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## *Perspectives*

# Pensions for State and Local Government Workers Not Covered by Social Security: Do Benefits Meet Federal Standards?

by Laura D. Quinby, Jean-Pierre Aubry, and Alicia H. Munnell*

*Federal law allows certain state and local governments to exclude employees from Social Security coverage if those employees are provided with a sufficiently generous pension. Because the benefits provided by many public pensions have declined in recent years, this article assesses whether those currently offered by state and local governments satisfy federal standards and whether the standards ensure pension benefits equivalent to those of Social Security. We find that state and local government plans adhere to the standards and provide equivalent benefits at the full retirement age. However, the standards ignore differences between public pensions and Social Security in key provisions that drive lifetime resource levels. Accounting for those differences, a wealth-based generosity test suggests that 43 percent of public pensions fall short of Social Security for a significant minority of noncovered new hires. Equally important, some plans could exhaust their trust funds within 10 years, putting beneficiaries at risk.*

## Introduction

In 2018, one-quarter of state and local government employees—approximately 6.5 million workers—were not covered by Social Security on their current job. The Social Security Act of 1935 excluded all federal, state, and local government employees from coverage because of constitutional ambiguity over the federal government's authority to impose Federal Insurance Contributions Act payroll taxes on public employers and because these employees were already covered by defined benefit pensions (Internal Revenue Service [IRS] 2014). Beginning in the 1950s, a series of amendments allowed governments to enroll some of their employees in Social Security, so that by 1991 the program covered all federal employees and most state and local government employees. Today, state and local government employers may continue to exclude some employees from Social Security coverage, but only if these employees are enrolled in a retirement plan that meets federal regulations requiring sufficiently generous benefits.

The legal requirements for benefit generosity are specified in IRS regulations known as the Employment Tax Regulations, issued pursuant to Section 3121 of the Internal Revenue Code (IRC). Defined benefit pensions—the dominant type of plan offered by state and local governments—must provide members with an annuity, commencing on or before the Social Security

**Selected Abbreviations**

| | |
|---|---|
| AIME | average indexed monthly earnings |
| AWI | average wage index |
| COLA | cost-of-living adjustment |
| CPI | Consumer Price Index |
| FAS | final average salary |
| FRA | full retirement age |

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**Selected Abbreviations—*Continued***

| | |
|---|---|
| GAO | Government Accountability Office |
| IRC | Internal Revenue Code |
| IRS | Internal Revenue Service |
| NASRA | National Association of State Retirement Administrators |
| NRA | normal retirement age |
| OASI | Old-Age and Survivors Insurance |
| PIA | primary insurance amount |
| SSA | Social Security Administration |
| WEP | Windfall Elimination Provision |

full retirement age (FRA), which ranges from 65 to 67 depending on the worker's birth year. The annuity must equal the value of the Social Security benefit the member would have received at FRA had he or she participated in the program. To help state and local governments determine whether the benefit formulas they offer comply with the regulations, the federal government has established "Safe Harbor" formulas to calculate annual benefits; the formulas were designed to assure that benefits equal those provided by Social Security for a typical noncovered public employee. Legally, state and local pensions that meet the Safe Harbor requirements comply with the Employment Tax Regulations.

Whether state and local governments currently satisfy the Safe Harbor standards, and whether the standards continue to ensure that the plans provide benefits equal in generosity to Social Security, is unclear. The need to assess whether state and local pensions comply with federal standards has increased since financial downturns in 2001 and 2008 dramatically reduced the assets held by state and local pension funds and triggered a wave of benefit reductions, usually affecting new hires (Aubry and Crawford 2017; Munnell and others 2013; Munnell, Aubry, and Cafarelli 2014). Additionally, some government pension plans could soon exhaust their assets and revert to pay-as-you-go systems, seriously endangering future benefit payments and compromising the retirement security of their members (Monahan 2017).

Given recent benefit cuts and looming reductions for some plans, this article explores the extent to which noncovered public employees receive benefits commensurate with what they would have received under Social Security. We first determine whether the retirement plans for noncovered state and local government employees satisfy the Safe Harbor requirements and whether the requirements provide Social Security–equivalent income at age 67 (the FRA for workers born in 1960 or later). We examine a large sample of benefit formulas for noncovered workers and find that all sampled formulas meet or exceed the Safe Harbor requirements. To determine whether the legislated Safe Harbor parameters produce the required income at age 67, we compare the benefit levels to which a typical employee would be entitled under a public plan that meets the minimum Safe Harbor requirements and under Social Security. Our finding suggests that the Safe Harbor–compliant benefit formulas produce about the same level of income at age 67 as Social Security.

Although the sampled state and local benefit formulas satisfy the letter of the law, noncovered public employees still might not receive Social Security–equivalent resources in retirement for three reasons. First, state and local government pensions often set very long vesting periods and, second, in recent years, they are increasingly unlikely to grant full cost-of-living adjustments (COLAs) after retirement. These shortcomings are partially offset by the third factor: the much younger normal retirement ages (NRAs) established by state and local government pensions. We incorporate the vesting period, COLA, and NRA into a wealth-based generosity test, which requires calculating the present value of lifetime retirement benefits—arguably, a more meaningful measure of retirement resources—for a typical noncovered public employee and for a worker continuously covered by Social Security. That calculation shows that 43 percent of sampled benefit formulas for noncovered workers fall short of Social Security benefit levels, although we note that the calculation is very sensitive to the employment and earnings patterns of the noncovered employees. Additionally, the legal standards for benefit generosity ignore the spousal, survivor, and disability benefits provided by Social Security. These ancillary benefits represent a potentially substantial difference between public plans and Social Security. Such benefits are beyond the scope of this article, but they are valuable to retirees and should be the focus of future work.

Finally, this article grapples with an additional conceptual complication: A number of pension plans for noncovered state and local government employees have low funded ratios, and Social Security likewise faces a projected financial shortfall. A simple projection of pension cash flows using information from the *Public Plans Database*, maintained by the Center for Retirement Research at Boston College (http://publicplansdata.org/), reveals that two plans sponsored by the City of Chicago could exhaust their assets within 10 years. The article summarizes the ongoing debate over the legal responsibility of state and local governments to provide full benefits after trust funds are exhausted. It also asks how state and local pension assets should be compared with Social Security's Old-Age and Survivors Insurance (OASI) trust fund. The question is pertinent, given that the 2019 *Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and the Federal Disability Insurance Trust Funds* (hereafter, the *Trustees Report*)[1] projects OASI trust fund depletion in 2034, which could trigger an automatic benefit reduction.

The article contains six sections, beginning with this introduction. The next section presents an overview of federal regulations on pension benefit generosity and frames the current analysis within the existing literature on state and local pension finances. The third section compares the various benefit formulas currently offered to noncovered state and local government employees with the Safe Harbor requirements and examines whether the Safe Harbor–compliant designs provide Social Security–equivalent benefits at age 67. The fourth section addresses the differing provisions for vesting periods, COLAs, and NRAs, then calculates lifetime retirement wealth for both a typical noncovered state or local employee and a similar worker continuously covered by Social Security. The fifth section addresses the issues surrounding the exhaustion of pension trust fund assets. The final section concludes with a discussion of potential policy responses should a public plan violate federal standards. Appendices provide methodological details, assumptions, and supporting materials.

## Background

This section outlines the federal standards regulating retirement benefit generosity for state and local government plans, then briefly discusses prior research on the topic.

### An Overview of Federal Generosity Requirements for State and Local Retirement Plans

Until the 1950s, wages in the public sector were not subject to payroll taxes, and employees earned no Social Security credit for their time in government. A series of amendments to the Social Security Act, enacted beginning in 1951, allowed state and local governments to enroll some of their employees by establishing job-specific agreements with the Social Security Administration (SSA) under Title II, Section 218 of the act, "Voluntary Agreements for Coverage of State and Local Employees" (42 U.S. Code § 418).[2] The Omnibus Budget Reconciliation Act (OBRA) of 1990 (Public Law 101-508, Section 11332(b)) mandated coverage for all state and local government employees who do not participate in their employer's retirement plan. Because Section 218 at that time did not clarify the definition of an employer "retirement system," OBRA 1990 also amended IRC Section 3121 to help government employers determine whether their employees were exempt from mandatory Social Security coverage. Specifically, IRC Section 3121(b)(7)(F) authorized the Secretary of the Treasury, in coordination with the SSA, to limit the definition of a retirement plan by setting minimum benefit requirements. IRC Section 3121 was meant to ensure that state and local government employees would be covered either by Social Security or by an employer-sponsored pension providing "meaningful" benefits comparable to those of Social Security (IRS 1991).

The minimum benefit requirements described in the IRS regulations issued pursuant to IRC Section 3121 are very specific. As described in the *Code of Federal Regulations,* a government employee's defined benefit plan meets the requirements

> if and only if, on that day, the employee has an accrued benefit under the system that entitles the employee to an annual benefit commencing on or before his or her Social Security retirement age that is at least equal to the annual Primary Insurance Amount the employee would have under Social Security.

The regulators' concept of benefit generosity is worth considering. First, it was not sufficient for an employee's benefit to be equivalent to that of Social Security at the time of separation from government employment; instead, the employee's public pension benefits had to accrue *at the exact same rate*, over the course of his or her career, at which Social Security benefits would have accrued. Second, by comparing the public pension benefit to the Social Security primary insurance amount (PIA)—defined as the benefit received by a worker if claimed at FRA—the regulators focused on retirement income adequacy at only one point in time.[3]

Perhaps recognizing that traditional defined benefit pensions might not provide benefits equivalent to the Social Security PIA for every member on every day, the IRS contemporaneously issued Revenue Procedure 91-40, describing the Safe Harbor formulas for defined benefit plans. The formulas are designed to produce a benefit equal to the Social Security PIA for the "average wage earner," and any plan that adopts one of the formulas satisfies the minimum benefit requirement for all employees covered by that formula (IRS 1991).[4] Table 1 outlines the acceptable formulas for defined benefit plans. All of the formulas assume an NRA of 65[5] and lack Social Security's guaranteed COLA. The regulations also outline Safe Harbor requirements for defined contribution plans (tax-deferred retirement savings accounts), stipulating that total employer and employee contributions equal at least 7.5 percent of salary annually and that assets be managed according to fiduciary standards.

**Table 1.**
**Safe Harbor minimum benefit factors for defined benefit pension plans, by basis for calculating final average salary**

| Basis | Benefit factor (%) |
|---|---|
| Highest— | |
| 3 years | 1.50 |
| 4 years | 1.55 |
| 5 years | 1.60 |
| 6–10 years | 1.75 |
| More than 10 years | 2.00 |

SOURCE: IRS Revenue Procedure 91-40.

NOTE: Safe Harbor formulas calculate benefits as final average salary times years of noncovered employment times the benefit factor.

### *Prior Research*

Despite the strong legal link between state and local pension generosity and Social Security coverage, the issue remains largely undiscussed. It is not clear that the benefits earned by newly hired state and local government employees satisfy the Safe Harbor requirements because years of inadequate contributions and two stock market downturns have left many public-sector defined benefit plans with insufficient assets to cover their liabilities. To try to alleviate the funding shortfalls, government sponsors have reduced plan benefits (Brown and Wilcox 2009; Novy-Marx and Rauh 2014; Aubry and Crawford 2017). The reduced benefit levels frequently target new hires because state statutes typically protect accrued pension benefits as contractual obligations that cannot be impinged (Munnell and Quinby 2012). These benefit reductions have taken various forms, including a lower COLA, a lower benefit multiplier, a longer period for computing the final average salary (FAS), and tighter retirement eligibility requirements for new hires than for their longer-tenured coworkers (Quinby, Sanzenbacher, and Aubry 2018).[6] Occasionally, governments have also cut the COLA for current workers, arguing in court that only first-year benefits are protected by statute. In the wake of these cutbacks, state and local pensions may not match Social Security for new hires. For example, Kan and Aldeman (2014) demonstrate that Chicago teachers, who are not covered by Social Security, often accrue less pension wealth than they would have earned under Social Security.

In addition, the legal hurdles to cutting promised benefits have left some state and local governments responsible for legacy liabilities that they may be unable to meet (Munnell and Aubry 2016; Warshawsky and Marchand 2016). Under a scenario in which sponsors exhaust the assets in their pension trust funds and convert them to pay-as-you-go systems, legal scholars question whether state legislatures could be forced to pay promised benefits in full (Monahan 2010, 2017; Cloud 2011; Reinke 2011). The federal pension generosity standards make no provision for an asset-exhaustion scenario.

