JUNE 2019

Automatic enrollment in 401(k) annuities: Boosting retiree lifetime income

Vanya Horneff
Finance Department, Goethe University

Raimond Maurer
Finance Department, Goethe University

Olivia S. Mitchell
Wharton School, University of Pennsylvania

This report is available online at: https://www.brookings.edu

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ABOUT THE AUTHORS

Vanya Horneff is a Post-Doc in Investment and Pension Finance at the Finance Department of the Goethe University Frankfurt. She is also a researcher at the Institute for Sustainable Architecture for Finance in Europe (SAFE).

Raimond Maurer is Professor of Investment, Portfolio Management and Pension Finance at the Finance Department of the Goethe University Frankfurt. He is a Research Associate for Sustainable Architecture for Finance in Europe (SAFE) and Advisory Committee member for the Pension Research Council at the Wharton School of the University of Pennsylvania.

Olivia S. Mitchell is International Foundation of Employee Benefit Plans Professor; Professor of Insurance/Risk Management/Business Economics/Policy; and Director of the Pension Research Council/Boettner Center on Pensions and Retirement Research, all at the Wharton School of the University of Pennsylvania. She is a NBER Research Associate; Co-Investigator for the Health & Retirement Study; Executive Board Member for Michigan's Retirement Research Center; Advisor for UNSW's CEPAR Advisory Board; Advisory Council member for Sustainable Architecture for Finance in Europe; Advisory Committee member for HEC Montreal's Retirement and Savings Institute; associate of SMU's Centre for Research on Aging; and a member of the Financial Economists Roundtable.

STATEMENT OF INDEPENDENCE

Olivia Mitchell is an Independent Trustee of the TIAA Institute at Wells Fargo and Director of the Pension Research Council of the Wharton School at the University of Pennsylvania.

The authors did not receive any financial support from any firm or person for this article or from any firm or person any views or positions expressed or advocated in this article. They are currently not an officer, director, or board member of any organization that has compensated or otherwise influenced them to write this article or to express or advocate any views or positions in this article. Accordingly, the views and positions expressed in this article are solely those of the authors and should not be attributed to any other person or organization.

ABSTRACT

Very few defined contribution retirement plans in the U.S. today pay out lifetime income streams, leaving retirees at risk to run out of money in old age. Our proposal is to include deferred lifetime income annuities (DIAs) as a default in employer-provided 401(k) plans. We investigate the pros and cons of such a proposal using a life cycle economic model which takes into account the value of having true longevity protection in one's retirement account. Specifically, we report results from a calibrated lifecycle consumption and portfolio choice model embodying realistic institutional considerations relevant to the American workforce. We show that automatically enrolling retirees using only a small portion of their 401(k) assets can substantively enhance retirement security and improve welfare.

ACKNOWLEDGEMENTS

The authors are grateful for support for this research from the Brookings Institution, the German Investment and Asset Management Association (BVI), the SAFE Research Center funded by the State of Hessen, the Pension Research Council/Boettner Center at The Wharton School of the University of Pennsylvania, and from the TIAA Institute. We also thank the initiative High Performance Computing in Hessen for granting us computing time at the LOEWE-CSC and Lichtenberg Cluster. Opinions and any errors are solely those of the authors and not those of any individual cited or any institutions with which the authors are affiliated.

Why manage longevity risk?

Americans are increasingly accumulating retirement assets in employer-sponsored defined contribution plans, which today have amassed almost $6 trillion (Satter, 2018). Nevertheless, very few of these 401(k) and similar accounts pay retirees regular benefit streams over their lifetimes. Instead, retirees themselves must figure out how to draw down their retirement wealth in an orderly fashion without running out of money in old age. This reality is set against the backdrop of a rapidly aging population, underfunded public pension and Social Security programs, and the disappearance of defined benefit plans. Consequently, policymakers are increasingly concerned that millions of financially inexperienced – and very likely, inattentive – older consumers may do a poor job handling investment and longevity risk in their self-directed retirement accounts.[1]

Longevity risk, of particular concern in the present study, results from the fact that people are uncertain about how long they will live. Such uncertainty can make it difficult to plan how to draw down one's retirement assets and not run out of money, particularly in old age, when few people can return to work and when healthcare costs may be large. For example, a 65-year-old U.S. female can expect an additional 20 years of life, using general population statistics (Arias, 2016), but there is considerable volatility around this mean, of nine years, implying substantial uncertainty about how long the 65-year old will live. This is illustrated in Figure 1, which shows that more than half of all 65-year-old females will live beyond age 85; one-third will live at least to age 90; and about 15 percent will survive their 95th birthdays. Such fundamental uncertainty about the length of one's lifetime can lead people to consume suboptimally in retirement, hence undermining their lifetime well-being.

