

# **Investing for Retirement in a Low Returns Environment: Making the Right Decisions to Make the Money Last**

Alistair Byrne and Catherine Reilly

September 2017

## **PRC WP2017**

### **Pension Research Council Working Paper**

#### **Pension Research Council**

The Wharton School, University of Pennsylvania

3620 Locust Walk, 3000 SH-DH

Philadelphia, PA 19104-6302

Tel.: 215.898.7620 Fax: 215.573.3418

Email: [prc@wharton.upenn.edu](mailto:prc@wharton.upenn.edu)

<http://www.pensionresearchcouncil.org>

All findings, interpretations, and conclusions of this paper represent the views of the author(s) and not those of the Wharton School or the Pension Research Council. © 2017 Pension Research Council of the Wharton School of the University of Pennsylvania. All rights reserved.

# **Investing for Retirement in a Low Returns Environment: Making the Right Decisions to Make the Money Last**

Alistair Byrne and Catherine Reilly

## Abstract

Low returns on financial assets and increasing longevity mean saving for retirement is becoming more challenging than it has been in the past. Generations retiring in the near term (boomers) face increased longevity, but have lived through periods with strong market returns boosting their assets, and many also have DB entitlements. Younger generations also face increasing longevity, and in addition are likely to earn much lower investment returns on their retirement assets and few have DB. The challenge for them is tougher. We model the likely outcomes for different cohorts under scenarios for savings behavior, investment returns and life expectancy. We take account of likely pillar one entitlements and varying replacement rate requirements and expected longevity in different demographic and income groups. We show that younger generations do face substantial challenges, but there are plausible courses of action involving increased contributions and delayed or partial retirement that can provide reasonable income replacement rates in retirement. We map out the steps that the retirement industry (government, employers, financial services providers) needs to take to support people in following these courses of action, such as providing more flexibility over social security.

### **Catherine Reilly**

Senior Investment Strategist  
Defined Contribution  
State Street Global Advisors  
Catherine\_reilly@ssga.com

### **Alistair Byrne**

Head of Investment Strategy  
European Defined Contribution  
Alistair\_byrne@ssga.com

At the same time that longevity has been increasing, expected investment returns have fallen below historical levels. Figure 1 shows that Society of Professional Forecasters estimates of 10 year real returns on key US assets classes, with forecasts made from 1992 to 2017. Expected bill rates, bond returns, and equities returns are all significantly lower now than in the recent decade. In a lower return environment, markets do less of the work for savers, so contributions need to be higher instead. For Baby Boomers who have enjoyed good returns for most of their careers, this will have little impact. For younger individuals, however, lower future returns are a more significant drag on retirement income prospects.

*Figure 1 here*

### **How to Reach Target Replacement Rates with Defined Contribution Plans**

**Approach and methodology.** One goal of this chapter is to provide participants, plan sponsors, and policymakers with simple guidelines on the strategies that participants can employ to have enough money available in retirement. It seems self-evident that people should save more and expect to work for longer, but how much more do they need to save and at what age should they aspire to retire? The answers to these questions may be different depending on the participant's current age and previous contribution history. Furthermore, because the Social Security replacement rate varies depending on income level, we also need to take this into consideration.

To do so, we first look at the replacement rate that different age cohorts can expect from their DC savings. We use identical savings assumptions, so that any differences in outcomes between cohorts are due purely to differences in market returns. We then study the impact that increasing the savings rate or postponing retirement would have on retirement readiness for the different age cohorts. Unsurprisingly, we find that the outlook for younger generations is

considerably more challenging than for older generations who have benefited from stronger historical returns. Of course, in addition to their DC savings, most participants will also receive income from Social Security in retirement and some will also have income from DB plans.

Second, we investigate the outlook for different income groups, taking into account both differences in life-expectancy and Social Security replacement rates. Primarily due to the progressive nature of Social Security, low income cohorts will need lower DC savings rates to achieve retirement readiness than will higher earning cohorts. Finally, we study the strategies that late-starters (i.e., 45 and 55 year participants without accumulated savings balances) can employ to improve their ability to retire in comfort. By employing aggressive savings rates (over 15%) and working to 70 or beyond, these groups are likely to achieve reasonable retirement outcomes.

**Challenges for different age cohorts.** To calculate outcomes by cohorts, we assume that all the individuals invest in identical portfolios consisting of 80 percent S&P500 stocks and 20 percent US government bonds throughout their working lives. While this portfolio is undeniably simplified and may not be the investment vehicle of choice for current cohorts, we choose it because something like it has been available to all the different cohorts (unlike e.g., target date funds, first launched in the mid-1990s). This also provides a reasonable approximation of the average equity/bond split of a target date fund during the accumulation phase. We assume that all participants join the plan at the age of 22 and invest the same amount of their salary (in our base case, 9%) in the portfolio, and they also experience the same nominal wage growth (2% per annum) throughout their careers. The nine percent contribution rate is our base case because the median employee contribution rate is about six percent and the most common employer matching contribution is three percent (Vanguard 2016). For older participants, their returns are based mainly on realized historical returns; for younger participants, their portfolio growth is based

mainly on forecasted future returns based on Monte Carlo simulations using asset class return forecasts from SSGA's Investment Solutions Group. We take into account that life expectancy will continue to rise, so that someone now is 25 years old will have higher life expectancy at age 65 than someone now 60 years old. We calculate the replacement rate that each age cohort can expect at retirement, based on the returns that their portfolios have delivered over their savings periods and their life expectancies at retirement.

We show that there is wide variation in outcomes by cohort (see Figure 2). A hypothetical individual currently 60 years old and who retires at age 65, having been the saving since age 22, could expect to achieve a 211 percent replacement rate from his DC savings alone. In addition, he can expect to receive Social Security and may well have some DB benefits as well. (While few 60-year-olds may have been in a DC plan since the age of 22, they could have made contributions to a retirement savings account by themselves.) By contrast, an individual currently 25 years old and who employs the same saving strategy could expect to achieve a 27 percent replacement rate if he was to retire at age 65. Furthermore, the younger individual is unlikely to have any DB entitlements and faces more uncertainty regarding the amount of Social Security that he will receive. A 45-year-old individual can expect better outcomes than the 25-year-old but is also clearly disadvantaged compared to the 60-year-old.

*Figure 2 here*

Due to these lower expected returns, younger cohorts are clearly at a disadvantage to older workers. The most obvious tactics that younger workers could adopt to improve their situation are to contribute more and to work for longer. Yet the real questions is, how much more and how much longer? We also seek combinations that are feasible: savings rates that are affordable, and working patterns that are manageable.

For example, let us assume that our worker aspires to achieve a 40 percent replacement rate from his DC plan (while relying on Social Security and other sources of income for the rest of his retirement income). Depending on his desired retirement age, he will have a menu of action plans to choose from (here, we assume in all cases that he employs the same savings rate throughout his working life). A 25-year-old could reach a 40 percent replacement rate by contributing about 13.5 percent by working until age 65; by contributing slightly above 10 percent and working to age 70, or by contributing about seven percent and working to age 75 (see Table 1 below). The 35 and 45-year-olds benefit from stronger historical returns, so they can achieve the target replacement rate at slightly lower contribution rates.

*Table 1 here*

It is encouraging to see that these contribution rates seem feasible. Yet it is important to note that this assumes consistent savings behavior during the entire working life, no career breaks, and no leakage from retirement savings. In fact, however, leakage can be a significant drag on savings accumulation (Munnell and Webb 2015). Moreover, those who start to save later or aspire to retire earlier will require higher savings rates. In sum, financial advisers' often-quoted rule of thumb of 12 – 15 percent of income seems surprisingly realistic (Munnell et al. 2014).

**Challenges for computations by income: differences in life-expectancy and Social Security replacement rates.** Participant income levels are relevant to our computations for reasons over and above the fact that those with more income will be more able to save. First, public Social Security or pension benefits tend to be (fairly) flat meaning that replacement rates from state pension are higher in percentage terms for lower earners. Second, life expectancies are correlated with income levels, in that higher earners tend to live longer. Both factors will influence our retirement income calculations.