## *Do Pension Benefits for Newly Hired Noncovered Workers Satisfy the Letter of the Law?*

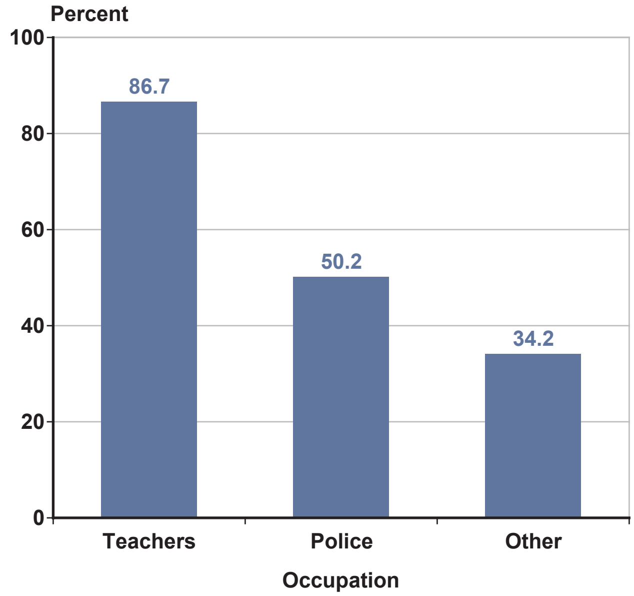
This section assesses the generosity of benefits currently offered to noncovered state and local government employees within the legal framework described above. The analysis has two goals: to determine whether retirement benefits for new hires meet the Safe Harbor requirements and to confirm that the Safe Harbor–required benefits provide Social Security–equivalent income at age 67.

To this end, data on Social Security coverage were gathered using two independent surveys of plan administrators, one conducted by the authors and the other by the National Association of State Retirement Administrators (NASRA). The surveys targeted the 56 largest state-administered retirement systems in 13 states that account for 80 percent of U.S. noncovered state and local payroll (Government Accountability Office [GAO] 2010). We also collected plan membership counts by occupation using the Census Bureau's Annual Survey of Public Employment & Payroll and obtained detailed descriptions of benefit provisions for state and local workers without Social Security coverage from the plans' actuarial valuation reports. The final study sample consists of 38 retirement plans offering 81 benefit formulas for significant numbers of noncovered workers in 12 of those 13 states.[7]

Table 2 shows that the Social Security coverage rates we estimate for state and local government workers in the 13 states are consistent with those reported in GAO (2010). The differences largely reflect the fact that we estimate the noncovered share of employees and GAO estimated the noncovered share of earnings. Because nearly 90 percent of teachers in the 13 sampled states were excluded from Social Security (Chart 1),[8] and teachers tend to be more highly paid than other public employees, an earnings-based estimate of the noncovered share of workers will usually be higher than an employee-based calculation.

Table 2 also shows the variation in the number of retirement systems and the types of benefit formulas offered, by state. Because benefit designs may vary by occupation, the number of formulas exceeds the number of systems in most states. Most of the formulas for noncovered workers are structured as traditional defined benefit pensions, although seven of the 38 systems offer voluntary defined contribution plans and three offer hybrid plans (either mandatory or voluntary) that pair a less-generous defined benefit formula with a defined contribution account. Five systems have a cash-balance structure for at least some members; in this type of defined benefit plan, the employer contributes a set percentage of the participant's salary each year and the account earns interest at a notional rate.

**Chart 1.**
**Percentage of state and local government employees in 13 states who are not covered by Social Security, by selected major occupation**




SOURCES: Authors' and NASRA surveys of public plan administrators; Census Bureau Annual Survey of Public Employment & Payroll; and various plan documents, websites, and news articles.

**Table 2.**
**Selected characteristics of the study sample, by state examined**

| State | Share of employees without Social Security coverage, as estimated in— | | Study sample number of offered— | |
|---|---|---|---|---|
| | This study (percentage of employees) | GAO (2010) (percentage of earnings) | Retirement systems | Benefit formulas |
| California | 42 | 60 | 3 | 12 |
| Colorado | 76 | 70 | 5 | 10 |
| Connecticut | 64 | 45 | 2 | 2 |
| Georgia | 22 | 25 | 2 | 2 |
| Illinois | 42 | 64 | 7 | 13 |
| Kentucky | 29 | 33 | 1 | 1 |
| Louisiana | 87 | 83 | 3 | 4 |
| Massachusetts | 100 | 97 | 8 | 22 |
| Missouri | 20 | 35 | 1 | 1 |
| Nevada | 100 | 96 | 1 | 2 |
| New Jersey | 0 | 9 | . . . | . . . |
| Ohio | 100 | 99 | 3 | 9 |
| Texas | 35 | 53 | 2 | 3 |

SOURCES: Authors' and NASRA surveys of public plan administrators; Census Bureau Annual Survey of Public Employment & Payroll; various plan documents, websites, and news articles; and GAO (2010).

NOTE: . . . = not applicable.

### *Do Retirement Benefits for Noncovered New Hires Meet the Safe Harbor Requirements?*

For defined benefit pensions, the Safe Harbor regulations set a maximum NRA and a formula for calculating annual benefits: FAS times years of state/local tenure times a benefit factor (multiplier). FAS is calculated using the worker's earnings in the final years of employment (that is, the highest earning years); the number of years used in the calculation varies from one benefit formula to another.[9] Table 3 summarizes the NRAs and the benefit factors for our sample of defined benefit formulas for noncovered workers, and compares the results with the Safe Harbor requirements. Although the NRAs set by a couple of formulas are older than the Safe Harbor NRA of 65, no formula's NRA exceeds the Social Security FRA of 67 (for workers born after 1959), and many allow for normal retirement at substantially younger ages: The median NRA is 62. Similarly, the parameters that determine the level of annual benefits are typically more generous than those required by law. For example, among formulas that calculate FAS using the final 3 years, the median benefit factor is 3 percent, whereas the Safe Harbor formula requires a minimum factor of only 1.5 percent. Among defined contribution plans, the median total contribution rate (employer plus employee) is 18 percent of salary and the sample minimum is 10 percent, well above the Safe Harbor minimum requirement of 7.5 percent. In short, the benefits earned by noncovered state and local new hires appear to satisfy the Safe Harbor requirements.

### *Do the Safe Harbor–Compliant Designs Provide Social Security–Equivalent Benefits at Age 67?*

The Employment Tax Regulations state that public-plan retirement benefits at age 67 should be equivalent to the Social Security PIA. The Safe Harbor–compliant plans could fall short because final-pay-based defined benefit pensions are back-loaded, providing generous benefits to long-tenure workers, but relatively little to their short- and medium-tenure colleagues (Poterba and others 2007; Diamond and others 2010; Costrell and Podgursky 2009; Beshears and others 2011; Quinby 2020). By contrast, Social Security benefits are front-loaded—a result of the program's progressive benefit formula using wage-indexed earnings.

This phase of the analysis compares the benefits generated by a Safe Harbor–compliant formula with Social Security benefits for a hypothetical worker who enters the labor market in 2018 at age 25 and works part of his or her career in noncovered government employment. The Safe Harbor–compliant defined benefit formula we analyze offers a 1.5 percent benefit factor, a 3-year FAS period, an NRA of 65, and

**Table 3.**
**Characteristics of benefit formulas offered to noncovered state and local government new hires in 2016**

| Characteristic | Number of benefit formulas | Mean | Median | Minimum | Maximum | Safe Harbor requirement |
|---|---|---|---|---|---|---|
| | | | *Defined benefit formulas* | | | |
| NRA | . . . | 62 | 62 | 50 | 67 | 65 |
| Benefit factor (%) in formulas that calculate FAS for a period of— | | | | | | |
| 1 year | 1 | 3 | 3 | 3 | 3 | 1.50 |
| 2 years | 1 | 2 | 2 | 2 | 2 | 1.50 |
| 3 years | 22 | 2 | 3 | 1 | 3 | 1.50 |
| 5 years | 33 | 2 | 3 | 2 | 3 | 1.60 |
| 6–10 years | 8 | 2 | 2 | 2 | 3 | 1.75 |
| | | | *Defined contribution formulas* [a] | | | |
| Combined employer and employee contribution rate (%) | 10 | 17.4 | 18.0 | 10.0 | 23.5 | 7.50 |

SOURCES: Authors' and NASRA surveys of public plan administrators; and plan actuarial valuation reports.

NOTES: Some complicated plan designs, such as benefit multipliers that vary based on tenure, have been simplified to reflect the experience of most employees.

. . . = not applicable.

a. Includes hybrid and cash-balance plans.

no COLA. Because Safe Harbor regulations do not stipulate a vesting requirement, the analysis assumes immediate vesting. We calculate Safe Harbor formula benefits at age 67 simply as the benefit factor times the FAS in the noncovered job times the total tenure in the noncovered job.

A Social Security benefit calculation is based on a worker's covered earnings. For our analysis, however, we exclude earnings in covered employment and only consider earnings in noncovered employment in calculating the hypothetical Social Security benefit for the noncovered state or local worker. The actual Social Security benefit calculation takes the average indexed monthly earnings (AIME)—the monthly average of the highest 35 years of covered earnings, indexed for wage inflation—then applies three graduated benefit multipliers. The formula applies a 90 percent multiplier to the lowest portion of the AIME, up to a given threshold amount (called a "bend point"); a 32 percent multiplier to any portion of the AIME above the first threshold, up to a second bend point; and a 15 percent multiplier to any portion of the AIME exceeding the second threshold. The AIME calculation omits annual earnings that exceed the maximum taxable amount. Normally, the AIME calculation also omits earnings from noncovered state and local employment, and the multiplier for AIME up to the first bend point is adjusted downward according to the Windfall Elimination Provision (WEP) if a worker receives a pension from noncovered employment (and the worker does not qualify for a WEP exception).[10] However, to compare Social Security and public pension benefits, our hypothetical AIME calculation includes earnings from noncovered public employment and replaces all earnings from covered employment with zeros (that is, as if the worker had no covered employment).[11] The calculation also purposely ignores the standard WEP adjustment.

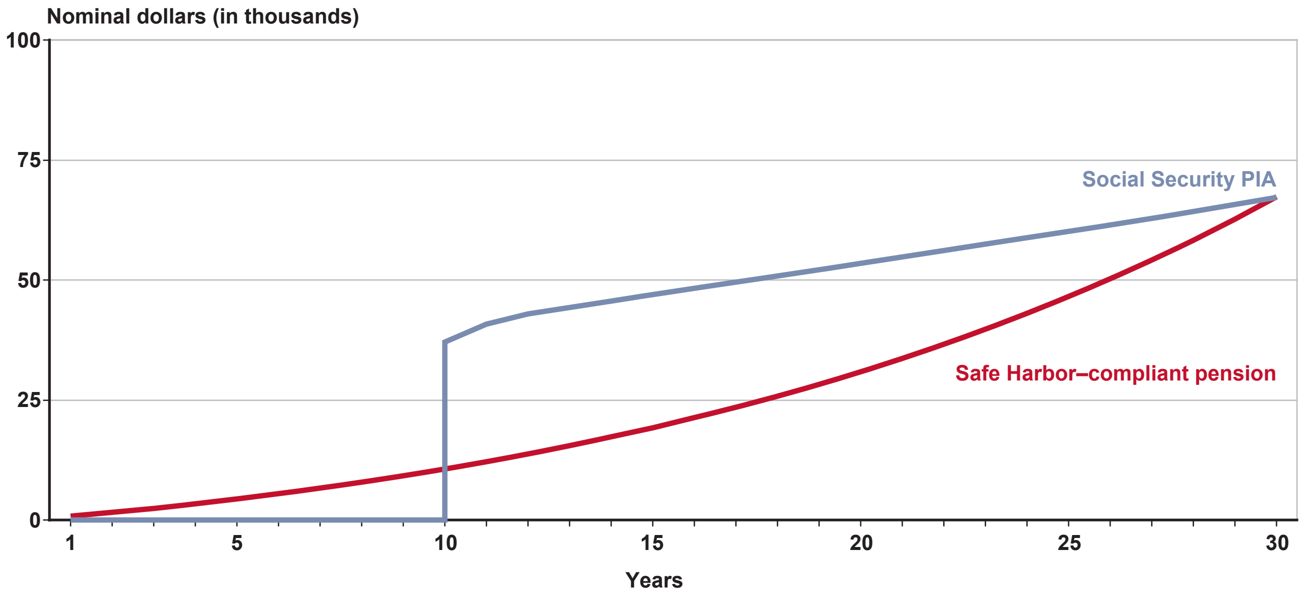
For analytical tractability, and to maintain the spirit of the Employment Tax Regulations, this article considers only individual benefits and ignores spousal and survivor benefits. Because the hypothetical worker will retire many years in the future (in 2058, at age 65), the Social Security benefit calculation requires projections of several annually adjusted program parameters, including the average wage index (AWI), the COLA, the taxable maximum, and the benefit formula's bend points. We assume that the AWI and COLA will increase by the long-run intermediate assumptions in the 2018 *Trustees Report;* the taxable maximum and bend points are projected using legislated formulas that refer to the AWI.[12]

Critical to the calculation is a set of assumptions about the earnings history of the hypothetical worker. The two key variables in the Safe Harbor formula are the worker's FAS and his or her total tenure in the noncovered job. For Social Security, the worker's earnings history determines AIME, on which the benefit calculation is based. We assume the hypothetical worker enters government employment at age 35 (in 2028) with a $50,000 starting salary and that his or her wages rise by 3.8 percent annually.[13] Alternative assumptions about his or her tenure in government range from 1 year to 30 years to reflect the uncertainty of the future tenure of new hires. Forty-five percent of new pension members stay in the system for no more than 5 years, 16 percent stay for 6–10 years, 32 percent stay for 11–30 years, and 7 percent stay for more than 30 years (Munnell and others 2012). The average expected tenure of new hires is 12 years.[14]

Chart 2 presents the results of this analysis.[15] Annual benefits (in nominal age-67 dollars) are plotted against the number of years worked in state or local government. From 1 to 10 years of state or local government tenure, the Safe Harbor–compliant formula provides more income at age 67 than Social Security does because the worker has not yet accrued the 40 quarters of covered earnings necessary to be insured. After 10 years of tenure, the relationship flips, with the Safe Harbor–compliant formula providing an annual average of 42 percent less income than Social Security. By 30 years of tenure, however, the Safe Harbor–compliant formula catches up with Social Security and provides a roughly equivalent benefit.