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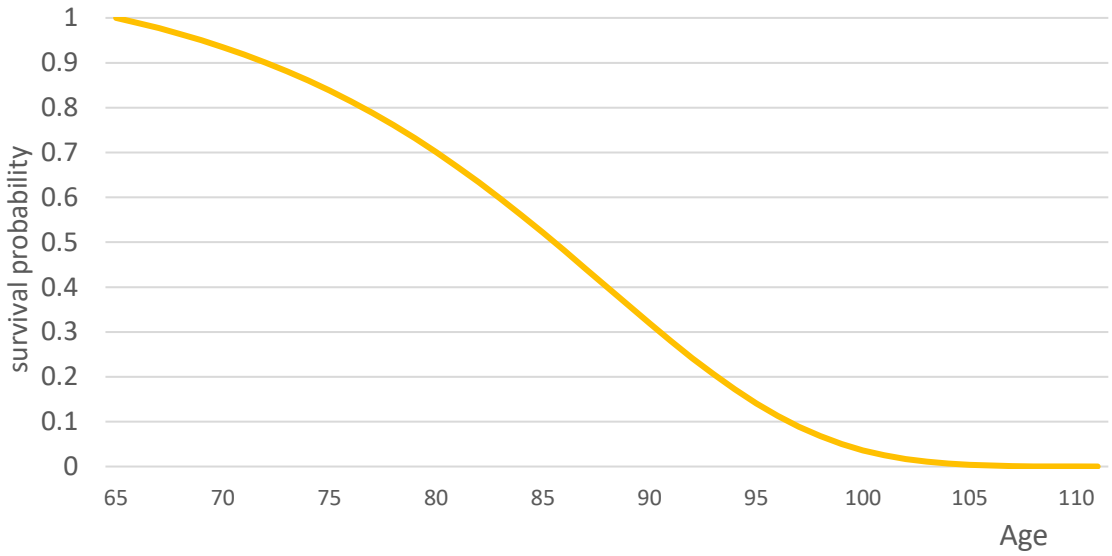
[1] For more on the impact of aging on financial literacy and economic behavior, see Lusardi and Mitchell (2014); Lusardi et al. (2018), Brown et al. (2017), and Mazzona and Perrachi (2018).

Figure 1. Survival Probability to Any Subsequent Age: U.S. Female Age 65



Note: This Figure uses the mortality table for the general U.S. female population (Arias 2016), which we use to model the survival probability distribution using the Gompertz Survival Law. Source: Authors' calculations.

The traditional way to protect against such longevity risk would be to purchase a payout annuity from a life insurance company with a portion of one's retirement nest egg. A life annuity is an insurance product which pays the policyholder a periodic benefit for as long as the annuitant is alive, in exchange for a premium. The insurer transfers the individual's longevity risk to itself, and then in turn, it organizes risk pools across a sufficiently large number of annuitants to make such insurance feasible. Many different annuity products are available, ranging from those that are fixed in nominal terms, vary over time, or depend on the insurance company's overall experience regarding asset returns and mortality. Immediate annuities begin paying from the date of purchase, while deferred annuities pay when the retiree survives a certain number of years.[2]

Numerous studies have shown the theoretical appeal of life annuities, yet in practice, investors are often reluctant to annuitize their entire retirement wealth. This phenomenon, termed the "annuity puzzle," has been the subject of much economic analysis. For instance, some authors have attributed low demand to factors such as the existence of Social Security, Medicare, and defined benefit pensions, which provide payouts as long as people live;[3] bequest motives which induce people to hold on to their money instead of annuitizing it

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[2] For a discussion of the different types of annuities see Brown et al. (2001)

[3] Dushi and Webb (2004), Peijnenburg et al. (2016), Reichling and Smetters (2015)

all;[4] and the sheer complexity of many annuity products on the market.[5] Consumers who own their own homes also have access to a flow of housing services, meaning that they may not need additional annuitization on top of their already-annuitized assets. And older couples can offer a form of 'self-annuitization,' when assets are spread across both partners when both are alive yet are available to the second-to-die (Kotlikoff and Spivak 1981; Hubener, et al. 2014). Other behavioral analyses have suggested that consumers may narrowly frame their survival probabilities, overestimating the chance that they will die young and not get their 'money's worth,' hence driving their unwillingness to annuitize (Gottlieb and Mitchell, 2019).

A distinct explanation for low levels of in-plan annuitization in the U.S., and the one we focus on here, is that institutional factors have discouraged the inclusion of lifetime income products in retirement accounts (Horneff et al., 2018). For instance, prior to 2014, a tax requirement strongly discouraged annuitization in employer-based 401(k) defined contribution plans. Specifically, the "Required Minimum Distribution" (RMD) rule under the Internal Revenue code forced retirees to withdraw a stipulated minimum amount from their retirement accounts each year after age 70.5. Moreover, if the withdrawals were insufficiently large, retirees were required to pay a 50% excise tax on the under-withdrawn amount. The problem with this arose since, if a retiree used plan assets to buy an annuity, the RMD calculation still included the annuity value in the amount she needed to withdraw, and this could cause liquidity problems.