Calculating required replacement rates. An often-cited rule of thumb suggests a two-thirds or 70 percent income replacement target, but this is rather imprecise. In reality, the required replacement rate depends on a variety of factors including household size, home equity, region, etc. (MacDonald et al. 2016). Broadly speaking, a lower earner will need a higher replacement rate in percentage terms (to cover essential expenditures) compared to a higher earner, though the latter may have higher aspirations.

There will also be differences in Social Security entitlements and other sources of income. Lower-paid individuals are likely to receive relatively high replacement rates (in percentage terms) from Social Security. Nevertheless, percentages can be misleading, as people on very low incomes may need close to a 100 percent replacement rate simply to meet their basic needs, especially if they have few other financial resources. Lower-income persons also typically have poorer health and lower life expectancies reducing their ability to extend their working life. Indeed only about 30 percent of males in the lowest income quintile are still in full-time employment at age 60, compared with almost 80 percent in the highest income quintile (Gordodnichenko et al. 2013). Yet this also reduces the number of years in retirement that lower-income persons need to fund.

Higher-income individuals will receive considerably lower replacement rates from Social Security, but they are more likely to be able to manage with the often-quoted 70 percent replacement rate or even less. They are also more likely to own their own homes and have other sources of income in addition to Social Security. Extending their working lives may also be more feasible, and indeed more necessary, since their higher life expectancies mean that they will have a longer retirement period to fund. In order to achieve a given replacement rate target, higher earners must also generate a higher replacement rate from their DC savings. Table 2 shows Social Security replacement rates by income levels for individuals retiring either at age 65 or 70 (currently

the maximum age for claiming Social Security). It illustrates the progressive nature of Social Security benefits. For example, a low earner can expect a 49 percent replacement rate from age 65, whereas someone earning at the contribution cap would have a replacement rate of only 24 percent, at that age.

*Table 2 here*

There is also substantial evidence that high income individuals have longer life expectancies than the lower income groups (see Table 3). This disparity has risen for several decades, and adding race and education to the computation makes the disparity even more striking. The life expectancy for white American males with 16 years or more of schooling in 2008 was 14.2 years more than for black American male with fewer than 12 years of education (Olshansky et al. 2012).

*Table 3 here*

Accordingly, higher earners also expect to spend a longer period in retirement, while receiving a lower replacement rate from Social Security. This means that in order to achieve a given target replacement rate, higher earners must save a higher proportion of their incomes than low income earners, or live on relatively less in retirement.

In our next round of calculations, we examine the case of a 25-year-old at the start of their career. We add our DC replacement rate calculations to the expected Social Security replacement rates for different income cohorts to assess how much individuals in different income cohorts would need to save in order to achieve a target income replacement rate at when retiring at age 65 or 70 (the current maximum age for starting Social Security benefits).

To illustrate, we assume that all households target a 70 percent replacement rate at retirement. As Figure 3 shows, the mix of DC savings and Social Security that provides this replacement rate varies by income group. A low earner retiring at age 70 would be able to rely



entirely on Social Security to provide a 70 percent replacement rate, whereas a maximum earner retiring at 65 would need to generate a 46 percent replacement rate from his DC savings. The maximum earner here is an individual earning the maximum wage on which Social Security contributions are paid (currently \$127,000); individuals on higher salaries will need to generate an even higher proportion of retirement income from their DC savings.

*Figure 3 here*

Moreover, higher earners must save considerably higher shares of their salaries than do the low earners. If we exclude the very lowest income group, people aspiring to retire at age 65 should save between 11 and 15 percent of their salary; those planning to defer retirement until 70 should save between four and eight percent (see figure 4).

*Figure 4 here*

Two interesting implications arise from this analysis. First, even in the low return environment, people who save systematically for retirement should be well equipped to retire even at fairly modest deferral rates (we reiterate that these are total savings rates including an employer matching contributions). Participants wishing to retire at 65 need to save almost twice as much of their salary as those planning to retire at 70. Our model assumes that participants keep the same 80/20 portfolio until retirement; this is more aggressive than most people are likely (or should) have, and it may slightly overstate the investment gains during the last years of working life. Accordingly, these should be interpreted as minimums rather than recommended rates. Yet this does not change the conclusion that postponing retirement has a very positive impact on retirement readiness, not least through its impact on the replacement rate offered by Social Security.

Second, because the low earners receive a high replacement rate from Social Security, they only need to save a fairly small proportion of their salaries. If they are able to work until age 70,

they may not need to save much at all. This has interesting implications for the potential introduction of automatic enrollment schemes targeted at uncovered employees, such as state plans in the US (Gale and John 2018) or automatic enrollment in the UK. Employees at the lower end of the earnings spectrum are also less likely to be offered retirement plans by their employers than those at the higher end, and automatic enrollment plans often have quite modest total contribution rates (a total rate of eight percent in the UK, while the Oregon State plan targets at 6%). These rates are likely to be inadequate for higher earners, but as we have demonstrated, they are probably ample for the low paid. Requiring people on low incomes to save more could be counter-productive, as it may lead them to opt out altogether. Since optimal savings rates will differ by earning levels, one potential solution could be to have different automatic enrollment rates for employees by income level. Alternatively, communication and engagement should focus on encouraging higher earners to save more, though plan sponsors will need to be aware of the powerful influence of inertia in preventing action.

**Challenges for late starters.** In the previous section, we showed that participants who systematically save for retirement throughout their careers can reach reasonable outcomes with fairly low savings rates, despite the low expected market returns. Yet, many people reach middle age without having saved significant amounts for retirement. What strategies can these individuals employ to maximize their chances of attaining financial security in retirement?

We study a 45 and a 55 year old who start saving for retirement, and first evaluate the impact of different contribution rates (10, 15, 20 and 25%) and alternative retirement ages. We then study how working part time in retirement (from 65 to 70 or from 70 to 75) could affect expected replacement rates. For such late starters, we assume that they make their contributions to an age-appropriate target date fund. Again, assumed investment returns are based on SSGA asset

class return forecasts, and in retirement, the same drawdown rates are used as in the previous section.

Participants who start the retirement saving journey late do face more challenges, yet they can also significantly improve their retirement readiness with a disciplined approach to saving and by postponing retirement. Figure 5 shows the DC replacement rates that an individual starting to save at age 45 or 55 can expect to achieve, depending on his contribution rate and retirement age. Unsurprisingly, even at these relatively high contribution rates, outcomes are considerably poorer than for early starters. Previously we showed the combinations of contribution rate and retirement age, that would lead to a 40 percent DC replacement rate. Here, by contrast, we see that even a 20 percent contribution rate and working until age 70 provides only a fraction of this target.

*Figure 5 here*

Figure 6 shows expected total replacement rates for late starters at different contribution rates, including Social Security. The first calculation assumes a medium earner who saves 15 percent and retires at age 65. He can expect a replacement rate of just over 50 percent; by delaying retirement to age 70, he could achieve a total replacement rate of 70 percent. Those on higher salaries will have lower Social Security replacement rates at all ages.

*Figure 6 here*

Potential policy reforms. As evident, postponing retirement is an extremely powerful tool for improving retirement outcomes. In fact, retiring at age 70 or even 75 would improve retirement readiness for all cohorts, but particularly for late starters and higher earners. Though some people may not be physically able to work full time that late, part-time work may be feasible for many.

Another consideration that Social Security payments currently start the latest at age 70, and there is no option for ‘partial retirement.’ One alternative policy would be to allow individuals to

take out partial Social Security benefits rather than obliging them to always take the full benefit. For example, in Sweden, people who have reached the minimum age of eligibility for Social Security (62) can take a 25 percent, 50 percent, 75 percent, or 100 percent benefit, and modify this percentage when desired at an actuarially fair rate. There is also no maximum age by which full payments must start (Pensions Myndigheten 2016). Such a flexible option could be particularly useful for people who start saving for retirement later in life.