Although Chart 2 seems to indicate that the Safe Harbor–compliant formula falls short for the one-third of noncovered state and local government employees who separate with 11 to 30 years of tenure, those workers could still have secure retirements if they earn Social Security benefits by working in the private or covered government sectors. To demonstrate this point, Chart 3 plots a more realistic alternative for calculating AIME than the assumption used in Chart 2.[16] In Chart 3, we assume that the worker's Social Security earnings history reflects positive earnings for all of the years he or she worked in covered employment and zero earnings for the years in noncovered employment. We also assume that Social Security benefits are reduced by the WEP. The analysis then estimates total retirement income at age 67 by adding Safe Harbor–compliant plan benefits to the PIA calculated using the more realistic AIME estimate and the WEP adjustment.[17] When periods of covered and noncovered

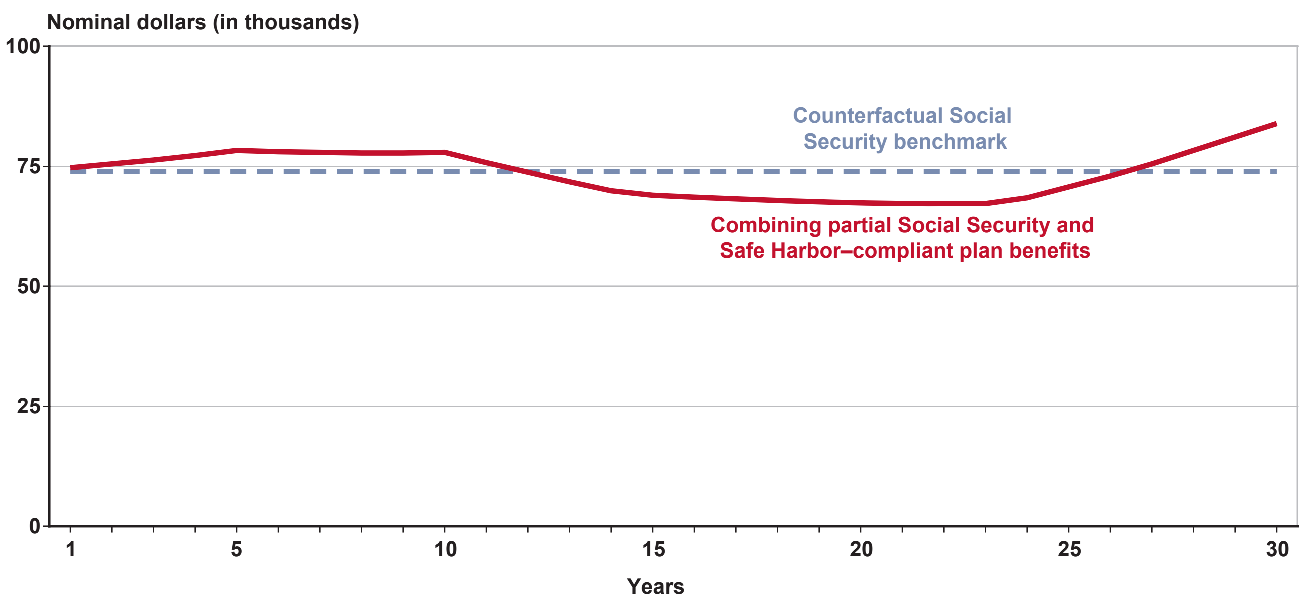
**Chart 2.**
**Estimated annuitized Social Security benefit and Safe Harbor–compliant pension benefit for a hypothetical 2018 labor force entrant aged 25, by number of years worked in noncovered employment**




SOURCE: Authors' calculations.

NOTE: Appendix Tables C-1 and C-2 present underlying assumptions and estimated yearly benefit amounts, respectively.

**Chart 3.**
**Estimated annuitized retirement benefit that combines some Social Security and some Safe Harbor–compliant pension coverage for a hypothetical 2018 labor force entrant aged 25, by number of years in noncovered employment**




SOURCE: Authors' calculations.

NOTES: Appendix Tables C-1 and C-2 present underlying assumptions and estimated yearly benefit amounts, respectively.

The Social Security component of the combined benefit is WEP-adjusted.

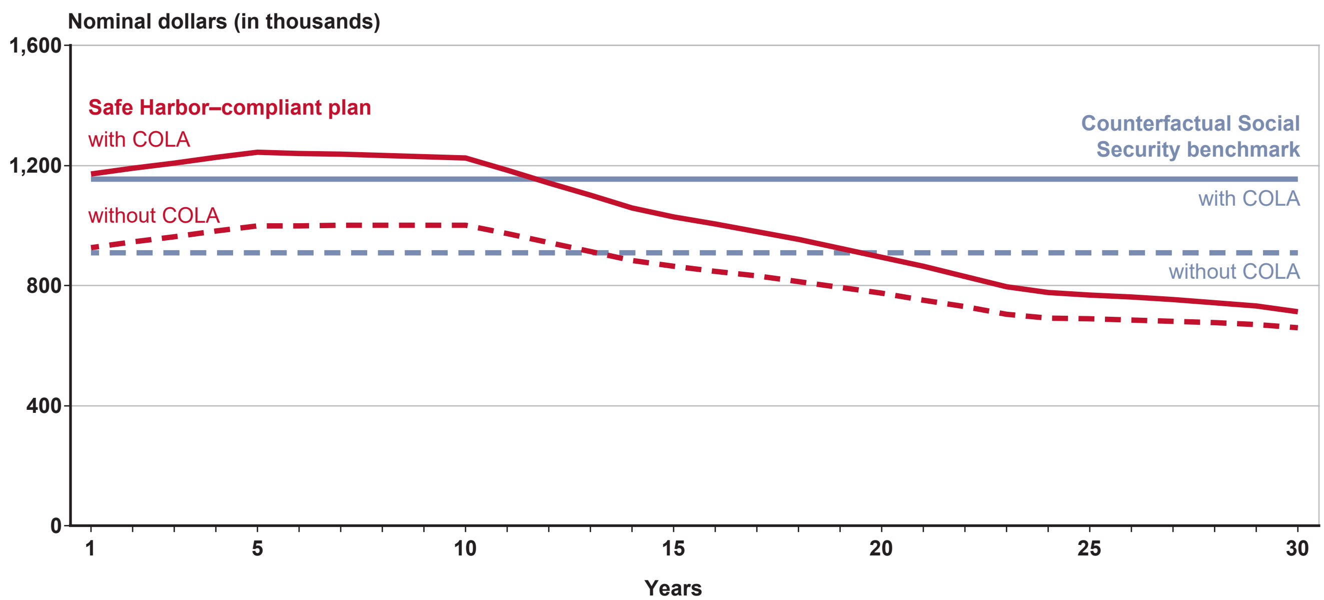
employment are combined, the years worked in noncovered employment have little effect on age-67 income, relative to a counterfactual Social Security benefit that assumes equivalent lifetime earnings in covered employment only. This analysis suggests that the Safe Harbor–compliant defined benefit formulas successfully match Social Security benefits at age 67.

The conclusion is less clear for the Safe Harbor–compliant defined contribution plan, which produces a stock of assets at age 67 rather than an annual benefit. In theory, this stock of assets should generate Social Security–equivalent benefits in retirement. A straightforward comparison measures the plan account balance at age 67 against the present value of lifetime Social Security benefits. To account for time worked in covered employment, this analysis adopts the assumption used for Chart 3, simulating the Safe Harbor–compliant plan account balance and adding its plan assets to Social Security wealth accrued from covered employment.

The analysis assumes that contributions to the Safe Harbor–compliant defined contribution account—7.5 percent of salary—are invested safely and yield a nominal return of 5.3 percent annually.[18] Contributions cease once the hypothetical worker separates from noncovered employment, but assets in the account continue to appreciate until the worker reaches age 67. The present value of lifetime Social Security benefits is calculated by adjusting each future benefit by the COLA, multiplying the projected benefit by the probability that the worker is still alive, and discounting these amounts to age 67.[19] For consistency, we set the discount rate as equal to the worker's expected return on assets.

The assumption about COLAs raises an interesting issue. The Safe Harbor formulas for defined benefit plans do not provide a COLA, suggesting that Safe Harbor–compliant defined contribution wealth should be compared with the present value of unadjusted Social Security benefits. Yet, Social Security benefits do have COLAs, and ignoring this adjustment paints an unrealistic picture of the defined contribution plan. As a compromise, the analysis calculates Social Security benefits with and without the COLA (Chart 4).[20] We find similar results in both COLA scenarios. Chart 4 suggests that, unlike the defined benefit formulas, the Safe Harbor–compliant defined contribution plan may not generate enough wealth to compensate noncovered state and local government employees fully for lost Social Security benefits.

**Chart 4.**
**Estimated present-value lifetime wealth from a combination of Social Security and a Safe Harbor–compliant defined contribution plan for a hypothetical 2018 labor force entrant aged 25, by number of years in noncovered employment**




SOURCE: Authors' calculations.

NOTES: Appendix Table C-1 presents the underlying assumptions.

The Social Security component of the combined benefit is WEP-adjusted.

## *Do Pension Benefits for Noncovered New Hires Provide the Same Lifetime Resources as Social Security?*

Although the defined benefit formulas currently offered to newly hired noncovered state and local government employees satisfy the Safe Harbor requirements, and the Safe Harbor–compliant defined benefit formulas achieve the goal of the IRS Employment Tax Regulations, it is not clear that noncovered new hires will enjoy Social Security–equivalent resources in retirement. The Safe Harbor formulas ignore three key contributors to lifetime resources that differ between the public pensions and Social Security. On the negative side, state and local pensions often have very long vesting periods and are increasingly unlikely to grant full COLAs after retirement.[21] For example, the median vesting period in our sample of benefit formulas for noncovered workers is 10 years (Table 4), and a few plan sponsors recently extended vesting periods from 5 years to 10 years as part of reforms intended to curb rising pension costs.[22] Similarly, 15 percent of plans for noncovered workers award COLAs only periodically or if plan investments perform well, and 20 percent of plans award only simple (noncompounding) COLAs. On the positive side, state and local pensions allow members to collect full benefits at much younger ages than are required to qualify for full Social Security benefits (see Table 3). Many plans also allow members to claim reduced benefits before the normal retirement age with an actuarial adjustment that is more generous than Social Security's.

To account for these factors in testing the generosity of noncovered workers' pension benefits, we turn from estimating age-67 benefits to estimating lifetime retirement wealth. To that end, we calculate the following ratio:

$$\frac{\textit{Noncovered pension wealth} + \textit{Covered Social Security wealth}}{\textit{Counterfactual Social Security wealth}}$$

We define noncovered pension wealth as the present value of future state and local pension benefits from noncovered employment. We define covered Social Security wealth as the present value of future Social Security benefits earned from covered employment (adjusted for the WEP). Counterfactual Social Security wealth equals the present value of the future Social Security benefits that the hypothetical worker *would have received* had he or she never entered the noncovered government position and instead accrued equivalent lifetime earnings entirely in covered employment. We refer to this equation as the "counterfactual wealth ratio." Values equal to or greater than 1 indicate that the noncovered worker is no worse off (and potentially better off) than he or she would have been if he or she never entered noncovered employment.

We evaluate state and local defined benefit formulas using the same hypothetical worker with whom we assessed Safe Harbor compliance.[23] We posit a baseline scenario in which this worker enters the labor market with a private-sector job at age 25. At age 35, the worker takes a noncovered government position with a $50,000 salary. He or she receives 3.8 percent nominal wage increases annually for 12 years, after which he or she returns to private-sector employment until retirement at age 65. Public pension benefits are calculated as in Charts 2 and 3, with the provisions of each state and local formula for noncovered workers substituting for the Safe Harbor parameters. We assume that the hypothetical worker claims his or her public pension benefit at the plan's NRA, after which benefits increase according to the plan's COLA provision.[24] We also assume that the 15 percent of state and local plans that grant only unscheduled COLAs will not grant any future adjustments. For consistency across plans with different NRAs, benefits are discounted to age 25.[25]

By definition, covered Social Security wealth (in the numerator of the equation above) excludes noncovered earnings from state or local government employment. We assume that covered Social Security benefits are claimed at the worker's FRA and are adjusted for the WEP and for cost-of-living increases after claiming. We discount the benefits to age 25, using the same rate as that used for the public pension (the worker's expected return on assets).