A potential solution to this problem emerged in 2014, when the U.S. Department of the Treasury and the Internal Revenue Service (IRS) corrected the institutional bias by supporting ways to "put the pension back" into defined contribution plans. Specifically, they allowed plan participants to use up to 25% of their 401(k) account balances (up to a limit) to purchase *deferred longevity income annuities* (DIAs), also referred to as "qualifying longevity annuity contracts" or QLAC's (US Treasury, 2014). The crucial point in the present context is that they protect the retiree's annuity purchase from counting when setting her RMD payouts. Additionally, proposed new legislation before Congress includes encouragement for retirees to convert a portion of their defined contribution accounts at retirement into deferred annuities.

In sum, there is growing interest in proposals to include annuitization into retirement plans so as to "put the pension back" into 401(k) plans and thus help retirees avoid outliving their assets (Horneff et al., 2018). Even more interesting is the idea to include deferred annuities as a default in defined contribution plans, a topic on which we elaborate below.

The context

Financial and economic analysts have long been interested in the factors spurring and deterring the demand for, and supply of, annuitization. Early work by Merton (1969) was followed by numerous studies developing and calibrating life cycle models of spending, saving, and investment behavior for private households facing factors such as labor income

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[4] Lockwood (2012)

[5] Brown et al. (2017)

risk, mortality risk, health risk, capital market risk, to study how investors should optimally allocate part of their financial assets to a variety of forms of insurance.[6] The broad conclusion from this literature is that annuities are the only financial product that helps pool survival risk across policyholders, and hence are extremely valuable in protecting people from running out of money in old age. Also, life annuities give people access to the "survival credit," or the extra return payable to survivors out of the pooled assets of early decedents. No other financial product other than annuities provide this extra return to annuity purchasers.

As noted above, the RMD regulations were amended in 2014 to allow the provision of longevity income annuities within the 401(k) space, as long as they were deferred lifetime income annuities (starting benefits no later than age 85) and limited to less than 25% of the retiree's account balance (up to a limit; see Iwry 2014). Accordingly, a retiree's DIA annuity purchase need not be counted in determining her RMD basis, meaning that this change dramatically relaxed the RMD requirements that had precluded the offering of longevity annuities in the 401(k).

While some employers may be reluctant to include annuities in workers' retirement plan options due to concerns over taking on fiduciary liability, the U.S. Department of Labor has interpreted the 2006 Pension Protection Act by identifying the types of products that can be included in the plans while still maintaining fiduciary protection (Iwry and Turner, 2009). These new deferred lifetime income products are referred to as "qualifying longevity annuity contracts" (or "QLACS") (see US Treasury, 2014). In other words, the evolving landscape for including deferred annuities in 401(k) plans offers a striking new opportunity for older workers to convert part of their savings into lifetime income streams -- potentially greatly enhancing Americans' old age consumption.

Our model framework

To illustrate how this idea would work, we build and calibrate an economic model to assess the impact of defaulting a portion of retirees' 401(k) assets at age 66 into a deferred income annuities (DIA) that commenced paying benefits at age 85. This model permits us to measure how much better off people would be from defaulting a relatively small portion – 10% of retirement plan assets above a threshold – into such a deferred income annuity. Our research builds on a realistically-calibrated economic model of lifecycle optimal consumption and portfolio choice that matches data on 401(k) balances, which we then use to quantify the impact of this new policy for a range of retiree types differentiated by sex, educational level, health status, and preferences (Horneff, Maurer, and Mitchell, 2018). Using the Panel Study of Income Dynamics (PSID), we generate estimates of (pre-tax) labor income dynamics by age, sex, and education. Most importantly, and distinct from prior research, we do so while accounting for the rich real-world diversity of income tax rules, Social Security contribution and benefit rules, as well as the RMD regulations for tax-qualified retirement plans. Assets inside and outside the 401(k) account can be invested in riskless bonds earning 1% return, and risky stocks having a risk premium of 4% and volatility of . . .

[6] See among others Horneff et al. (2008, 2010, 2015), Chai et al. (2011); Hubener et al. (2016); Inkmann et al. (2011) and Koijen et al. (2011, 2016) and Huang et al. (2017)

18%. Annuities are priced using a unisex table derived from the US Annuity 2000 mortality table provided by the Society of Actuaries (SOA n.d.) and assuming an interest rate of 1%.