Another option would be to give people a choice to defer the start of Social Security benefits beyond age 70, to make the most efficient use of Social Security's cost-efficient longevity insurance. This would make it possible to use Social Security as a longevity backstop providing the main source of income in late life, rather than a steady source of income throughout retirement. For example, in Australia, eligibility for the Age Pension is based on an asset test (reassessed annually) rather than retirees' age. People are not eligible for the Age Pension until they have drawn their assets down to a minimum level, after which they receive the flat rate Age Pension for the rest of their lives. Johnson (2016) suggests a similar modification to the UK State Pension, postponing the start of payments to age 80 but doubling the payment.

If it were possible to defer Social Security payments until age 75 at an actuarially fair rate, this would substantially increase replacement rates. Some people might find it preferable to run down their DC balances first, in order to maximize the benefit from Social Security by claiming at a later date. The ability to postpone payments and receive higher benefits for a shorter period could be particularly valuable for higher earners, who would now actually receive meaningful income and valuable longevity insurance from Social Security. Table 4, calculates the Social Security replacement rate for starting payments at age 75 by assuming that this would lead to the same increase as deferring from 65 to 70. As a matter of fact, this understates the actuarially fair

increase, as mortality credits would accumulate faster between open 70 and 75 than between 65 and 70. Nevertheless, a flat rate has the benefit of simplicity and is used in a number of countries. For example, the UK uses a flat rate increase of 5.8 percent per annum for deferring the state pension.

*Table 4 here*

Another policy alternative would be to offer people a lump sum rather than a higher annuity payment as a means to encourage people to defer retirement. Maurer et al. (2016) found that offering a lump sum incentive rather than a higher monthly payment after the Early Retirement Age (62) induced people to voluntarily claim 6 – 8 months later than they otherwise would. In essence, offering lump sum incentives builds on the behavioral reluctance of people to annuitize. The fact that those who currently claim at the youngest ages were also most responsive to the lump sum offer indicates that this could be an effective incentive, particularly for the less financially literate sections of the population. Maurer et al. (2017) also found that lump sums of 85-90 percent of the actuarially fair amount were still effective in encouraging later claiming.

As the population approaching retirement is becoming increasingly heterogeneous, it may also be necessary to offer different incentive structures for different groups. For example, offering lump sum incentives could be an effective and equitable way of encouraging lower earners to defer claiming Social Security. As lower earners have lower life expectancies. They expect to derive less benefit from deferring Social Security for a higher payment than higher earners. Offering them a lump sum would allow them to reap the full benefit of deferring retirement.

We have also modeled what would happen if employees had the option of taking out 50 percent Social Security at ages 65 or 70. For those who work part time from 65 to 70, we calculate the Social Security benefit by assuming that at age 65 they receive 50 percent of the benefit payable

at 65; from age 70, they receive 50 percent of the benefit payable at 65 and 50 percent of the benefit payable at age 70. We follow an equivalent procedure for those who work part time from 70 to 75. We model the income stream that they would receive by subtracting the DC contribution rate from the wage income (hence the 85 percent replacement rate while in full time work).

Figure 7 shows that for the participant who started saving at age 45, working part time in retirement until age 70 would get him to a replacement rate slightly higher than 60 percent. While this may not be optimal, it is still a 10 percentage point improvement compared to if he had retired full time at age 65 (Figure 6). The participant who did not start saving until age 55 only achieves a 55 percent replacement rate because of his limited DC savings (Figure 8).

*Figure 6, 7 and 8 here*

Late starters aiming for higher replacement rates could also benefit from working part time from all 70 to 75, as they would reap the benefit of higher Social Security payments and a longer savings period (Figures 9 and 10). The income stream in these calculations is rather uneven; one solution would be to start drawing down some DC savings at age 70 to generate a smoother income stream.

*Figure 9 here*

*Figure 10 here*

This hypothetical delayed Social Security payment is not currently available, yet the simulations illustrate how powerful delaying retirement and the start of Social Security payments can be. Even with the current system, it can be beneficial for employees with limited savings to use their DC balances to delay taking Social Security as long as possible, rather than to use them to supplement their Social Security payments. Offering more flexibility to defer Social Security

payments could further enhance the value of this benefit and allow individuals to optimize the value of their DC savings.

### **Altering the Choice Environment**

These approaches require individuals to save consistently over their working lives, and there is a range of behavioral interventions ('nudges') that can help people save more to generate better replacement rates. It is now fairly well established that automatic enrolment can boost pension participation rates. Automatic enrolment is now mandated in the UK and achieving opt outs of only around 5-15 percent (DWP 2014). Many large US DC plans also use automatic enrollment (Vanguard 2016) and the approach is under consideration for improving participation in Ireland. Australia and Chile go even further with compulsory retirement plan participation for all employees.

It has also been shown that 'save more tomorrow' approaches – involving automatically escalating contribution rates – can be effective in boosting contribution rates over time (Benartzi and Thaler 2007). This can allow for participants to be introduced to retirement saving at a low rate, avoiding adverse reaction to reductions in take home pay, before being raised to the long-term required levels. This approach is in use in a growing number of large US plans (Vanguard 2016), and in the UK and Australia automatic enrolment and autoescalation have been introduced.

Matching contributions can also be used to encourage voluntary contributions to the match threshold. This can be employer contributions in response to employee contributions, or tax relief for employee contributions which may be presented as a form of matching (relief from 20 percent tax can be recast as 1:4 matching, which may be simpler for participants to understand.)

Finally, reducing pre-retirement ‘leakage’ of retirement assets will help enhance savings rates. This can include ensuring accumulated assets rollover into a retirement plan on job change rather than being cashed out, and avoiding early withdrawals. For example, the UK ‘pension freedoms’ abolished annuitization and provided full access to retirement assets from age 55. Early evidence shows a significant number of participants taking withdrawals in their 50s for non-retirement reasons (leisure, home improvement) with relatively little consideration for the impact on longer term retirement income (SSGA 2016).

**Making it easier for people to work for longer.** As the calculations above show, creating a better retirement income system in the face of low returns will require longer working lives. This means creating incentives for individuals to stay employed (which may mean reskilling or reengineering job roles), and moving away from conventional ages.

Another important question is how employers will facilitate and value older workers. Some firms already employ them as a source of competitive advantage: for example B&Q, a home improvements store chain in the UK, is known to employ retirees who are able to advise customers with a lifetime of experience of household maintenance. Yet other firms are not ready for the increasing number of older workers (Sonsino 2017). There may also be regulatory barriers such as compulsory retirement ages to be overcome. For example, both Sweden and the UK have abolished the compulsory retirement age for most positions. Additionally, policymakers may need to take steps to encourage the hiring of older workers, e.g. by subsidizing healthcare costs or reducing employment protections.

Another way to make retirement systems more sustainable is to require people to work longer, by raising the retirement age. Yet a uniform increase in the minimum retirement age risks may be seen as unfair to low earners who have lower average life expectancies and likely to be



employed in professions where extending the work life is challenging (Belbase et al. 2016). Many low earners also start their working careers earlier than those with higher levels of education, so asking everyone to extend their working lives could be seen as inequitable (Sanzenbacher et al. 2015). One answer might be to link the minimum eligibility for retirement benefits to years of work rather than age; as many low earners start work earlier than their college-educated contemporaries, the former would then qualify for retirement benefits at young age. Such an approach was considered by a recent UK review of state pension age (Cridland 2016), though no recommendation or policy change to that effect has been made as yet.

## **Conclusions**

Increasing longevity and low expected returns confront today's workers with a more challenging environment in retirement saving than previous generations. Yet, if they save systematically throughout their careers and extend their working lives to age 70, a 10 percent contribution rate should be sufficient for most wage-earners to achieve a reasonable replacement rate in retirement. Those aiming to retire earlier will obviously need to contribute more.