**Table 4.**
**Vesting and COLA provisions of defined benefit formulas offered to noncovered state and local government new hires in 2016**

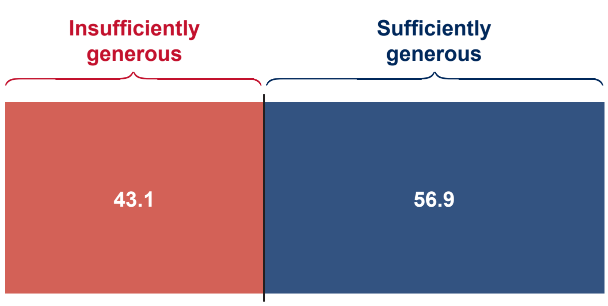
| Characteristic | Value |
|---|---|
| Vesting period (years) | |
| Mean | 8.3 |
| Median | 10 |
| Minimum | 5 |
| Maximum | 15 |
| Percentage of plans with— | |
| Any COLA | 100 |
| A COLA applied only at unscheduled intervals | 15 |
| A noncompounding COLA | 20 |

SOURCES: Authors' and NASRA surveys of public plan administrators; and plan actuarial valuation reports.

We calculate counterfactual Social Security wealth (the denominator of the equation above) assuming that the worker never entered noncovered government employment; hence, his or her entire earnings record is in covered employment and provides the basis for his or her benefit calculation. We assume that the worker claims counterfactual Social Security benefits at FRA, that the benefits are not adjusted for the WEP, and that COLAs will be applied after claiming. Counterfactual Social Security benefits are likewise discounted to age 25, with the discount rate set to equal the worker's expected return on assets.

Chart 5 shows that 57 percent of the evaluated formulas have a counterfactual wealth ratio of 1 or more, indicating sufficient generosity. Of course, formulas that "pass" the test with a counterfactual wealth ratio of 1.01 provide substantively equivalent benefits to those that "fail" with a ratio of 0.99. For this reason, Chart 6 plots the full distribution of formulas by counterfactual wealth ratios. Of the 43 percent of formulas that do not pass the test, all provide at least 85 percent of the worker's counterfactual Social Security wealth and most provide 95–99 percent. Among the formulas that pass, a number of designs provide substantially more wealth than the worker would have received from Social Security alone. In particular, police officers and firefighters often amass significant pension wealth over their lifetimes because they tend to retire earlier and receive benefits for many more years than teachers do. Chart 7 compares the counterfactual

**Chart 5.**
**Sufficiency of state and local government defined benefit plans for new hires as evaluated using the counterfactual wealth ratio (in percent)**




SOURCE: Authors' calculations based on plan actuarial valuation reports.

NOTES: "Sufficiency" is indicated by a counterfactual wealth ratio of 1 or more.

Appendix Table C-3 presents the assumptions about the hypothetical worker for whom each plan's counterfactual wealth ratio is calculated.

wealth-ratio distributions for teachers and police officers. Moreover, state and local employers may design their pension formulas not only to replace Social Security as required by statute and regulation but also to attract and retain desirable workers by offering benefits that provide supplemental retirement saving, as many private-sector employers do.

Each formula's counterfactual wealth ratio is sensitive to assumptions about the worker's employment history, particularly about his or her tenure in the noncovered government position. Chart 8 illustrates by contrasting two distributions of counterfactual wealth ratios. It compares the baseline distribution from Chart 6, which assumes 12 years of noncovered tenure, with the distribution for a worker who stays only 5 years in the noncovered government position (recall that 45 percent of new hires remain no longer than 5 years). The 5-year state or local worker always accrues benefits at least as valuable as he or she would have accrued from a career in Social Security–covered work, most often a nearly equal amount. This result is intuitive: Although the public pension provides very little, the worker still has 35 years in which to earn full Social Security benefits in covered employment.

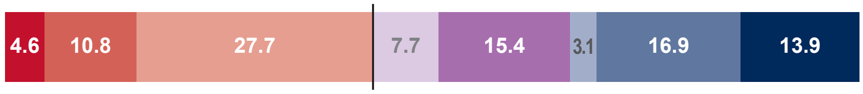
A related analysis considers how the worker's vesting status affects benefit sufficiency. Chart 8 shows that a nonvested worker is at risk of falling short only if he or she accrues more than 5 years in noncovered employment. In practice, around half of the formulas sampled have vesting periods longer than 5 years and, as expected, none of those formulas satisfy the counterfactual wealth test for a worker who separates right before vesting.[26] However, even if those formulas were to shorten their vesting periods, they still might not pass the counterfactual wealth test; very few formulas require more than 10 years to vest, yet Chart 8 shows that many fall short for a worker with 12 years of tenure.

The counterfactual wealth ratio is also sensitive, albeit less so, to the assumed age of entry into noncovered public-sector employment. Chart 9 contrasts the baseline distribution of counterfactual wealth ratios with a new distribution that assumes that the worker begins his or her 12-year government-job tenure at age 25 instead of age 35. The public benefit formulas are less likely to provide Social Security–equivalent benefits to the worker who enters at age 25 because the worker's pension benefit, which is based on final salary, erodes with wage inflation for an additional 10 years.

Finally, the distribution of counterfactual wealth ratios does not appear to be sensitive to realistic

## Chart 6.
**Percentage distribution of state and local government defined benefit plans, by counterfactual wealth ratio**

**Wealth ratio:** 0.85–0.89 | 0.90–0.94 | 0.95–0.99 | 1.00–1.04 | 1.05–1.09 | 1.10–1.14 | 1.15–1.19 | 1.20 or higher



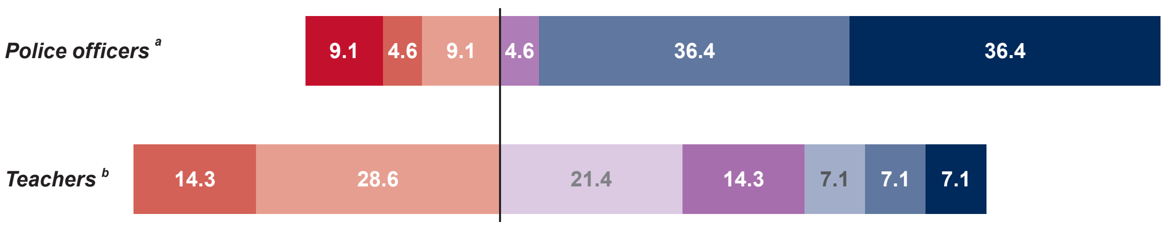

SOURCE: Authors' calculations based on plan actuarial valuation reports.

NOTES: Rounded components of percentage distribution do not sum to 100.0.

Appendix Table C-3 presents the assumptions about the hypothetical worker for whom each plan's counterfactual wealth ratio is calculated.

## Chart 7.
**Percentage distribution of state and local government defined benefit plans for teachers and police officers, by counterfactual wealth ratio**

**Wealth ratio:** 0.85–0.89 | 0.90–0.94 | 0.95–0.99 | 1.00–1.04 | 1.05–1.09 | 1.10–1.14 | 1.15–1.19 | 1.20 or higher




SOURCE: Authors' calculations based on plan actuarial valuation reports.

NOTES: Rounded components of percentage distributions do not sum to 100.0.

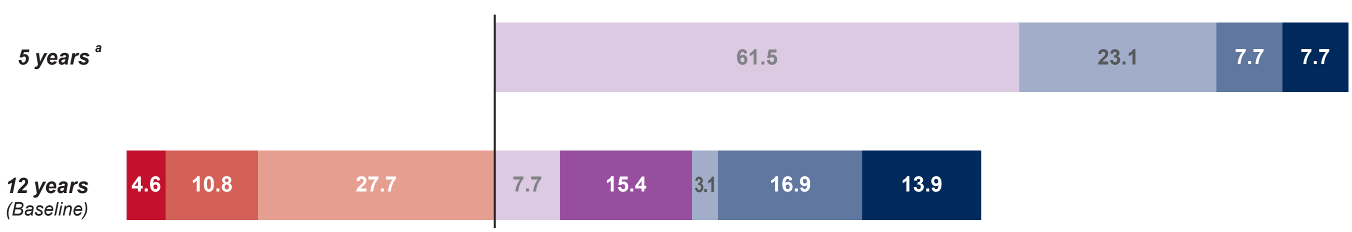
Appendix Table C-3 presents the assumptions about the hypothetical workers for whom each plan's counterfactual wealth ratio is calculated.

a. No plans in the 1.00–1.04 or 1.10–1.14 ranges.

b. No plans in the 0.85–0.89 range.

## Chart 8.
**Percentage distribution of state and local government defined benefit plans, by counterfactual wealth ratio and worker's tenure in noncovered employment**

**Wealth ratio:** 0.85–0.89 | 0.90–0.94 | 0.95–0.99 | 1.00–1.04 | 1.05–1.09 | 1.10–1.14 | 1.15–1.19 | 1.20 or higher




SOURCE: Authors' calculations based on plan actuarial valuation reports.

NOTES: Rounded components of percentage distributions do not necessarily sum to 100.0.

Appendix Table C-3 presents the assumptions about the hypothetical workers for whom each plan's counterfactual wealth ratio is calculated.

a. No plans in the 0.85–0.89, 0.90–0.94, 0.95–0.99, or 1.05–1.09 ranges.

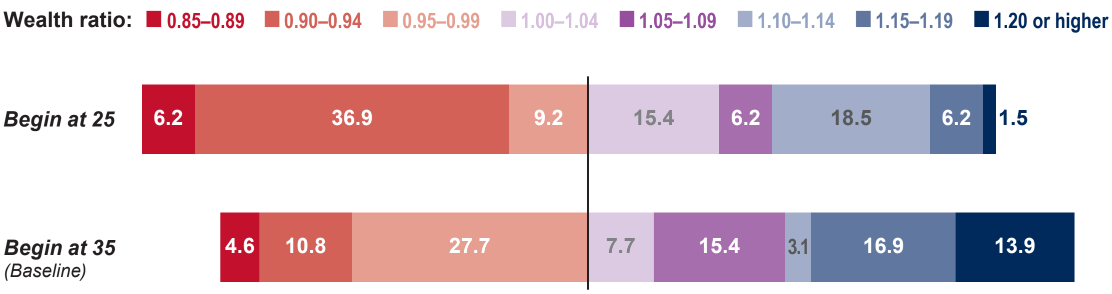
variation in earnings levels. We define a hypothetical high earner as having a $60,000 starting salary in noncovered employment with 4.3 percent annual wage increases and a hypothetical low earner as starting at $40,000 and having annual wage increases of 3.3 percent.[27] For each earner, about 45 percent of formulas generate a counterfactual wealth ratio of less than 1 (Chart 10). However, the story changes for very high earners (not shown). If a worker is assumed to earn the taxable maximum amount each year, then 95 percent of formulas generate counterfactual wealth ratios greater than 1, and most provide benefits considerably greater than the counterfactual Social Security level.

The preceding analysis suggests that a number of state and local pension formulas fall short of providing Social Security–equivalent benefits for some of their members. In practice, of course, the extent of the problem depends on the demographic characteristics of workers earning benefits under the different formulas, particularly their propensity to stay in state or local government for a full career. However, fully accounting for these formula-specific factors would require highly detailed data on plan members and assistance from each plan's actuary.

In summary, although the benefit formulas for noncovered state and local government employees meet the federal Safe Harbor requirements, those requirements do not account for vesting-period, COLA, and retirement-age differences between the public plans and Social Security. As such, some formulas may still fall short of Social Security equivalence for a significant minority of members.

The analysis to this point has assumed that future public pension benefits will be paid as promised. The next section tests that assumption and considers

**Chart 9.**
**Percentage distribution of state and local government defined benefit plans, by counterfactual wealth ratio and worker's age of entry into noncovered employment**

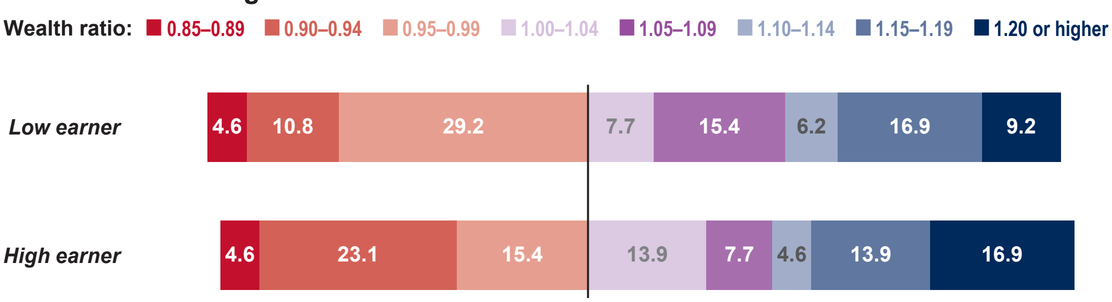



SOURCE: Authors' calculations based on plan actuarial valuation reports.

NOTES: Rounded components of percentage distributions do not sum to 100.0.

Appendix Table C-3 presents the assumptions about the hypothetical workers for whom each plan's counterfactual wealth ratio is calculated.