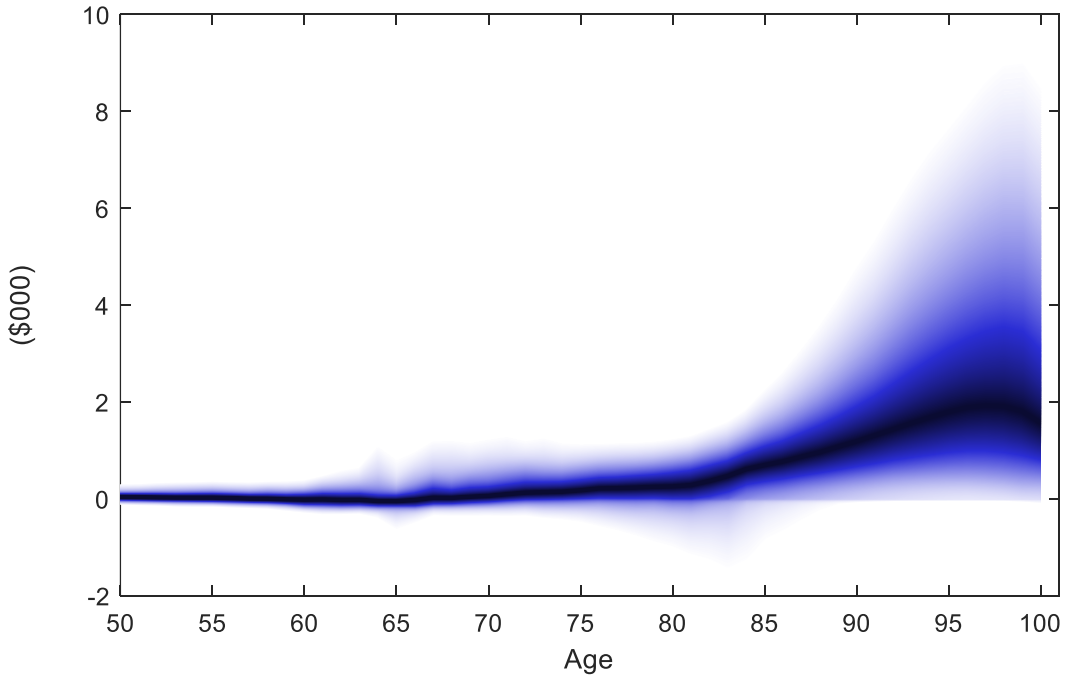
Our prior work (Horneff, Maurer, and Mitchell, 2018) showed that older households would, at age 66, optimally commit from 5-15% of their plan balances to a DIA that started paying lifetime benefits from age 85 onward. By contrast, to simplify the analysis and make it more practical for a real-world setting, here we stipulate that the uniform default would be set at 10 percent of retirement assets and used to purchase a deferred annuity payable from age 85 onward. We are also sensitive to the concern that some workers may anticipate higher mortality rates than the population at large, and for such workers, it may be less attractive to buy longevity annuities. This we address by defaulting 10 percent of workers' assets into a DIA only so long as they have at least $65,000 accumulated in their 401(k) accounts. This is a reasonable threshold inasmuch as workers in their 60s who earned $40-$60,000 per year averaged $96,400 in their 401(k) accounts; those earning $60-$80,000 per year averaged $151,800; and those earning $80-$100,000 held an average of $223,640 in these retirement accounts, as of 2014 (Vanderhei et al., 2016).

Using this approach, we next evaluate how much employees will optimally elect to annuitize given the opportunity to do so under the new RMD rules, when they face income, spending, and capital market shocks, and where they are also subject to uncertainty about their lifespans. We also show how much better off participants will be with a DIA default, versus without one. Finally, we illustrate the potential improvements in well-being if plan sponsors were to default a given percentage of retirees' assets over a certain threshold into deferred lifetime income annuities, taking into account mortality heterogeneity by education and sex.

Results

A first set of results from our model appears in Figure 2. Here we illustrate why longevity income annuities should be very attractive to most DC plan participants. Specifically, the fan chart in Figure 2 illustrates the difference in consumption for households *without* versus *with* access to a default DIA funded using 10 percent of the 401(k) account over a $65,000 threshold. The x-axis of the fan chart represents age, and the y-axis the consumption difference in the two cases (in $000). These differences are measured for each of the 100,000 simulation paths generated by the life cycle model with and without the default DIA. Darker areas represent higher probability masses, and the solid line represents the expectation.

Figure 2. Life Cycle Consumption Differences Using Unisex Mortality Tables: Default Longevity Income Annuity (DIA) minus Case with No Annuity Access



Note: This figure depicts the (95%; 5%) distribution of consumption differences for 100,000 simulated life-cycles based on optimal feedback controls for average US workers with 401(k) plans. The DIA case assumes 10% of 401(k) assets over $65,000 are used to buy a deferred lifetime annuity at age 65, which benefits starting at age 85 in the DIA case; the no DIA case assumes no annuity. Darker areas represent higher probability mass. The DIA is priced using a unisex table based on US Annuity 2000 mortality table provided by the Society of Actuaries (SOA nd). For further information on parameter values, see Horneff et al. (2018). Source: Authors' calculations.