When considering appropriate contribution rates and retirement ages, it is necessary to take into account in life expectancy differentials and the progressive replacement rate structure of state entitlements. Two implications for policymakers are relevant. First, rather than linking a right to receive the state pension to a uniform minimum age, one could link it to a minimum number of years of contributions. Second, those on very low incomes can achieve a reasonable replacement rate in retirement with savings rates in the low single digits, whereas those on higher incomes will require 12 – 15 percent saving rates. Policymakers considering introducing auto-enrollment regimes should think carefully about how high to set the default enrollment rates, because setting

too high a rate may cause low earners to opt out. Yet a rate appropriate for low earners will be too low for those in higher wage groups. One possibility could be to have different auto-enrollment rates for different income cohorts.

For those who have started saving for retirement late, deferring retirement is an extremely powerful tool for improving retirement readiness. Not only does it shorten the time in retirement and increase the period of contributions and investment returns, it also significantly increases the income that participants can expect from Social Security. Participants who do not start saving until later in their working lives should plan to work until at least age 70 or beyond.

Removing the maximum age for claiming Social Security benefits would likely benefit high earners the most, while providing lump sum incentives to defer claiming benefits could be more effective in encouraging low income earners to delay retirement. While this analysis has focused mainly on retirement savings and Social Security claiming behavior. Other strategies are worthy of future research. For instance housing equity can also be used to support retirement income. Our discussion has also ignored other strategies that could be used to boost investment returns (e.g. additional diversification or investing in illiquid assets) or to increase sustainable withdrawal rates (such as full or partial annuitization). Other chapters in this volume take these up (Ilmanen 2018; Fichtner and Seligman 2018).

## References

- Belbase, A., G. T. Sanzenbacher, C. M. Gillis (2016). 'How do Job Skills that Decline with Age Affect White-Collar Workers?' Center for Retirement Research Working Paper Number 16-6. Boston, MA: Boston College.
- Benartzi, S. and R. Thaler (2007). 'Heuristics and Biases in Retirement Savings Behavior,' *Journal of Economic Perspectives*, 21(3): 81-104.
- Cridland, J. (2016). *State Pension Age Independent Review: Interim Report*, London, UK: Department for Work and Pensions.
- Department for Work and Pensions (2014). *Automatic Enrolment Opt Out Rates*, Department for Work and Pensions. London, UK: DWP.
- Fichtner, J. J. and J. S. Seligman (2018). 'Retirement Saving and Decumulation in a Persistent Low-Return Environment.' in R. Clark, R. Maurer, and O. S. Mitchell, eds., *How Persistent Low Returns Will Shape Saving and Retirement*. Oxford, UK: Oxford University Press, pp. xxx-xxx.
- Gale, W. G. and D. C. John (2018). 'State Sponsored Retirement Savings Plans: New Approaches to Boost Retirement Plan Coverage.' in R. Clark, R. Maurer, and O. S. Mitchell, eds., *How Persistent Low Returns Will Shape Saving and Retirement*. Oxford, UK: Oxford University Press, pp. xxx-xxx.
- Gordodnichenkoko, Y., J. Song, and D. Stolyarov (2013). *Macroeconomic Determinants of Retirement Timing*. Bonn, Germany: Institute for the Study of Labor (IZA).
- Ilmanen, A. (2018). 'Smarter Saving and Investing in a Lower Expected Return World.' in R. Clark, R. Maurer, and O. S. Mitchell, eds., *How Persistent Low Returns Will Shape Saving and Retirement*. Oxford, UK: Oxford University Press, pp. xxx-xxx.

- Johnson, M. (2016). 'The State Pension: No Longer Fit for the Purpose,' *Centre for Policy Studies*. London, UK: CPS. <http://www.cps.org.uk/publications/the-state-pension/>
- MacDonald, B. J., L. Osberg, and K. D. Moore (2016). 'How Accurately Does 70% Final Employment Earnings Replacement Measure Retirement Income (In)adequacy? Introducing the Living Standards Replacement Rate (LSSR),' *Astin Bulletin*, 46(3): 627-676.
- Maurer, R., O. S. Mitchell, R. Rogalla, and T. Schimetscheck (2016). 'Will They Take the Money and Work? People's Willingness to Delay Claiming Social Security Benefits for a Lump Sum,' NBER Working Paper No. 20614. Cambridge, MA: National Bureau of Economic Research.
- Maurer, R., O. S. Mitchell, R. Rogalla, and T. Schimetscheck (2017). 'Optimal Social Security Claiming Behavior under Lump Sum Incentives: Theory and Evidence,' NBER Working Paper No. 203073. Cambridge, MA: National Bureau of Economic Research.
- Munnell, A., A. Webb, and W. Hou (2014). 'How Much Should People Save?' Center for Retirement Research at Boston College Working Paper No. 14-11. Boston, MA: Center for Retirement Research.
- Munnell, A. and A. Webb (2015). 'The Impact of Leakages from 401(k)s and IRAs,' Center for Retirement Research at Boston College Working Paper No. 2015-2. Boston, MA: Center for Retirement Research.
- Olshansky, S. J., T. Antonucci, R. H. Binstock, A. Boersch-Supan, J. T. Cacioppo, B. A. Carnes, L. L. Carstensen, L. P. Fried, D. P. Goldman, J. Jackson, M. Kohli, J. Rother, Y. Zheng, and J. Rowe (2012). 'Differences in Life Expectancy Due to Race and Educational

Differences are Widening, And Many May Not Catch Up,' *Health Affairs*, (31)8: 1803-1813.

Pensions Myndigheten (2016). *Du Bestämmer Självt när du Vill ta ut Pension*. Stockholm, Sweden: Swedish Pensions Authority. [www.pensionsmyndigheten.se](http://www.pensionsmyndigheten.se)

Sanzenbacher, G. T., A. Webb, C. M. Cosgrove, and N. S. Orlova (2015). 'Calculating Neutral Increases in Retirement Age by Socioeconomic Status' Center for Retirement Research Working Paper No. 2015-22. Boston, MA: Boston College.

Sonsino, Y. (2018). 'Helping Employers Become Age-Ready.' in R. Clark, R. Maurer, and O. S. Mitchell, eds., *How Persistent Low Returns Will Shape Saving and Retirement*. Oxford, UK: Oxford University Press, pp. xxx-xxx.

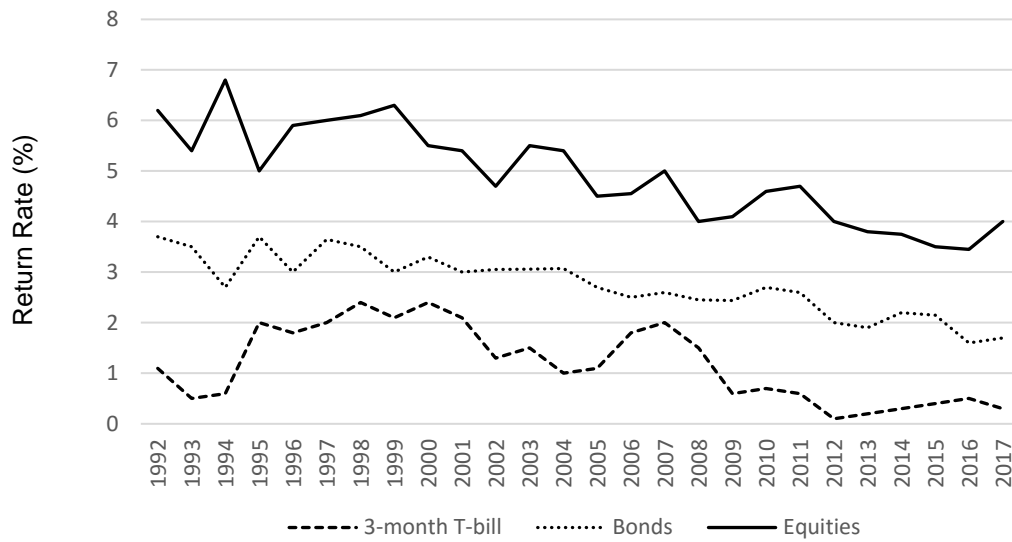
State Street Global Advisors (2016). 'New Choices: Big Decisions,' State Street Global Advisors SSGA White Paper. Boston, MA: State Street Global Advisors.