**Chart 10.**
**Percentage distribution of state and local government defined benefit plans, by counterfactual wealth ratio for low and high earners**




SOURCE: Authors' calculations based on plan actuarial valuation reports.

NOTES: Rounded components of percentage distributions do not necessarily sum to 100.0.

Appendix Table C-3 presents the assumptions about the hypothetical workers for whom each plan's counterfactual wealth ratio is calculated.

whether federal regulators may want to account for the financial health of pension funds for noncovered state and local government employees.

## Will State and Local Retirement Benefits Be Paid in the Future as Currently Promised?

In the wake of the 2008 financial crisis, the aggregate funded ratio reported by state and local defined benefit plan sponsors declined from 86 percent to 72 percent, and the trust funds have yet to fully recover (Aubry, Crawford, and Wandrei 2018).[28] Additionally, a handful of governments have persistently failed to make the actuarially required contributions to build a meaningful stock of assets. What might happen if a public pension exhausts the assets in its trust fund and reverts to pay-as-you-go status?

The legal scholarship on state and local pension plans notes tension between strong contractual protections for promised benefits and a state's sovereign power to choose how it collects and allocates revenue. Most state statutes grant retired public employees contractual rights to the benefits that they were promised when they joined the government workforce (Munnell and Quinby 2012). The IRC also discourages government sponsors from dipping into pension trust funds to pay for other services (26 U.S. Code § 401(a)). Monahan (2017) argues that although state and local government retirees have a legal right to disbursements from the trust fund, neither state nor federal courts would grant them the right to general appropriations. Hence, so long as trust funds are well stocked, state and local retirees can claim a legal right to the benefits that they were promised during their working life. Once trust funds are depleted, however, benefit payments depend on the goodwill of the government. This logic also seems to apply in the years preceding trust fund exhaustion. For example, several state and local governments have been able to renege on pension promises by making the case in court that pension costs are crowding out vital public services such as police protection and sanitation (Monahan 2010; Cloud 2011; Reinke 2011). Ancillary features, such as COLAs, have proven particularly vulnerable to default.

Moreover, Monahan (2017) argues that retirees may have little *legal* recourse even in states such as Illinois, where the state constitution grants strong pension rights. Of course, such constitutional protections exert strong *political* pressure on state legislatures to respect pension promises because the legal challenges to pension cuts would likely prove costly.

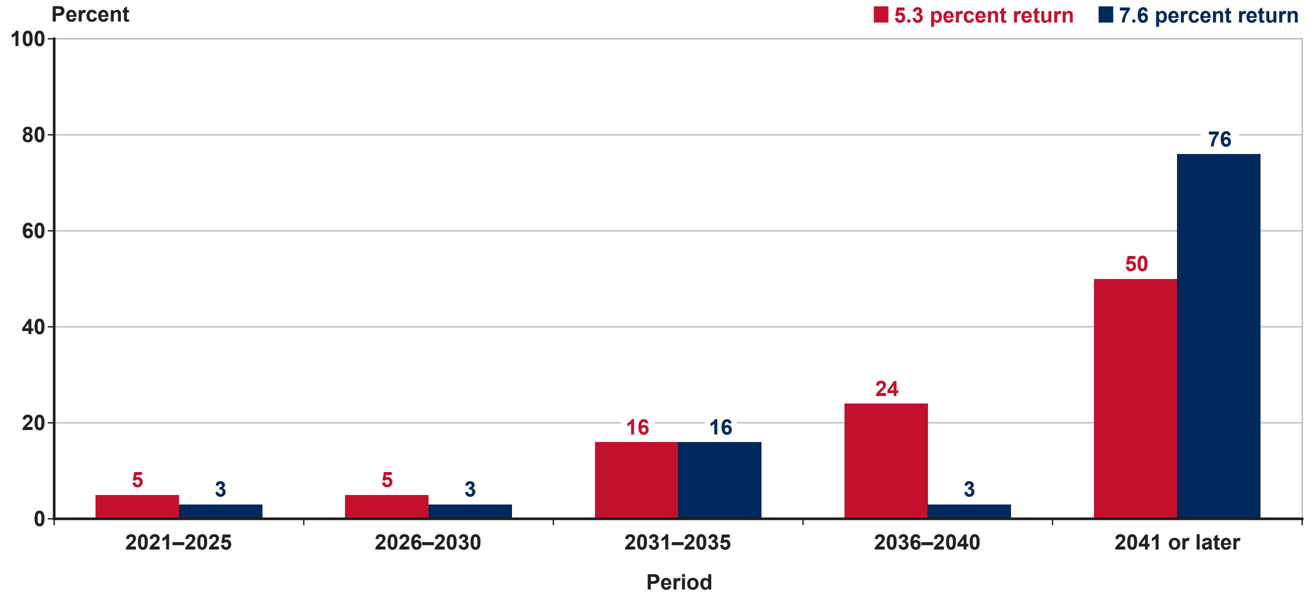
Consequently, the possibility of trust fund exhaustion is an important metric of benefit generosity. This article assesses the likelihood of exhaustion in the near term by projecting cash flows and estimating the date on which each of the pension plans in the sample could run out of assets.[29] For this analysis, we use information from the *Public Plans Database* maintained by the Center for Retirement Research at Boston College. For each trust fund, the database provides the market level of assets, annual expenditures, payroll, and employer and employee contributions. We assume that the future annual growth rates for expenditures and payroll will equal their average growth rates from 2012 to 2016. Future contributions as a percentage of payroll are held at their 2016 level. In each year, the projected balance in the plan's trust fund equals the prior-year balance, plus investment income and contributions, minus expenditures.

A fund's investment return is a key parameter in our asset projection. Munnell and Aubry (2016) note that assumed investment return for state and local pensions in the *Public Plans Database* is far higher than the returns assumed by many investment firms. Specifically, in 2016, the public plans reported a 7.6 percent expected annual return on their portfolios. Because more than half of the assets were invested in equities, that assumption implies expected stock returns of 9.6 percent. By contrast, eight large investment firms surveyed by Munnell and Aubry projected an average equity return of only 5.5 percent over the next decade. To acknowledge uncertainty around the future performance of equities, we project assets under two portfolio investment-return assumptions: 7.6 percent and 5.3 percent.[30] The outcome of interest is the fund's exhaustion date, defined as the year in which assets decline below zero.

Chart 11 shows the distribution of defined benefit public plans by projected exhaustion dates under the two investment-return assumptions. Under either assumption, two plans for noncovered workers in Chicago—the Municipal Employees' Annuity and Benefit Fund and the Policemen's Annuity and Benefit Fund—are projected to exhaust their assets by 2026 (results by individual plan are not shown). Another six plans are projected to exhaust their trust funds by 2035 under both investment-return assumptions.[31]

This simple projection is an imperfect indicator of a plan's future financial health. Because returns to risky investments do not follow a deterministic path, many

**Chart 11.**
**Percentage distributions of state and local government defined benefit plans by year of projected trust fund exhaustion under alternative rates of return on investment**




SOURCE: Authors' calculations based on data for 2012–2016 from the *Public Plans Database*.

NOTE: Rounded components of percentage distributions do not necessarily sum to 100.

studies have simulated pension finances stochastically (for example, Boyd and Yin 2017; Farrell and Shoag 2016; and Munnell, Aubry, and Hurwitz 2013). Additionally, expenditures are unlikely to grow at historical rates in perpetuity because the baby boom generation will complete its transition to retirement and be followed by cohorts with less generous benefit packages. Most importantly, plan sponsors could shore up troubled pension systems by infusing their trust funds with new revenue, as a few have begun to do.[32] Nevertheless, the projection is sufficient for the short run to identify financially precarious plans. For example, in 2010, the Commission to Strengthen Chicago's Pension Funds similarly predicted that pension trust fund assets for the police would exhaust in 2022 and those for municipal workers would exhaust in 2026.[33]

Although the Illinois constitution grants strong pension rights to Chicago's public employees, it is possible that benefits will be cut if the municipal-worker and police plans revert to pay-as-you-go systems. According to the *Public Plans Database*, in 2016, the municipal workers' trust fund paid benefits equal to 53 percent of municipal payroll, while contributions from the city and pension members were each equal to only about 9 percent of payroll. Similarly, the police trust fund paid benefits equal to 62 percent of payroll, whereas total contributions equaled only 25 percent.

Chicago's pension plans all satisfy the federal Safe Harbor requirements. In 2017, the Chicago municipal-worker and police plans each offered two design options to new members. The first is a cash-balance plan in which around 20 percent of the employee's salary is deposited into an account that earns interest and is annuitized when the member reaches age 60 (50 for police).[34] The second is a defined benefit pension with an NRA of 65 (55 for police), an 8-year period for computing FAS, a 2.4 percent benefit multiplier (2.5 percent for police), a 10-year vesting period, and a noncompounding COLA capped at one-half of the Consumer Price Index (CPI) for All Urban Consumers. For newly hired municipal workers and police, both options currently provide benefits well above those required by law. Trust-fund exhaustion is a separate problem, unrelated to the level of benefits currently promised to new hires.[35]

This looming challenge has important implications for noncovered state and local workers and for federal policymakers. Underscoring the challenge is the uncertainty of how unfunded state and local benefit promises should be valued.[36] A similar problem arises with respect to Social Security, which also faces a financial shortfall. The 2019 *Trustees Report* estimates that the OASI trust fund will exhaust its assets in 2034. At that point, absent new legislation, OASI will become a pay-as-you-go program, with benefit payments supported entirely by payroll tax revenue. The *Trustees Report* projects that the payroll tax as currently legislated will be sufficient to fund about 80 percent of scheduled benefits in 2035, implying a sharp 20-percent reduction for current and future retirees. Hence, not only are state and local pension promises vulnerable to cuts, but benchmark Social Security benefits also entail risk.

## Conclusion

Section 218 of the Social Security Act allows state and local governments to extend Social Security coverage to their employees, and the Omnibus Budget Reconciliation Act of 1990 mandates Social Security coverage for state and local workers unless they participate in a sufficiently generous employer-sponsored retirement system. The requirements for generosity are elaborated in the IRS Employment Tax Regulations, pursuant to IRC Section 3121. Public plans must provide their members, on reaching their Social Security FRA, with a monthly benefit that matches the PIA that the member would have received had he or she been covered by Social Security. Alternatively, a public plan's benefit formula can simply match one of the Safe Harbor formulas established by the IRS's Revenue Procedure 91-40.

State and local plans adhere to the Safe Harbor guidelines, and the Safe Harbor–compliant plans provide Social Security–equivalent benefits at the member's FRA, but the federal standards ignore three key drivers of lifetime resources that often differ between public pensions and Social Security. On one hand, state and local plans often require very long vesting periods and are increasingly unlikely to grant full COLAs. On the other hand, public pensions frequently allow members to claim full benefits at a younger age than that required to claim full Social Security benefits. Incorporating these factors into a wealth-based measure of benefit generosity suggests that 43 percent of benefit formulas for noncovered workers fall short of Social Security equivalence for a significant minority of new hires. Specifically, the public plans fall short for members who stay in their noncovered position for more than a few years but less than a full career. These medium-tenure employees make up about one-third of the state and local government workforce.

Of equal concern is that a few state and local pensions are so poorly funded that their dedicated trust funds may be depleted within the next decade. Once these plans revert to pay-as-you-go status, sponsors and beneficiaries will enter a legal gray zone with an elevated likelihood of future benefit cuts and possible defaults.

How could policymakers ensure Social Security–equivalent protections for all state and local government employees? A practical first step might be to update the Safe Harbor defined benefit plan requirements with reasonable vesting periods and full COLAs. Policymakers could also revisit the contribution-rate requirements for defined contribution plans in light of current economic conditions, and develop new Safe Harbor requirements for the hybrid defined benefit/defined contribution plans that are becoming more prevalent in state and local government (IRS 2017).

Alternatively, legislators could obviate the need for federal generosity standards by enrolling all state and local government employees in Social Security. Mandatory coverage is already a common feature of proposals to improve Social Security's financial position (Bipartisan Commission on Entitlement and Tax Reform 1994; Diamond and Orszag 2005; Domenici and Rivlin 2012; Gale, Holmes, and John 2015; GAO 2005; National Commission on Fiscal Responsibility and Reform 2010; Munnell 2000; Warshawsky 2016). It would also provide noncovered state and local government employees with important ancillary benefits that they may currently lack, such as spousal and survivor benefits and disability protection (Nuschler, Shelton, and Topoleski 2011; Munnell, Aubry, and Belbase 2014).[37]

However, mandatory Social Security coverage of all future earnings will not protect currently noncovered state and local retirees whose pensions are poorly funded. Of course, Social Security also faces financial challenges, with the 2019 *Trustees Report* predicting exhaustion of the OASI trust fund in 2034. Should the program revert to a pure pay-as-you-go system, the payroll-tax contribution rate as currently legislated is projected to be sufficient to fund about 80 percent of scheduled benefits initially, before declining to 75 percent in the long run. Given the uncertainty over future benefit levels, it is not obvious how public pension benefits should be valued relative to an underfunded Social Security program. We leave that question to future research.