Here we see that, prior to age 85, consumption differences are small either way: the median difference is only $3 at age 50. But by age 85, the retiree with the default DIA can consume about $700 more per year on average, and $2,600 more by age 95. There is also very little heterogeneity in the outcomes prior to retirement. For example, at age 50, the difference is only -$1 for the bottom quarter of the sample, while it is $9 for the 75th percentile. The heterogeneity in outcomes rises substantially after retirement: for instance, at age 85 (95), the difference is $280 ($800) for the 25th percentile, but $1,170 ($3,600) for the 75th quantile. Overall, we conclude that the risk of consuming less is very low for those with the default DIA, while the possibility of enhanced consumption at older ages with the DIA is very high.

Another way to quantify the beneficial effect of this policy is provided in Table 1, which shows how wellbeing rises with the default DIA. The values indicate the additional 401(k)

wealth that would be required at age 66 to compensate households lacking access to DIAs, to make them as well off as those as with access to the products (see Horneff et al., 2018 for details on the procedure). For the Coll+ female, access to the default DIA enhances welfare by a value equivalent to $13,521 (first row), or about 6.1% of average retirement plan accruals) assuming average mortality rates). The next few rows of the table report results by sex and different educational groups. Among women, we see that welfare is substantially enhanced by having access to the DIA product, with gains of $7,796 for the HS graduates and $4,403 for HS dropouts.

Table 1. Welfare Gains as of Age 66, Without and With Access to Deferred Longevity Income Annuities (DIA): Default 10% of 401(k) Amount over the $65,000 Threshold into DIA

Case	Education	Alternative specifications	Welfare gain ($)
Female age 66	Coll+		13,521
	High School		7,796
	< High school		4,403
	< High school	Mortality +34%	558
Male age 66	Coll+		28,445
	High school		10,787
	< High School		4,481
	< High School	Mortality +25%	1,317

Notes: The default approach converts 10% of 401(k) assets at age 65 into a longevity income annuity as long as the worker's 401(k) account equals or exceeds the $65,000 threshold. Welfare Gain ($) refers to the retiree's additional utility value measured at age 66 from having access to the DIA, versus no access, at age 66. Model simulations are generated for 100,000 simulated lifecycles for each of six subgroups of employees (male/female by three education groups, <HS, HS, and Coll+). See text and Horneff et al. (2018).

For men, the gain for the Coll+ group is substantial when default DIAs are available, on the order of $28,445 or 11% more 401(k) assets as of age 66. Smaller welfare gains apply for the less-educated males, $10,787 for those with a HS degree and $4,481 for HS dropouts. Males and females with lower survival probabilities still benefit from having access to default DIA, about 1% of 401(k) account balances for females and 2% for males.

Table 2 reports the change in welfare if retirees were to optimally switch their 401(k) assets into the DIA, instead of the employer having to default 10% over the $65,000 threshold. A comparison of the welfare gains of Table 2 and 1 show that default DIA would still raise average retiree wellbeing almost as much as compared to the optimum. For example,

in the optimal case, women having at least a college education use 14.5% of pension accruals to purchase the DIA, which increases welfare by $15,384 (or 7% of retirement assets). This is a relatively small difference ($1,863) versus the default case of using 10% over the $65,000 threshold to purchase a DIA. Differences are even smaller for the other education groups and similar for males. Accordingly, including well-designed DIA defaults in DC plans yields quite positive consequences for 401(k)-covered workers.

Table 2. Welfare Gains as of Age 66, Without and With Deferred Longevity Income Annuity (DIA): Optimal Annuitization Outcomes

Case	Education	Alternative specifications	Welfare gain ($)
Female age 66	Coll+		15,384
	High School		8,044
	< High school		4,518
	< High school	Mortality +34%	781
Male age 66	Coll+		30,912
	High school		11,405
	< High School		4,653
	< High School	Mortality +25%	1,720

Notes: This approach converts the optimal fraction of 401(k) retirement assets into a DIA at age 66. See Table 1 and Horneff et al. (2018).

Overall, we conclude that defaulting workers into a DIA worth 10% of plan assets provides individuals with the potential to save less, yet consume substantially more, particularly at older ages.