Vanguard (2016). *How America Saves 2016: Annual Report on Trends in Retirement Saving*. Malvern, PA: Vanguard.

[https://pressroom.vanguard.com/nonindexed/HAS2016\\_Final.pdf](https://pressroom.vanguard.com/nonindexed/HAS2016_Final.pdf)

Waldron, H. (2007). 'Trends in Mortality Differentials and Life Expectancy for Male Social Security-covered Workers, by Socioeconomic Status,' *Social Security Bulletin*, 67(3): 1-28.

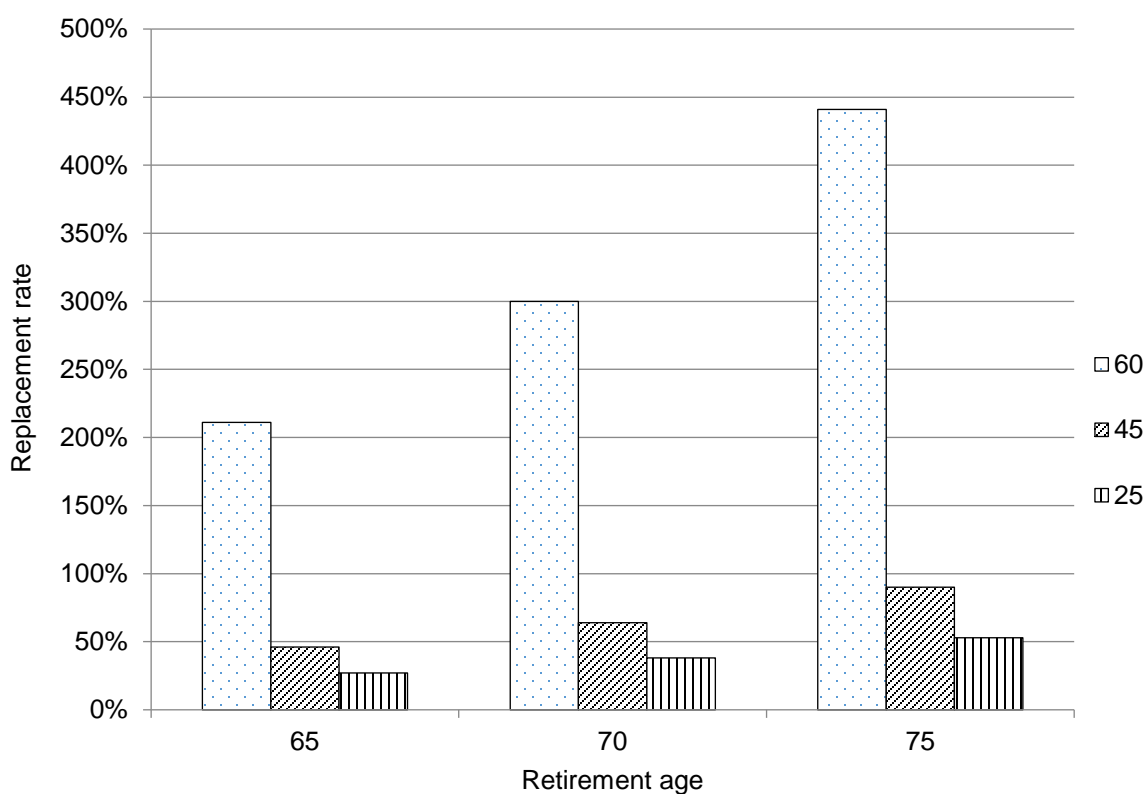
Williams, J. (2017), *Three Questions of R-Star*. San Francisco, CA: Federal Reserve Bank of San Francisco. <http://www.frbsf.org/economic-research/publications/economic-letter/2017/february/three-questions-on-r-star-natural-rate-of-interest>



**Figure 1.** Ten-year Expected Returns from the Society of Professional Forecasters.

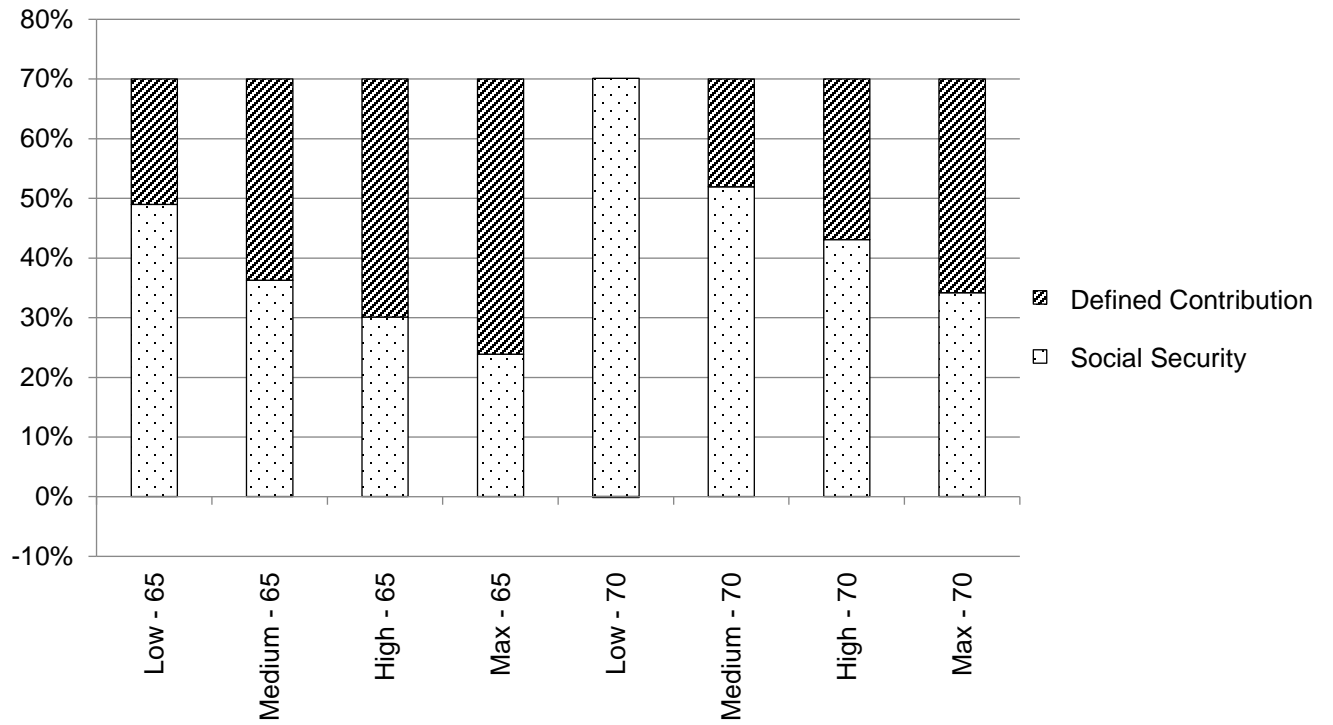
*Notes:* Returns are deflated with Survey of Professional Forecasters (SPF) long-run consumer price index inflation forecast.

*Source:* Williams (2017).