## *Appendix A: Retirement Systems Reviewed for This Analysis*

**Table A-1.**
**State and local government pension systems included in the analysis sample**

| State or local retirement system | Source of data on Social Security coverage of plan members |
|---|---|
| California | |
| Public Employees' Retirement Fund [a] | NASRA survey |
| Teachers' Retirement Fund | Authors' survey |
| University of California Retirement Plan [a] | 2016 actuarial valuation report |
| Colorado | |
| Fire and Police Pension Association | Authors' survey |
| Public Employees' Retirement Association— | |
| Local Government Division | NASRA survey |
| Police and Fire Division | NASRA survey |
| School Division | NASRA survey |
| State Division | NASRA survey |
| Connecticut | |
| Municipal Employees' Retirement System [a] | 2016 actuarial valuation report |
| Teachers' Retirement System | NASRA survey |
| Georgia | |
| Public School Employees' Retirement System [a] | Authors' survey |
| Teachers' Retirement System [a] | NASRA survey |
| Illinois | |
| City of Chicago— | |
| Firemen's Annuity and Benefit Fund | Baker (2013); Hicken (2014); other blogs/articles |
| Municipal Employees' Annuity and Benefit Fund | Baker (2013); Hicken (2014); other blogs/articles |
| Policemen's Annuity and Benefit Fund | Baker (2013); Hicken (2014); other blogs/articles |
| Public School Teachers' Pension and Retirement Fund | Chicago Teachers' Union website |
| State Employees' Retirement System [a] | 2016 actuarial valuation report |
| State Universities Retirement System | NASRA survey |
| Teachers' Retirement System | NASRA survey |
| Kentucky | |
| Teachers' Retirement System | NASRA survey |
| Louisiana | |
| Parochial Employees' Retirement System [a] | Authors' survey |
| State Employees' Retirement System | NASRA survey |
| Teachers' Retirement System | NASRA survey |
| Massachusetts | |
| Barnstable County Retirement Association | Authors' survey |
| Boston Retirement Board | Authors' survey |
| Cambridge Retirement System | Authors' survey |
| Middlesex Regional Retirement Board | Authors' survey |
| Plymouth County Retirement Board | Authors' survey |
| State Employees' Retirement System | Authors' survey |
| Teachers' Retirement System | Authors' survey |
| Worcester Regional Retirement Board | Authors' survey |
| Missouri | |
| Public Schools' Retirement System | 2016 actuarial valuation report |
| Nevada | |
| Public Employees' Retirement System | NASRA survey |

(Continued)

**Table A-1.**
**State and local government pension systems included in the analysis sample—*Continued***

| State or local retirement system | Source of data on Social Security coverage of plan members |
|---|---|
| Ohio | |
| Police and Fire Pension Fund | NASRA survey |
| Public Employees' Retirement System | NASRA survey |
| Teachers' Retirement System | NASRA survey |
| Texas | |
| Municipal Retirement System [a] | NASRA survey |
| Teachers' Retirement System | Texas Classroom Teachers Association website |

SOURCE: Authors' research.

NOTE: Except as noted, less than 10 percent of plan members are also covered by Social Security.

a. Between 10 percent and 89 percent of plan members are also covered by Social Security.

**Table A-2.**
**State and local government pension systems studied but omitted from the analysis sample**

| State or local retirement system | Reason omitted |
|---|---|
| Colorado | |
| Denver Employees' Retirement Plan | ≥90% of plan members also covered by Social Security |
| Connecticut | |
| State Employees' Retirement System | No data on Social Security coverage available |
| Georgia | |
| Employees' Retirement System | ≥90% of plan members also covered by Social Security |
| Municipal Employees' Benefit System | No data on Social Security coverage available |
| Peace Officers' Annuity and Benefit Fund | No data on Social Security coverage available |
| Illinois | |
| Municipal Retirement Fund | ≥90% of plan members also covered by Social Security |
| Kentucky | |
| County Employees Retirement System | ≥90% of plan members also covered by Social Security |
| Employees' Retirement System | ≥90% of plan members also covered by Social Security |
| Louisiana | |
| Municipal Police Employees' Retirement System | No data on Social Security coverage available |
| Missouri | |
| County Employees' Retirement System | No data on Social Security coverage available |
| Local Government Retirement System | ≥90% of plan members also covered by Social Security |
| Public Education Employee's Retirement System | ≥90% of plan members also covered by Social Security |
| State Employees' Retirement System | ≥90% of plan members also covered by Social Security |
| New Jersey | |
| Police and Firemen's Retirement System | ≥90% of plan members also covered by Social Security |
| Public Employees' Retirement System | ≥90% of plan members also covered by Social Security |
| Teachers' Retirement System | ≥90% of plan members also covered by Social Security |
| Texas | |
| County and District Retirement System | ≥90% of plan members also covered by Social Security |
| Employees' Retirement System | ≥90% of plan members also covered by Social Security |

SOURCE: Authors' research.

**Table A-3.**
**Estimated percentage of state and local government employees who are represented by retirement systems whose administrators provided valid responses**

| State | Among active defined benefit plan members | Among all full-time equivalent employees |
|---|---|---|
| California | 79 | 79 |
| Colorado | 91 | 75 |
| Connecticut | 41 | 33 |
| Georgia | 77 | 61 |
| Illinois | 90 | 85 |
| Kentucky | 99 | 84 |
| Louisiana | 70 | 54 |
| Massachusetts | 100 | 94 |
| Missouri | 72 | 66 |
| Nevada | 100 | 93 |
| Ohio | 79 | 89 |
| Texas | 91 | 83 |

SOURCES: Authors' and NASRA surveys of public plan administrators; Census Bureau Annual Survey of Public Employment & Payroll; and various plan documents, websites, and news articles.

NOTE: Many part-time, seasonal, and temporary state and local government employees do not participate in an employer-provided retirement system.

## *Appendix B: Methodology for Calculating State and Local Retirement Benefits and Social Security Old-Age Benefits*

Our calculations follow the sequence described below.

### *Calculating State and Local Defined Benefit Pension Benefits*

We begin by projecting the worker's nominal earnings from labor-market entry to labor-market exit:

$$Salary_{current\ age} = Salary_{age\ entering\ noncovered\ job} \times (1 + wage\ growth)^{current\ age - age\ entering\ noncovered\ job} \tag{1}$$

Next, we calculate the FAS depending on the age at which the worker leaves the noncovered job:

$$FAS_{current\ age} = \frac{\sum_{y=current\ age-FAS\ period}^{current\ age} Salary_y}{FAS\ period} \tag{2}$$

The nominal pension benefit equation is simply:

$$Benefit_{current\ age} = Benefit\ multiplier \times FAS_{current\ age} \times Tenure\ in\ noncovered\ job_{current\ age} \tag{3}$$

### *Calculating State and Local Defined Contribution Wealth*

The defined contribution account balance is calculated using the worker's salary history and the assumed return on plan assets. Contributions are assumed to take place at the end of each year, with interest credited at the beginning of the next year:

$$Balance_{current\ age} = Balance_{end\ of\ prior\ year} \times (1 + investment\ return) + (0.075 \times Salary_{current\ age}) \tag{4}$$

The account balance continues to earn interest after the worker separates from the noncovered state or local job. The account earns interest until the worker's Social Security FRA:

$$Balance_{FRA} = Balance_{current\ age} \times (1 + investment\ return)^{FRA - current\ age} \tag{5}$$

### *Calculating Social Security Benefits According to IRC Section 3121*

The first step in this calculation is to alter the worker's earnings history by entering zero covered earnings for the years when the worker was *not* employed in the noncovered state or local job, regardless of actual earnings in those years.

The next step is to cap the altered earnings at the Social Security taxable maximum ("tax max") in any year when it may apply. To do this, the tax max in future years must be projected according to a legislated formula (rounded to the nearest multiple of 300). The tax max formula depends on the Social Security AWI, which must also be projected:

$$Tax\ max_{current\ age} = \frac{60{,}600 \times AWI_{current\ age-2}}{AWI_{year\ 1992}} \tag{6}$$

where

$$AWI_{current\ age} = AWI_{current\ age-1} \times (1 + CPI + Real\ wage\ differential) \tag{7}$$

and

$$Capped\ salary_{current\ age} = min\{Salary_{current\ age},\ Tax\ max_{current\ age}\} \tag{8}$$

The third step in the calculation is to index the capped earnings history to reflect the growth in the AWI:

$$Index\ factor_{current\ age} = \begin{cases} \dfrac{AWI_{age\ 60}}{AWI_{current\ age}} & if\ current\ age < 61 \\ 1 & if\ current\ age \geq 61 \end{cases} \tag{9}$$

$$Indexed\ salary_{current\ age} = Capped\ salary_{current\ age} \times Index\ factor_{current\ age} \tag{10}$$

Using the indexed earnings history, we calculate the AIME:

$$AIME_{current\ age} = \frac{\sum Highest\ 35\ indexed\ annual\ earnings\ amounts}{35 \times 12} \tag{11}$$

Then we obtain the worker's PIA by applying the formula:

$$\begin{aligned} PIA_{age\ 62} = & \left(0.9 \times AIME\ up\ to\ the\ first\ bend\ point\right) \\ & + \left(0.32 \times AIME\ between\ the\ first\ and\ second\ bend\ points\right) \\ & + \left(0.15 \times AIME\ above\ second\ bend\ point\right) \end{aligned} \tag{12}$$

SSA revises the bend points each year based on the AWI. The PIA formula uses the bend points in the year when the worker reaches age 62. SSA uses the following formulas to calculate bend points:

$$First\ bend\ point = \frac{180}{9{,}779.44} \times AWI_{age\ 60} \tag{13}$$

$$Second\ bend\ point = \frac{1{,}085}{9{,}779.44} \times AWI_{age\ 60} \tag{14}$$

Lastly, the PIA is adjusted to keep pace with inflation in the years after the worker reaches age 62 until he or she reaches FRA:

$$PIA_{age\ FRA} = PIA_{age\ 62} \times \left(1 + CPI\right)^{age\ FRA - age\ 62} \tag{15}$$

### *Calculating WEP-Adjusted Social Security Benefits from Private-Sector or Covered Public-Sector Employment*

To simulate a more realistic Social Security benefit for the noncovered worker, this phase of the analysis alters the worker's earnings history (equation 1) by entering the positive earnings amounts for the years when the worker was not employed in the noncovered position, and zero earnings for the years when the worker was employed in the noncovered position. The procedure then follows equations (6) through (15) to calculate the worker's PIA.

The next step is to apply the WEP to the PIA. The WEP adjusts the multipliers in the PIA formula (equation 12) based on the number of years with "substantial earnings." A year of earnings is substantial if the worker's salary exceeds one-quarter of what is called the Old Law Contribution and Benefits Base (that is, what the tax max would have been if the 1977 Social Security Amendments had not been enacted). The Old Law Contribution and Benefits Base is determined by a legislated formula (rounded to the nearest multiple of 300):

$$Substantial\,threshold_{current\ age} = \frac{45{,}000 \times AWI_{current\ age-2}}{22{,}935.42} \times 0.25 \tag{16}$$

Table B-1 shows the WEP multiplier that applies to the PIA formula for each number of years with substantial earnings.

**Table B-1.**
**PIA formula multipliers required under the WEP, by number of years with substantial covered earnings**

| Years | Multiplier |
|---|---|
| 30 or more | 0.90 |
| 29 | 0.85 |
| 28 | 0.80 |
| 27 | 0.75 |
| 26 | 0.70 |
| 25 | 0.65 |
| 24 | 0.60 |
| 23 | 0.55 |
| 22 | 0.50 |
| 21 | 0.45 |
| 20 or fewer | 0.40 |

SOURCE: SSA.