Thoughts regarding implementation

Ours is the first paper to build a default longevity annuity into a comprehensive life cycle model of consumer behavior including volatile labor income, taxes, Social Security, and risky capital markets. Nevertheless, a number of other authors have indicated sympathy for the idea of deferred annuities.[7] One factor that all seem to favor in the design of retirement annuitization is to avoid an "all-or-nothing" decision, where the retiree is forced to convert his or her entire nest egg into an insured income stream. Our DIA approach fits well within this framework, as the partial annuitization of 10% of assets over a threshold should reduce retirees' concern about lacking liquidity in old age. We also favor the idea of persuading DC plan sponsors to describe all benefit amounts in the 401(k) plans as monthly

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[7] Among them are Milevsky (2005) Gale, Iwry, John, and Walker (2008), Iwry and Turner (2009), Scott (2008), Blanchett (2015), and Vanderhei (2019).

or annual income streams, so as to emphasize the role of the DIA in helping retirees meet consumption needs, rather than as a "loss" of access to a portion of their account balances.

It is also likely that retirees whose consumption needs are covered by a relatively secure income stream from Social Security paired with their DIA benefits would be willing to take more investment risk with their liquid 401(k) or IRA assets. In this way, the DIA could help enhance retirement security, enabling households to benefit from the equity premium later in life. This could be a particularly important strategy in light of the permanently lower interest rates that many financial economists expect in the future (Horneff, Maurer, and Mitchell 2018). A related approach might be to include DIAs into a target date account intended to carry older workers not only 'to' but also 'through' retirement. Regulations issued by the U.S. Department of Labor have made it possible to embed lifetime income offerings into target date plans, naturally with full disclosure provided to participants. Because annuities generally do not provide workers with an option to move from one firm to another, it is believed that the appropriate point to begin offering embedded annuities would be at or near the employee's retirement age.

Another factor that could ease implementation of the default longevity income annuity would be to direct the assets generated by the employer contributions and matches to the DIA. As noted by Iwry and Turner (2009), current law allows plan sponsors to require that the employers' contributions be held in a deferred annuity, and it would even be feasible for the employer contributions to be defaulted into a DIA. Employees subject to "framing" could become accustomed to such an allocation prior to retirement, making it easier to convert 401(k) assets into deferred annuities upon retirement.

A separate issue regarding the inclusion of deferred income annuities in retirement plans has to do with employer concerns that they may be held liable in the event that insurers lack the ability to pay future claims. It has been proposed (GAO 2016) that plan sponsors be provided with more clearly defined criteria regarding the steps they must take to obtain relief from such liability,

In sum, defaulting a portion of retirees' portfolios into deferred income annuities is a practical and attractive way for plan sponsors to provide a lifetime income for workers in defined contribution accounts, partially compensating for the lack of defined benefit coverage in the private sector.[8]

Conclusions and policy implications

Default saving mechanisms are a widely acclaimed way to encourage employees to save in their 401(k) plans, but to date, few default policies are in place to help retirees from these plans manage their money successfully in old age. This paper shows that including a longevity annuity as part of a defined contribution retirement plan – potentially only a small portion of retiree assets – does much to help protect against longevity risk. We find that plan sponsors could elect a default longevity income annuity using only 10% of retirees' nest eggs, as long as their asset base exceeds a reasonable threshold amount. This, we show, can have an important impact enhancing retiree consumption in later life.

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[8] See also Strakosh and Kahn (2015).

Helping plan sponsors to default a portion of retirees' retirement plan accruals into a deferred lifetime income annuity without negative tax consequences will do much to correct Americans' traditional reluctance to annuitize. Our realistic and richly-specified life cycle model demonstrates this, taking account of uncertain capital market returns, labor income streams, and lifetimes, as well as rich institutional details on taxes, Social Security benefits, and RMD rules for 401(k) plans. Moreover, our proposal is particularly timely given that many employers have begun to express concern that their workers may be unable to manage their retirement assets sensibly when they take their assets out of their employer-sponsored plans (Callan 2019). In fact, many retirees would actually do well to retain their funds in their plan sponsors' lower-cost investment options offered by 401(k) plans. Additionally, plan sponsors who do so can help cut costs for all plan participants (Correia 2019). Finally, when retirees may suffer from aging-related cognitive declines (Smith et al. 2010; Mazzona and Perrachi 2019), having an annuity can greatly enhance their old-age consumption. All told, the inclusion of a deferred annuity within US retirement plans can be a valuable proposition for plan sponsors, active employees, and retirees.

Other policies to enhance retirement income could also be mentioned, such as encouraging people to delay claiming their Social Security benefits. As shown by Shoven and Slavov (2014) and Hubener, Maurer, and Mitchell (2018), deferring claiming from age 62 (the so-called early claiming age) to age 70 (the latest retirement age under Social Security) boosts annual benefit payments by over 75%. Accordingly, delaying claiming these benefits is yet a different way to purchase a more generous retirement annuity. In related research, we investigate how that could work in practice (Maurer, Mitchell, Rogalla, and Schimetschek, 2018).

