncertainty: The Continuous-Time Case." *Review of Economics and Statistics*, 51 (1969), pp. 247-257.

———. "The Crisis in Retirement Planning." *Harvard Business Review*, July-August 2014.

Modigliani, F., and R. Brumberg. "Utility Analysis and the Consumption Function." In *Post-Keynesian Economics*, edited by K. Kurihara, pp. 338-436. New Brunswick, NJ: Rutgers University Press, 1954.

Munnell, A., J.-P. Aubry, and C. Crawford. "Investment Returns: Defined Benefit vs. Defined Contribution Plans." Working Paper 15-21, Center for Retirement Research at Boston College, December 2015.

Sexauer, S.C., and L.B. Siegel. "A Pension Promise to Oneself." *Financial Analysts Journal*, Vol. 69, No. 6 (2013), pp. 13-32.

Siegel, L.B. "After 70 Years of Fruitful Research, Why Is There Still a Retirement Crisis?" *Financial Analysts Journal*, Vol. 71, No. 1 (2015), pp. 6-15, www.cfapubs.org/doi/pdf/10.2469/faj.v71.n1.1.

Tackett, M. "Pensions Began as Reward, Remain Employer's Option." *Chicago Tribune*, December 3, 1989, http://articles.chicagotribune.com/1989-12-03/news/8903140981_1_older-workers-american-workers-american-express.

Yaari, M.E. "Uncertain Lifetime, Life Insurance and the Theory of the Consumer." *Review of Economic Studies*, Vol. 32, No. 2 (1965), pp. 137-150.

Yang, T. "Understanding the Defined Benefit versus Defined Contribution Choice." Working Paper 2005-04, Pension Research Council: Wharton School, 2005.

Disclosure

The views and opinions expressed herein are those of the author and do not necessarily reflect the views of AQR Capital Management, LLC, its affiliates or its employees.

This document does not represent valuation judgments, investment advice or research with respect to any financial instrument, issuer, security or sector that may be described or referenced herein and does not represent a formal or official view of AQR.

This information is not intended to, and does not relate specifically to any investment strategy or product that AQR offers. It is being provided merely to provide a framework to assist in the implementation of an investor's own analysis and an investor's own view on the topic discussed herein.

To order reprints of this article, please contact Dewey Palmieri at dpalmieri@ijournals.com or 212-224-3675.