Then, the penultimate step in the calculation applies the WEP-adjusted PIA formula to the AIME as described in equation (12). The amount by which the WEP reduces the PIA is capped at one-half of the monthly public pension benefit that the worker receives at FRA:

$$PIA_{age\ 62} = \max\left\{PIA_{WEP}, PIA_{unadjusted} - \frac{monthly\ pension\ benefit}{2}\right\} \tag{17}$$

Finally, as with equation 15, the worker's PIA is adjusted for cost-of-living increases until his or her Social Security FRA:

$$PIA_{age\ FRA} = PIA_{age\ 62} \times \left(1 + CPI\right)^{age\ FRA-62} \tag{18}$$

### *Transforming Annual Benefits into Lifetime Wealth*

We calculate the present discounted value of future benefits from Social Security or a public pension by multiplying the annual benefit by a factor that accounts for cost-of-living increases, the cumulative probability of survival, and the discount rate:

$$Wealth_{age\ FRA} = Benefit_{age\ FRA} \times \sum_{age=FRA}^{120} \frac{\Pr\left(alive\right)_{age} \times \left(1+CPI\right)^{age-FRA}}{\left(1+discount\,rate\right)^{age-FRA}} \tag{19}$$

## *Appendix C: Economic and Demographic Assumptions About the Hypothetical Worker; and Additional Results*

**Table C-1.**
**Economic and demographic assumptions used for benefit comparisons in Charts 2–4**

| Parameter | Chart 2 | Chart 3 | Chart 4 |
|---|---|---|---|
| Defined benefit plans for noncovered workers | | | |
| Vesting period | Immediate | Immediate | . . . |
| FAS calculation period (years) | 3 | 3 | . . . |
| Benefit factor (multiplier) | 1.5 | 1.5 | . . . |
| Claiming age | 65 | 65 | . . . |
| COLA | None | None | . . . |
| Defined contribution plans for noncovered workers | | | |
| Vesting period | . . . | . . . | Immediate |
| Total contribution rate (%) | . . . | . . . | 7.5 |
| Nominal return on assets (%) | . . . | . . . | 5.3 |
| Claiming age | . . . | . . . | 67 |
| Social Security | | | |
| Credited earnings are from— | Noncovered employment | Covered employment | Covered employment |
| Nominal AWI growth (%) | 3.8 | 3.8 | 3.8 |
| Inflation (%) | 2.6 | 2.6 | 2.6 |
| Claiming age | 67 | 67 | 67 |
| WEP adjustment | No | Yes | Yes |
| Worker demographics | | | |
| Age at labor force entry | 25 | 25 | 25 |
| Age at start of noncovered employment | 35 | 35 | 35 |
| Starting annual salary in noncovered job ($) | 50,000 | 50,000 | 50,000 |
| Nominal wage growth (%) | 3.8 | 3.8 | 3.8 |
| Age at retirement | 65 | 65 | 65 |

SOURCES: Authors' research based on intermediate assumptions of the 2018 *Trustees Report,* Munnell and others (2012), and plan actuarial valuation reports.

NOTE: . . . = not applicable.

**Table C-2.**
**Nominal benefits received at age 67 by the hypothetical worker in Charts 2 and 3, by years in noncovered employment**

| Years | Chart 2 | | Chart 3 | | | |
|---|---|---|---|---|---|---|
| | | | Combined-benefit component | | | |
| | Safe Harbor–compliant pension | Social Security PIA | Safe Harbor–compliant pension | Social Security PIA | Total combined benefit | Counterfactual Social Security benchmark |
| 1 | 789.51 | 0.00 | 789.51 | 73,865.29 | 74,654.79 | 73,865.29 |
| 2 | 1,609.02 | 0.00 | 1,609.02 | 73,865.29 | 75,474.30 | 73,865.29 |
| 3 | 2,459.66 | 0.00 | 2,459.66 | 73,865.29 | 76,324.95 | 73,865.29 |
| 4 | 3,404.18 | 0.00 | 3,404.18 | 73,865.29 | 77,269.46 | 73,865.29 |
| 5 | 4,416.92 | 0.00 | 4,416.92 | 73,865.29 | 78,282.21 | 73,865.29 |
| 6 | 5,501.71 | 0.00 | 5,501.71 | 72,544.84 | 78,046.55 | 73,865.29 |
| 7 | 6,662.58 | 0.00 | 6,662.58 | 71,224.38 | 77,886.96 | 73,865.29 |
| 8 | 7,903.72 | 0.00 | 7,903.72 | 69,903.93 | 77,807.65 | 73,865.29 |
| 9 | 9,229.57 | 0.00 | 9,229.57 | 68,583.48 | 77,813.05 | 73,865.29 |
| 10 | 10,644.77 | 37,137.71 | 10,644.77 | 67,263.03 | 77,907.79 | 73,865.29 |
| 11 | 12,154.19 | 40,851.48 | 12,154.19 | 63,603.93 | 75,758.13 | 73,865.29 |
| 12 | 13,762.97 | 42,973.69 | 13,762.97 | 59,944.84 | 73,707.80 | 73,865.29 |
| 13 | 15,476.46 | 44,294.14 | 15,476.46 | 56,285.74 | 71,762.20 | 73,865.29 |
| 14 | 17,300.30 | 45,614.59 | 17,300.30 | 52,626.65 | 69,926.94 | 73,865.29 |
| 15 | 19,240.40 | 46,935.05 | 19,240.40 | 49,723.19 | 68,963.60 | 73,865.29 |
| 16 | 21,302.98 | 48,255.50 | 21,302.98 | 47,230.23 | 68,533.21 | 73,865.29 |
| 17 | 23,494.52 | 49,575.95 | 23,494.52 | 44,663.96 | 68,158.48 | 73,865.29 |
| 18 | 25,821.86 | 50,896.40 | 25,821.86 | 42,020.49 | 67,842.34 | 73,865.29 |
| 19 | 28,292.15 | 52,216.85 | 28,292.15 | 39,295.75 | 67,587.90 | 73,865.29 |
| 20 | 30,912.90 | 53,537.30 | 30,912.90 | 36,485.49 | 67,398.38 | 73,865.29 |
| 21 | 33,691.96 | 54,857.76 | 33,691.96 | 33,585.22 | 67,277.18 | 73,865.29 |
| 22 | 36,637.61 | 56,178.21 | 36,637.61 | 30,590.26 | 67,227.87 | 73,865.29 |
| 23 | 39,758.46 | 57,498.66 | 39,758.46 | 27,495.70 | 67,254.16 | 73,865.29 |
| 24 | 43,063.60 | 58,819.11 | 43,063.60 | 25,390.26 | 68,453.87 | 73,865.29 |
| 25 | 46,562.52 | 60,139.56 | 46,562.52 | 24,069.81 | 70,632.33 | 73,865.29 |
| 26 | 50,265.17 | 61,460.02 | 50,265.17 | 22,749.36 | 73,014.53 | 73,865.29 |
| 27 | 54,181.99 | 62,830.64 | 54,181.99 | 21,378.73 | 75,560.72 | 73,865.29 |
| 28 | 58,323.90 | 64,253.36 | 58,323.90 | 19,956.02 | 78,279.92 | 73,865.29 |
| 29 | 62,702.36 | 65,730.13 | 62,702.36 | 18,421.77 | 81,124.12 | 73,865.29 |
| 30 | 67,329.36 | 67,263.03 | 67,329.36 | 16,505.65 | 83,835.01 | 73,865.29 |

SOURCE: Authors' calculations.

NOTES: The hypothetical worker is assumed to enter the labor market in the private sector in 2018 at age 25, enter noncovered government employment at age 35 with a starting salary of $50,000 and experience 3.8 percent nominal annual wage growth until retiring at age 65.

Appendix Table C-1 summarizes the underlying economic and demographic assumptions.

**Table C-3.**
**Economic and demographic assumptions used for benefit comparisons in Charts 5–10**

| Parameter | Charts 5–7 | Chart 8 | Chart 9 | Chart 10 |
|---|---|---|---|---|
| Defined benefit plans for noncovered workers | | | | |
| Vesting period | a | a | a | a |
| FAS calculation period (years) | a | a | a | a |
| Benefit factor (multiplier) | a | a | a | a |
| Claiming age | [a] NRA | [a] NRA | [a] NRA | [a] NRA |
| COLA | a | a | a | a |
| Social Security | | | | |
| Credited earnings | b | b | b | b |
| Nominal AWI growth (%) | 3.8 | 3.8 | 3.8 | 3.8 |
| Inflation (%) | 2.6 | 2.6 | 2.6 | 2.6 |
| Claiming age | [c] 67 | [c] 67 | [c] 67 | [c] 67 |
| WEP adjustment | d | d | d | d |
| Worker demographics | | | | |
| Year of labor force entry | 2018 | 2018 | 2018 | 2018 |
| Age at labor force entry | 25 | 25 | 25 | 25 |
| Age at start of noncovered employment | 35 | 35 | 25 and 35 | 35 |
| Starting annual salary in noncovered job ($) | 50,000 | 50,000 | 50,000 | [e] 40,000 and 60,000 |
| Nominal wage growth (%) | 3.8 | 3.8 | 3.8 | [e] 3.3 and 4.3 |
| Discount rate (%) | 5.3 | 5.3 | 5.3 | 5.3 |
| Age at retirement | 65 | 65 | 65 | 65 |
| Years in noncovered employment | 12 | 5 and 12 | 12 | 12 |

SOURCES: Authors' research based on intermediate assumptions of the 2018 *Trustees Report,* Munnell and others (2012), and plan actuarial valuation reports.

NOTE: Cells containing two values indicate the variable(s) that the given chart compares.

a. Varies from plan to plan.

b. In the numerator of the counterfactual wealth ratio equation, lifetime earnings in covered employment are credited; in the denominator, total lifetime earnings from covered and noncovered employment are credited.

c. FRA for the hypothetical worker (born 1993).

d. Adjustment is applied to covered Social Security wealth (in the numerator of the counterfactual wealth ratio equation) but not to the counterfactual Social Security wealth calculation (the denominator of that equation).

e. The "low earner" is assumed to have a $40,000 starting salary and 3.3 percent wage growth; the "high earner" is assumed to have a $60,000 starting salary and 4.3 percent wage growth.

## *Notes*

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[1] This article refers to various recent editions of the *Trustees Report.* Current and previous *Trustees Reports* are available at https://www.ssa.gov/OACT/TR/index.html.

[2] A single government may employ both covered and noncovered workers. Early amendments prohibited many states from enrolling police officers and firefighters, but other employee groups could elect Social Security coverage with a referendum by secret ballot. In 1983, existing and future Section 218 agreements were made irrevocable. Most state and local government employees are covered by Medicare, which became mandatory for new hires in 1986. All states were allowed to enroll police and firefighters beginning in 1994. For detailed information about Section 218 agreements, see https://www.ssa.gov/slge/sect_218_agree.htm.

[3] Further, the regulators focused on old-age benefits for the primary earner, without requiring public pensions to provide spousal, survivor, or disability benefits comparable to Social Security's.

[4] For a detailed introduction to Revenue Procedure 91-40, see https://www.ssa.gov/slge/revenue_procedure_91-40.htm. The formula approach was adopted because the administrative burden of confirming benefit levels for every plan member individually would have been excessive.

[5] Note the distinction between the Social Security FRA and the varying NRAs set by individual state and local government retirement plans.

[6] Many traditional defined benefit pensions calculate benefits with the formula of FAS times the benefit multiplier times years of tenure.

[7] In Appendix A, Table A-1 lists the 38 retirement systems in our final sample and Table A-2 lists the other 18 systems covered by either our survey or the NASRA survey. We found that large state-administered retirement systems are more likely to share information with researchers. Teachers and other state employees typically participate in the large retirement systems administered by their states, whereas local employees—especially police and firefighters—often participate in small, locally administered retirement systems, which are less likely to appear in the final sample. Table A-3 presents the estimated shares of all state and local pension plan participants in each state who are included in our sample. With a few exceptions, we were able to gather information for sizable majorities of state and local defined benefit plan members.

[8] Kan and Aldeman (2014) likewise found that teachers are least likely to be covered.

[9] The longer the period, the lower the FAS.

[10] The WEP reduces the PIA of workers who receive both Social Security benefits and pensions based on their noncovered employment. The WEP aims to counteract the progressivity of the PIA formula for noncovered workers whose AIMEs would understate their full lifetime earnings. See Brown and Weisbenner (2013) for a detailed discussion of the WEP.

[11] This methodology for comparing a Safe Harbor–compliant formula with Social Security is described in IRC Section 3121.

[12] Appendix B presents the calculation methodologies, including the details of these formulas.

[13] The starting salary is consistent with membership data published in pension plan actuarial valuation reports, if projected to 2028. The wage growth assumption is the long-run intermediate assumption of the 2018 *Trustees Report.* Public pension actuaries typically assume nominal annual wage growth between 5 percent and 10 percent during the first 10–15 years of public employment, decreasing to around 4 percent after 20 years. Because that earnings profile is very steep relative to private-sector profiles estimated by the Federal Reserve Bank of Atlanta's *Wage Growth Tracker,* this study adopts wage-growth assumptions consistent with those of the SSA actuaries, which reflect private-sector employment.

[14] This distribution of tenure accounts for workers who switch jobs while remaining in the same retirement system (for example, a teacher who moves to a different school district within the state). It underestimates tenure for workers who move to a public-sector job covered by a different retirement system but are able to transfer their tenure credits to the new system. Although some locally administered pension plans have tenure reciprocity agreements with state-administered plans in the same state, cross-state reciprocity agreements are relatively rare.

[15] In Appendix C, Table C-1 summarizes the underlying economic and demographic assumptions and Table C-2 presents the year-by-year estimated benefits.

[16] Appendix B describes the calculation methodology and Appendix Table C-1 presents the underlying economic and demographic assumptions.

[17] Appendix Table C-2 presents the year-by-year estimated benefits plotted in Chart 3.

[18] This return assumption equals the assumed long-run real Treasury yield from the 2018 *Trustees Report* plus inflation.

[19] The present-value calculations employ a 50-50 male-female split of the cohort mortality tables developed for the

2017 *Trustees Report.* The cohort tables were obtained on request from the SSA's Office of the Chief Actuary. Appendix B describes the present-value formulas.

[20] Appendix Table C-1 presents the underlying economic and demographic assumptions.