REFERENCES

Arias, E. 2010. United States Life Tables, 2005. *National Vital Statistics Reports*. 58(10), US National Center for Health Statistics: Hyattsville, Maryland.

Blanchett, David. 2015. Allocating to a Deferred Income Annuity in a Defined Contribution Plan. *The Journal of Retirement*. 2(4): 54-68.

Brown, Jeffrey R., Olivia S. Mitchell, Jim Poterba, and Mark Warshawsky. 2001. *The Role of Annuities in Financing Retirement*. Cambridge, MA: MIT Press.

Brown, Jeffrey R., Arie Kapteyn, Erzo Luttmer, and Olivia S. Mitchell. 2017. Cognitive Constraints on Valuing Annuities. *Journal of the European Economic Association*. 15(2): 429-462.

Callan Institute 2019. *2019 Defined Contribution Trends*. https://www.callan.com/wp-content/uploads/2019/01/Callan-2019-DC-Trends-Survey.pdf

Chai, Jingjing, Wolfram Horneff, Raimond Maurer, and Olivia S. Mitchell. 2011. Optimal Portfolio Choice over the Life-Cycle with Flexible Work, Endogenous Retirement, and Lifetime Payouts. *Review of Finance*. 15: 875-907.

Correia, Margarida. 2019. Ex-employees' Retirement Assets Help Plan Sponsors Keep a Lid on Fees. *Pensions and Investments* online. https://www.pionline.com/article/20190118/ONLINE/190119854/ex-employees-retirement-assets-help-plan-sponsors-keep-a-lid-on-fees-8211-survey

Dushi, Irena and Webb, Anthony. 2004. Household Annuitization Decisions: Simulations and Empirical Analyses. *Journal of Pension Economics and Finance*. *3*(2): 109–43.

Gale, William G.; Iwry, J. Mark; John, David C. and Walker, Lina. 2008. "Increasing Annuitization in 401(k) Plans with Automatic Trial Income." The Hamilton Project, Discussion Paper 2008-02.

GAO. 2016. *401(k) Plans: DOL Could Take Steps to Improve Retirement Income Options for Plan Participants.* Washington DC: United States Government Accountability Office.

Gottlieb, Daniel and Olivia S. Mitchell. 2019. Narrow Framing and Long-Term Care Insurance. *Journal of Risk and Insurance. forthcoming*.

Horneff, Vanya, Raimond Maurer, and Olivia S. Mitchell. (2018). "How Low Returns Alter Optimal Life Cycle Saving, Investment, and Retirement Behavior." In Robert Clark, Raimond Maurer, and Olivia S. Mitchell, eds. *How Persistent Low Returns Will Shape Saving and Retirement*. (2018). Oxford: Oxford University Press. 119-131.

Horneff, Vanya, Raimond Maurer, Olivia S. Mitchell 2018. Putting the Pension Back in 401(k) Retirement Plans: Optimal versus Default Longevity Income Annuities. CFS WP 607.

Horneff, Vanya, Raimond Maurer, Olivia S. Mitchell, and Ralph Rogalla. 2015. Optimal Life Cycle Portfolio Choice with Variable Annuities Offering Liquidity and Investment Downside Protection. *Insurance: Mathematics and Economics*. 63, 91-107

Horneff, Wolfram, Raimond Maurer, and Michael Stamos. 2008. Life-Cycle Asset Allocation with Annuity Markets. *Journal of Economic Dynamics and Control*. 32, 3590-3612.

Horneff, Wolfram. Raimond Maurer, and Ralph Rogalla. 2010. Dynamic Portfolio Choice with Deferred Annuities**.** *Journal of Banking and Finance*. 34, 2652-2664.

Huang, Huaxiong, Moshe A. Milevsky, and Virginia R. Young. 2017. Optimal Purchasing of Deferred Income Annuities When Payout Yields are Mean-Reverting. *Review of Finance*. 21, 327-361.

Hubener, Andreas, Raimond Maurer, and Olivia S. Mitchell. 2016. How Family Status and Social Security Claiming Options Shape Optimal Life Cycle Portfolios. *Review of Financial Studies*. 29(4): 937-978.

Inkmann, Joachim, Paula Lopes, and Alexander Michaelides. 2011. How Deep is the Annuity Market Participation Puzzle? *Review of Financial Studies*. 24(1): 279-319.

Iwry, J. Mark. 2014. Excerpted Remarks of J. Mark Iwry, Senior Advisor to the Secretary of the Treasury and Deputy Assistant Secretary for Retirement and Health Policy. For the *Insured Retirement Institute*, July 1.

Iwry, J. Mark and John A. Turner. 2009. Automatic Annuitization: New Behavioral Strategies for Expanding Lifetime Income in 401(k)s. *Retirement Security Project Report* No. 2009-2, July. Washington, D.C.: Brookings Institution.