**Figure 2.** Expected replacement rate by current age of participant and retirement age, 9% contribution rate.

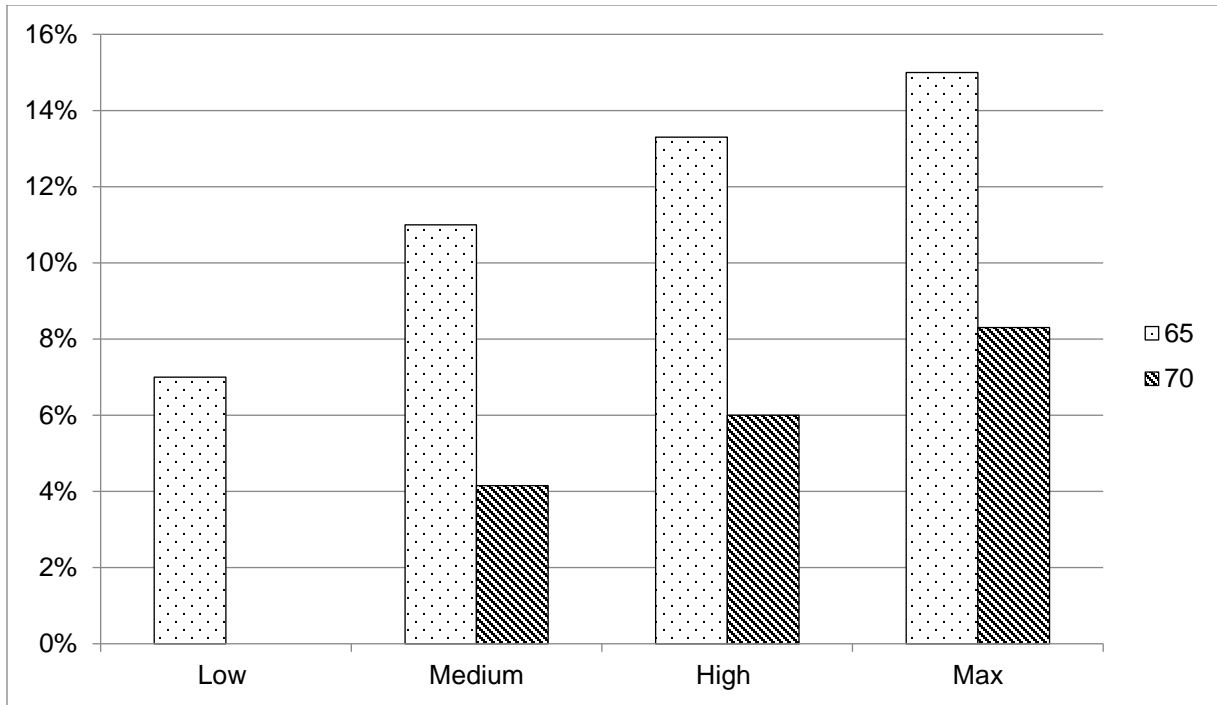
*Source:* Authors' calculations, based on Investment Security Group (ISG) asset class forecasts and UN population projections. The drawdown rate assumes a 90% that the assets will last until at least 5 years beyond median life-expectancy for each cohort (equivalent to approximately the 75<sup>th</sup> percentile).



**Figure 3.** Getting to a 70% replacement rate: Different strategies by earnings groups.

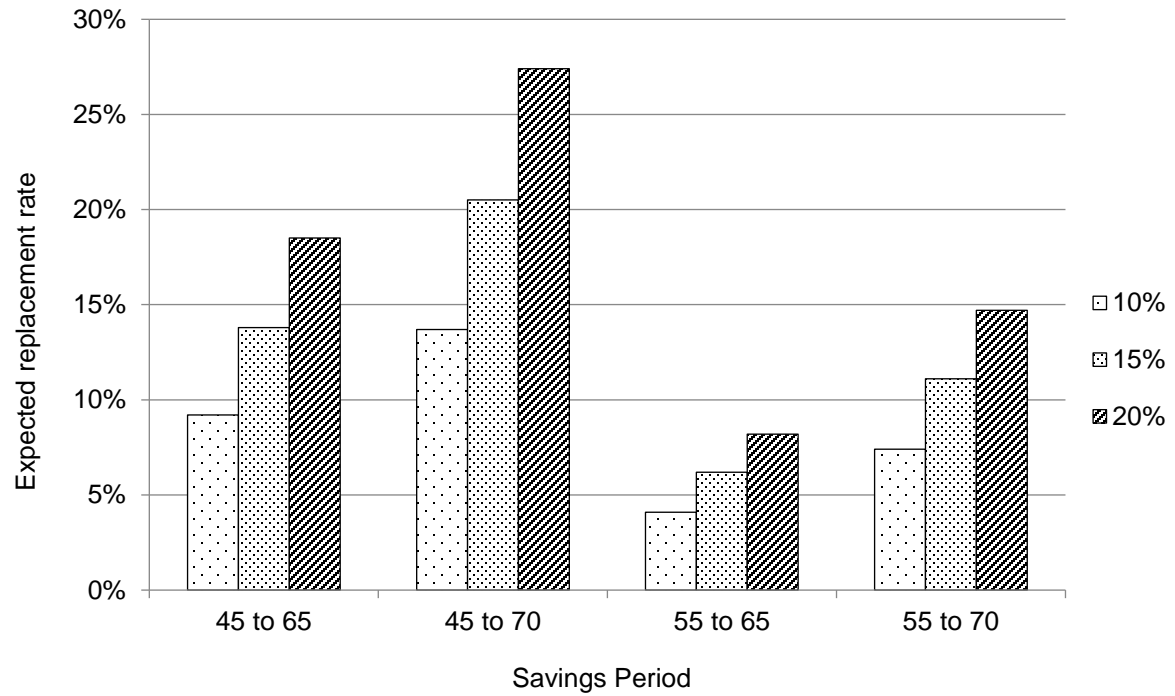
*Source:* Authors' calculations.





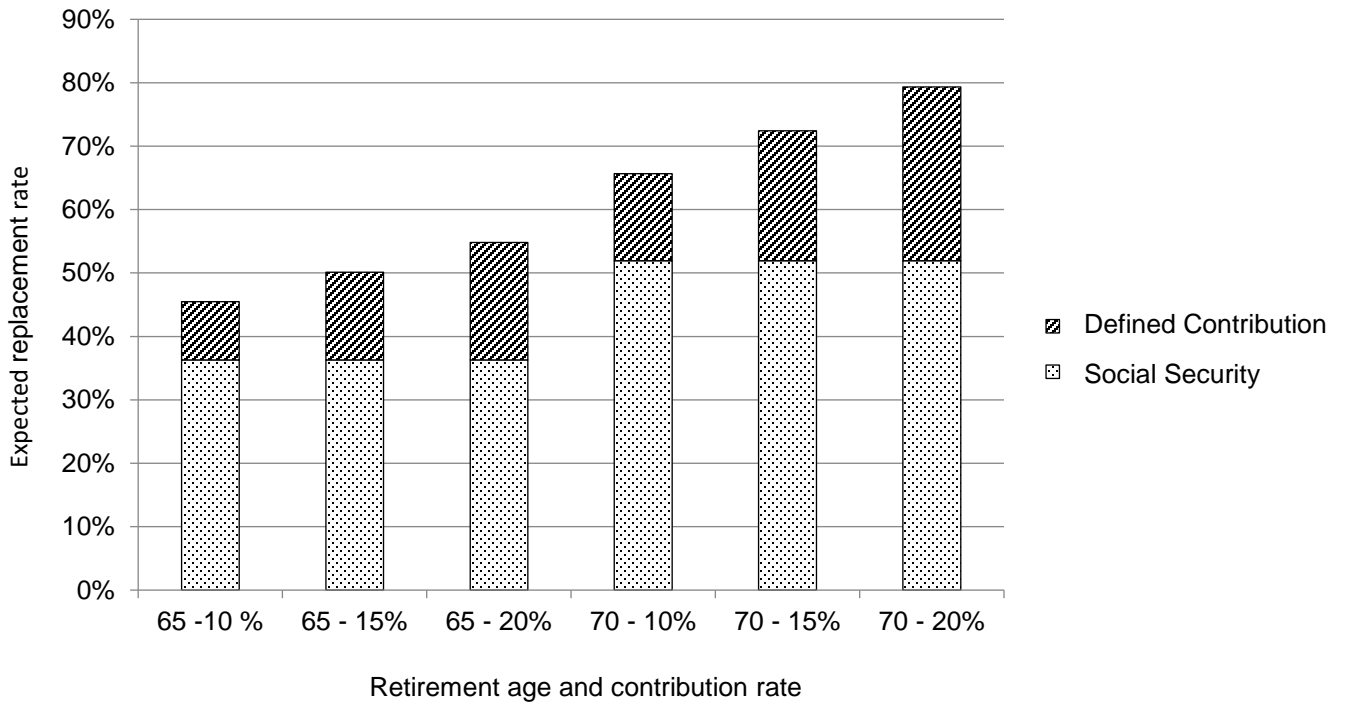
**Figure 4.** Required defined contribution rates to achieve 70% replacement rate target, by earnings group and retirement age.