Koijen, Ralph, S., Theo F. Nijman, and Bas J.M. Werker. 2011. Optimal Annuity Risk Management. *Review of Finance*. 15(2): 799-833.

Koijen, Ralph, Stijn van Nieuwerburgh and Motohiro Yogo. 2016. Health and Mortality Delta: Assessing the Welfare Cost of Household Insurance Choice. *Journal of Finance*. 71(2): 957–1010.

Kotlikoff, Laurence J. and Avia Spivak. 1981. The Family as an Incomplete Annuities Market. *Journal of Political Economy*. 89, 372–391.

Lockwood, L. 2012. Bequest Motives and the Annuity Puzzle. *Review of Economic Dynamics*. 15: 226–243.

Lusardi, Annamaria, Olivia S. Mitchell, and Noemi Oggero. 2018. The Changing Face of Debt and Financial Fragility at Older Ages." *American Economic Review P&P*. 108: 407-411.

Lusardi, Annamaria and Olivia S. Mitchell. 2014. The Economic Importance of Financial Literacy: Theory and Evidence. *Journal of Economic Literature*. 52(1), 5-44.

Mazzona, Fabrizio and Franco Peracchi. 2018. "Self-Assessed Cognitive Ability and Financial Wealth: Are People Aware of their Cognitive Decline?" Working Paper, December.

Maurer, Raymond, Olivia S. Mitchell, Ralph Rogalla, and Tatjana Schimetschek. 2018. "Will They Take the Money and Work? An Empirical Analysis of People's Willingness to Delay Claiming Social Security Benefits for a Lump Sum." *Journal of Risk and Insurance*. 85(4): 877–909.

Merton, Robert C. 1969. Lifetime Portfolio Selection under Uncertainty: The Continuous-time Case. *Review of Economics and Statistics*. 51: 247–257.

Milevsky, Moshe. 2005. "Real Longevity Insurance with a Deductible: Introduction to Advanced-Life Delayed Annuities (ALDA)." *North American Actuarial Journal*. 9(4): 109-122.

Peijnenburg, Kim, Theo Nijman, and Bas J.M. Werker. 2016. Health Cost Risk: A Potential Solution to the Annuity Puzzle. *Economic Journal*. 127: 1598-1625.

Reichling, Felix and Kent Smetters. 2015. Optimal Annuitization with Stochastic Mortality and Correlated Medical Costs, *American Economic Review*. 105(11): 3273-3320.

Satter, Marlene. 2018. Retirement Assets Hit $29.2T: ICI Report. ThinkAdvisor.com, https://www.thinkadvisor.com/2018/12/27/retirement-assets-hit-29-2t-ici-report/?slreturn=20190117154826

Scott, Jason S. 2008. The Longevity Annuity: An Annuity for Everyone? Financial Analysts Journal 64(1): 40-48.

Smith, James, John J. McArdle, and Robert Willis. 2010. Financial Decision Making and Cognition in a Family Context. *The Economic Journal*. 129: F363-F380.

Shoven, J.B., and S. N. Slavov. (2014). Does it Pay to Delay Social Security? *Journal of Pension Economics and Finance*. 13 (2): 121-144.

Society of Actuaries (SOA). nd. RP-2000 Mortality Tables. https://www.soa.org/research/experience-study/pension/research-rp-2000-mortality-tables.aspx

Strakosh, Jody and Melissa Kahn. 2016. Better Outcomes from Defined Contribution Plans. *The Journal of Retirement*. 2(3): 87-93.

US Treasury (US Treasury). 2014. *Treasury Issues Final Rules Regarding Longevity Annuities*. Press Release. http://www.treasury.gov/press-center/press-releases/Pages/jl2448.aspx.

Vanderhei, Jack. 2019. Deferred Income Annuity Purchases: Optimal Levels for Retirement Income Adequacy. January 3. www.annuityfyi.com/blog/2019/01/new-study-deferred-income-annuities-could-be-key-to-retirement-security/

Vanderhei, Jack, Sarah Holden, Luis Alonso, and Steven Bass. 2016. 401(k) Plan Asset Allocation, Account Balances, and Loan Activity in 2014. *EBRI Issue Brief #423,* ICI Research Perspective, Vol. 22(2).

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The Retirement Security Project is dedicated to promoting common sense solutions to improve the retirement income prospects of millions of American workers. Nearly half of all workers do not have access to an employer-sponsored retirement savings plan or a traditional pension. Among workers who do have access to such a plan, the shift from defined benefit pension plans to defined contribution plans makes it even more important for individuals to save for their own retirement. To address these trends, RSP proposes research-based policy solutions aimed at helping middle- and low-income Americans to better prepare for a financially secure retirement.