*Source:* Authors' calculations.



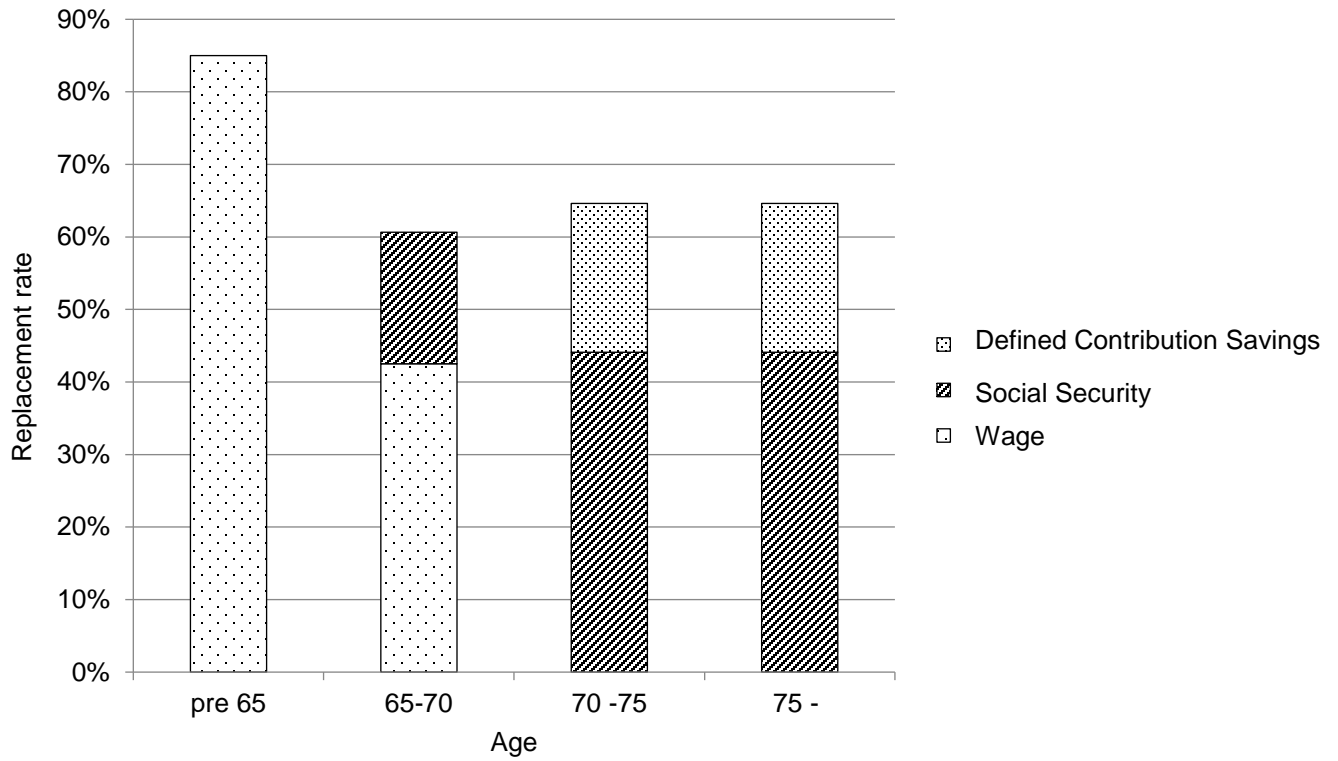
**Figure 5.** Expected defined contribution replacement rates for individuals starting to save at 45 or 55 and working until 65 or 70 by contribution rate.

*Source:* Authors' calculations.



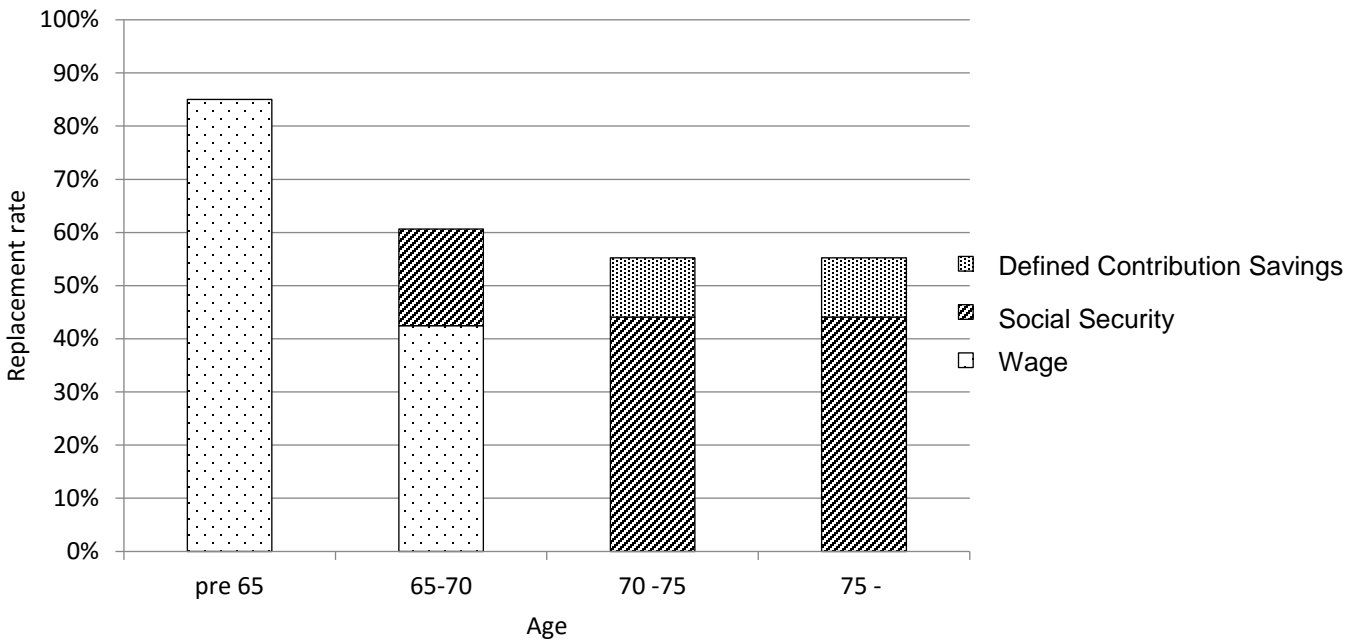
**Figure 6.** Expected total replacement rate for a medium earner who started saving at age 45, by retirement age and contribution rate.

*Source:* Authors' calculations.



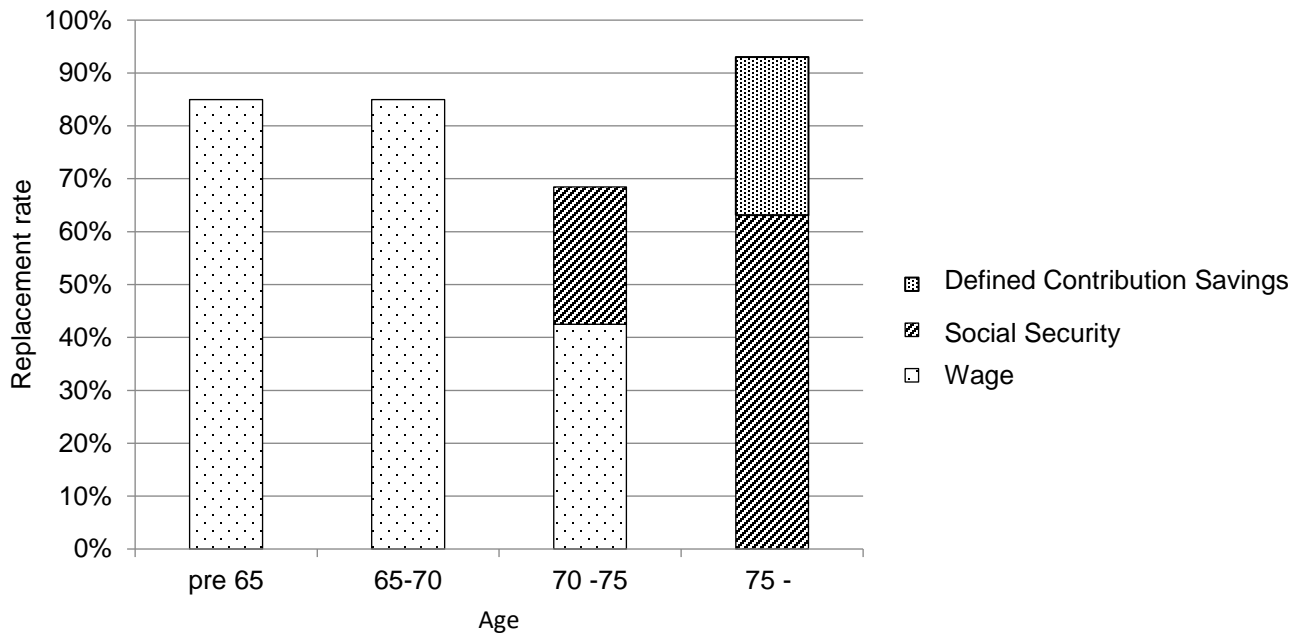
**Figure 7.** Income stream for a medium earner participant who started saving at age 45 at 15%, who works halftime and takes half his Social Security between years 65-70.

*Source:* Authors' calculations.



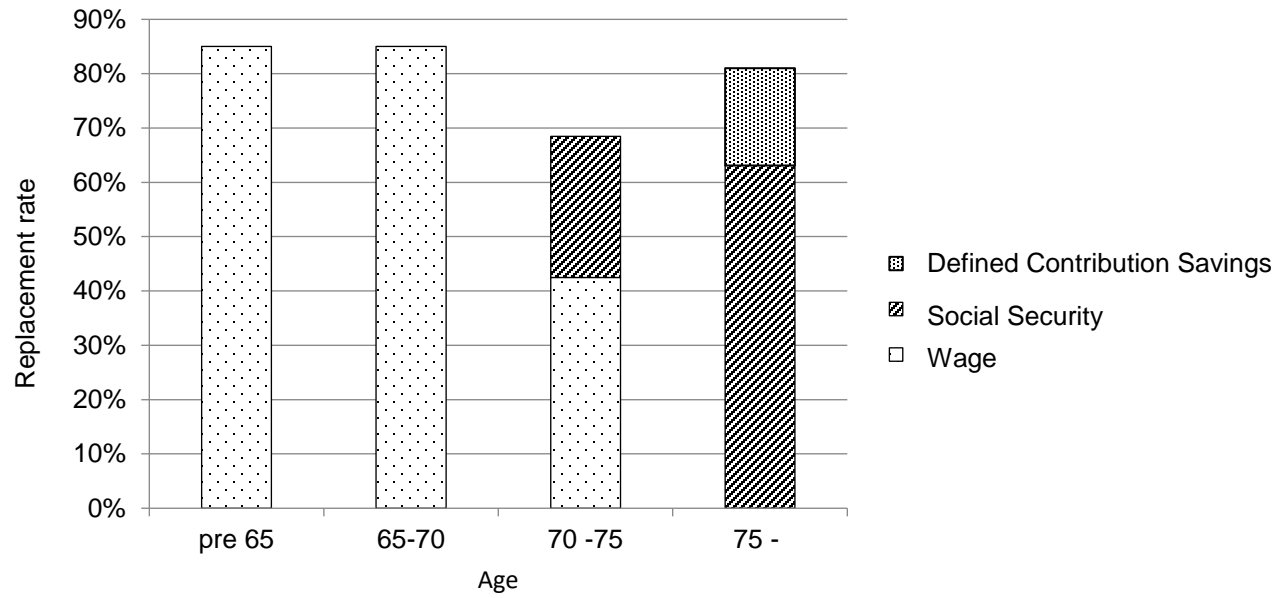
**Figure 8.** Income stream for a medium earner participant who started saving at age 55 at 15%, who works halftime and takes half his Social Security between years 65-70.

*Source:* Authors' calculations.



**Figure 9.** Income stream for a medium income participant who started saving at age 45 at 15%, who works halftime and takes half his Social Security between years 70-75.

*Source:* Authors' calculations.



**Figure 10.** Income stream for a medium income participant who started saving at age 55 at 15%, who works halftime and takes half his Social Security between years 70-75.

*Source:* Authors' calculations.

**Table 1.** Expected replacement rate by retirement age and contribution rate

25-year-olds Contribution rate (%)	Retirement age		
	65 (%)	70 (%)	75 (%)
3	9	13	18
6	18	26	35
9	27	38	53
12	36	51	71
15	45	64	89
35-year-olds			
3	11	15	22
6	22	31	44
9	33	46	66
12	44	62	88
15	55	77	110
45-year-olds			
3	15	21	30
6	31	43	60
9	46	64	90
12	62	86	120
15	77	107	150

*Notes:* The drawdown rate assumes a 90% probability that the assets will last until at least 5 years beyond median life-expectancy for each cohort (equivalent to approximately the 75<sup>th</sup> percentile).

*Source:* Authors' calculations, based on Investment Security Group (ISG) asset class forecasts and UN population projections.



**Table 2.** US Social Security replacement rates by income level and retirement age

Earnings group (2014)	Ending salary (2014\$)	Retirement age	
		65 (%)	70 (%)
Low	21,176	49.0	60.8
Medium	47,125	36.3	45.0
High	75,393	30.1	37.3
Max	114,391	23.9	29.6

*Notes:* Benefit adjustments calculated for persons born in 1960 or later.

*Source:* Authors' calculations, based on Social Security replacement rate data consistent with the 2014 OASDI Trustees' Report, Social Security Online 'Effect of Early or Delayed Retirement on Retirement Benefit.'

**Table 3.** Difference in life expectancy for male Social Security-covered workers, by age between selected earnings groups for the period 1999-2000 (in years) at different ages between top and bottom income quartiles

	Top half minus bottom half	Top quarter minus bottom quarter
60	2.6	3.3
65	1.9	2.3
70	1.2	1.3
75	0.5	0.3
80	0	-0.4
85	-0.4	-0.9

*Source:* Waldron (2007).

**Table 4.** How would allowing deferral to age 75 affect Social Security replacement rates for different income cohorts?

Income level	Claiming age		
	65 (%)	70 (%)	75(%)
Low	49%	70%	100%
Medium	36%	52%	74%
High	30%	43%	62%
Max	24%	34%	49%

*Notes:* For simplicity we have adjusted the benefit to age 75 using the same increase as from age 65 to 70; in reality, the actuarially fair adjustment would be higher, as mortality credits would accrue more rapidly at more advanced ages.

*Source:* Authors' calculations.