[21] Vesting periods in plans for noncovered state and local government workers are long relative to those of private-sector defined contribution plans. The Pension Protection Act of 2006 requires that private-sector employer contributions to defined contribution plans vest after a 3-year cliff or on a 6-year graded schedule. Consequently, around 50 percent of the plans managed by the Vanguard Group investment advisors have vesting periods no longer than 3 years (Vanguard 2018). Like private-sector defined contribution plans, most public-sector defined benefit plans require employees to contribute to prefund benefits. These contributory plans frequently allow nonvested members who separate from the government to withdraw their employee contributions, which have earned a low rate of interest. Consistent with Kan and Aldeman (2014), this analysis does not treat withdrawn contributions as retirement benefits.

[22] The distribution of vesting periods is bimodal, with peaks at 5 years and 10 years. Consequently, small changes in the sample of benefit formulas can produce large shifts in the median vesting period. Although plans do not frequently change their vesting periods, the three plans covering teachers and university faculty in Illinois extended their vesting periods from 5 years to 10 years following the 2008 financial crisis.

[23] Appendix Table C-3 presents the economic and demographic assumptions used to calculate counterfactual wealth ratios for the hypothetical worker.

[24] We assume that the worker claims pension benefits at his or her NRA because incorporating early retirement provisions would require peak wealth calculations (see Coile and Gruber 2007).

[25] The worker is assumed to live until at least age 25, and then have a positive probability of dying in each subsequent year. This mortality assumption rewards state and local plans with early NRAs. The discount rate is the long-run nominal interest rate from the 2018 *Trustees Report.*

[26] Relatively few nonvested workers have more than 5 years of tenure. Munnell and others (2012) show that only 16 percent of newly hired state and local government employees stay in their jobs for 6 to 10 years. Moreover, studies have shown that public employees adjust their separation patterns in order to vest in their pensions (Quinby 2020 reviews the literature).

[27] The difference in wage growth is designed to simulate a college-educated worker and a high-school educated worker, based on the Federal Reserve Bank of Atlanta's *Wage Growth Tracker.*

[28] Financial economists frequently contend that the funded ratios reported by plan sponsors overstate plan health because the rates used to discount future liabilities are artificially high (Brown and Wilcox 2009; Novy-Marx and Rauh 2009). Whereas public plans currently discount liabilities by the assumed return on assets in the trust fund (around 8 percent historically), financial economists recommend discounting liabilities using a rate that reflects the risk of default on the pension debt.

[29] The estimation methodology is similar to those in Rauh (2010) and Munnell and others (2011).

[30] The 5.3-percent return assumption is consistent with the 2018 *Trustees Report.*

[31] The six plans are the Chicago Public School Teachers' Pension and Retirement Fund, the Illinois State Employees' and State Universities Retirement Systems, the Kentucky Teachers' Retirement System, the Louisiana State Employees' Retirement System, and the Ohio Teachers' Retirement System.

[32] For example, the city of Chicago revised its funding policy in 2016 and 2017 (Public Acts 99-0506 and 100-0023, respectively) to raise the funding levels for police and municipal worker pensions to 90 percent by 2058.

[33] The analysis assumed an 8 percent annual return on assets (Commission to Strengthen Chicago's Pension Funds 2010).

[34] The interest rate is not disclosed in the actuarial valuation reports or other publications for members. The contribution rate varies over time, depending on the statutory employer contribution rate.

[35] In general, the exhaustion dates estimated in this analysis are positively correlated with counterfactual wealth ratios—suggesting that plans with robust finances also offer more generous benefits—but the association is very weak (a correlation coefficient of 0.08).

[36] Warshawsky and Marchand (2016) suggest a methodology for valuing underfunded pensions.

[37] Unlike Social Security, state and local government plans do not permit households to receive a separate spousal benefit based on the government employee's work history. Survivor benefits are also typically less generous in nonfederal government plans because they require retirees to purchase a joint-survivor annuity at the cost of reduced monthly income. Most government pensions offer disability insurance, but we are not aware of research establishing whether these benefits are comparable with those from Social Security.

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# Retirement Implications of a Low Wage Growth, Low Real Interest Rate Economy

by Jason Scott, John B. Shoven, Sita Nataraj Slavov, and John G. Watson*

*We use a lifecycle model to examine the implications of persistent low real interest rates and low wage growth for individuals nearing retirement. We find that low returns and low wage growth affect welfare substantially, often producing large compensating variations. Low economywide wage growth has a much larger welfare effect than low individual wage growth, largely because the Social Security benefit formula is progressive and incorporates wage indexing. Low economywide wage growth undercuts the effects of wage indexation as average wages fall along with individual wages. Low returns raise the optimal Social Security claiming age and the marginal benefit of working longer, while low wage growth decreases the marginal benefit of working longer. Low returns also increase the relative price of consumption during retirement, suggesting that individuals may wish to reduce future consumption relative to current consumption. We also compare these results with standard financial planning advice.*

## Introduction

Real interest rates (net of inflation) have remained persistently low for the last decade. Yields on 10- and 20-year Treasury Inflation Protected Securities have averaged less than 1 percent since the start of 2010 (Department of the Treasury 2020). The macroeconomics literature has attempted to explain this phenomenon by arguing that the natural rate of interest (also known as r-star)—the real, safe short-term interest rate that is neither expansionary nor contractionary—has declined considerably since 2000 and has been close to zero since 2008 (Laubach and Williams 2003, 2015). A related concept is the growth rate of potential output. Macroeconomic models that estimate r-star also suggest that the growth rate of potential output has fallen over the last 10 years. Persistently low economic growth translates into persistently low real wage growth.[1]

These macroeconomic shifts have important implications for retirement planning and security. Two key aspects of any retirement plan are future rates of return on retirement assets and future wage growth rates. In this article, we use a lifecycle model to simulate the effects of low real interest rates and economywide real wage growth on the retirement planning and well-being of individuals in their 50s today. We find that low real interest rates increase the Social Security claiming ages that maximize utility. Low economic growth (characterized by both low interest rates and low real wage growth) depresses optimal saving rates close to retirement and reduces consumption in retirement.[2] For any given retirement age, low economic

**Selected Abbreviations**

| | |
|---|---|
| AIME | average indexed monthly earnings |
| AWI | average wage index |
| FRA | full retirement age |
| PIA | primary insurance amount |
| WWI | worker's wage index |

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growth also increases the marginal benefit of working an additional year, suggesting that working longer is part of an optimal response to the current macroeconomic environment.[3]

We further demonstrate that the low economywide rate of wage growth has a much stronger adverse effect on retirement well-being than low individual wage growth. Social Security benefits are calculated by applying a progressive benefit formula to the highest 35 years of earnings indexed to economywide wage growth. Specifically, earnings prior to age 60 are indexed by dividing them by the economywide average wage during the year in which they were earned and then multiplying the result by the economywide average wage at age 60. (Earnings during and after the year in which the worker attains age 60 count at their nominal value.) If individual wage growth is lower than expected while economywide wage growth remains constant, the individual's projected earnings trajectory declines but the indexation of earnings does not change. The decline in wage growth affects only a portion of the worker's average indexed earnings (the portion occurring after wage growth slows), and the progressive benefit formula ensures that Social Security benefits are affected less than proportionately. On the other hand, if low individual wage growth reflects low economywide wage growth, the individual's position and the economywide average wage move in tandem and the progressive benefit formula provides no insurance benefit. Moreover, all years of the worker's wages are indexed to a lower benchmark, which exacerbates the effect of low personal wage growth on retirement income.

Economists often analyze retirement planning using a lifecycle model, a conceptual framework designed to capture the key elements of those planning decisions. A lifecycle model simulates an individual's or household's long-term experiences and assumptions, and the decisions about labor supply, saving, and consumption that are meant to maximize expected utility over the remaining lifetime. These plans can be updated in subsequent periods as new information becomes available. A standard property of lifecycle models is that individuals aim to smooth consumption over their lifetime—that is, to avoid sharp changes in their standard of living despite income fluctuations—accounting for the relative prices of current and future consumption, as determined by the interest rate. A large body of literature examines various insights revealed by the lifecycle model. One well-known finding is that a decrease in lifetime income, possibly arising through lower wage growth, reduces consumption in every future period (Friedman 1957; Modigliani 1966). Individuals smooth their consumption by reducing their standard of living, both in the present and after retirement. Another standard finding is that saving behavior is subject to two conflicting influences, an income effect and a substitution effect, when the rate of return on saving decreases. The income effect encourages lower consumption both immediately and in the future. Because current consumption falls and labor income is held constant, saving increases. The substitution effect works in the opposite direction, causing a reduction in saving because the return has declined; that is, individuals choose to consume more in the present and less in the future.[4] When individuals face liquidity constraints and uncertainty about income, they may use wealth as a buffer stock against future income fluctuations (Deaton 1991; Carroll 1997). Closely related to the themes of our research, Carroll (2009) finds that a reduction in wage growth lowers saving rates as individuals need a smaller buffer stock of wealth.

The extent to which the lifecycle model accurately describes retirement behavior has been debated in the literature, and numerous authors have added different features to the basic model in order to bridge the gap between theory and data.[5] For example, Shefrin and Thaler (1988) add behavioral features such as self-control, mental accounting, and framing. For this analysis, we use a standard lifecycle model with no behavioral features. Our model is at odds with some aspects of observed behavior; for example, it suggests that Social Security should be claimed at age 68, although most individuals claim at younger ages. One motivation for using a standard lifecycle model is that its predictions for the current economic environment lay the groundwork for further research into how and why actual behavior deviates from these predictions. Another motivation is that the principles of the lifecycle model are sometimes used prescriptively to provide advice about what individuals *could* do when faced with low returns. Although we take no position on whether individuals should behave according to findings of the lifecycle model, we note that financial planners often assume that individuals wish to smooth consumption (maintain a consistent standard of living) and respond rationally to changes in their economic environment. As discussed by Shefrin and Thaler (1988), the standard lifecycle model is appropriate for that purpose, although behavioral features may be needed to explain why actual behavior deviates from its predictions. Thus, a lifecycle model can help inform financial planning advice.

In this context, our work contributes to the discussion on the extent to which standard financial planning advice is or should be consistent with the lifecycle model.[6] Financial planning often relies on a target replacement rate; that is, the share of preretirement income that needs to be replaced during retirement to meet the goal of maintaining one's standard of living in retirement. That goal is consistent with consumption smoothing, suggesting that a lifecycle model can help identify the appropriate target replacement rate. Indeed, Scholz and Seshadri (2009) derive optimal replacement rates and other financial planning guidelines from a lifecycle model. They show that the median optimal replacement rate is 68 percent of average household lifetime earnings, which is consistent with standard financial planning recommendations. However, individual optimal replacement rates vary greatly depending on income level, number of children, and other characteristics. Thus, standard rules of thumb for the target replacement rate—even if they are chosen because they are accurate for the median household—are not optimal for most households analyzed with a lifecycle model. Our results can similarly help inform financial planning guidelines. As we will discuss later, the results derived from our standard lifecycle model are at odds with common financial planning advice regarding the optimal response to low returns. In particular, our work suggests that replacement rate targets should be adjusted when interest rates or wage growth change.

Lifecycle models have been used to study a range of retirement behavior. For example, Haan and Prowse (2014) and Gustman and Steinmeier (2008, 2015) examine the effects of changes in Social Security or pension claiming rules on consumption and retirement behavior. In the study most closely related to this article, Horneff, Maurer, and Mitchell (2018) examine the effect of persistently low real asset returns on lifecycle consumption and retirement behavior. Their model is calibrated to the U.S. economy and shows that low real returns cause individuals to save less in tax-preferred accounts and more in taxable accounts; overall, saving declines. In addition, individuals claim Social Security benefits later. Bronshtein and others (2019) do not use a lifecycle model but show that working 3–6 months longer, and delaying Social Security over that period, has the same effect on retirement living standards as saving an extra 1 percent of earnings over 30 years. The closer one is to retirement, and the lower one's real asset returns, the greater the relative effect of working longer.

This article extends the work of Horneff, Maurer, and Mitchell (2018) by exploring the implications of low wage growth in conjunction with low interest rates. Low economywide wage growth has important implications for retirement income given its interaction with the Social Security benefit formula. For a retiree aged 62, for example, low economywide wage growth affects economic well-being more than low individual wage growth does—by roughly 65 percent. We consider the optimal strategies for individuals who are approaching retirement (aged 55) and estimate the welfare cost of low real interest rates and wage growth. Expanding on Bronshtein and others (2019), we formally show lifecycle model estimates indicating that the marginal benefit of additional work increases in a low-return environment. This effect is even larger when individuals follow the commonly observed behavior of claiming Social Security upon retirement (Shoven, Slavov, and Wise 2018) rather than at the optimal claiming age. Individuals who make retirement decisions by comparing the marginal benefit of deferring retirement to the marginal cost of effort are likely to work longer.

Our work is also related to the extensive literature examining the tradeoffs involved in choosing Social Security claiming dates and the effect of recent low real interest rates on those tradeoffs (for example, Meyer and Reichenstein 2010; Munnell and Soto 2005; Sass, Sun, and Webb 2007, 2013; Coile and others 2002; Mahaney and Carlson 2007; Shoven and Slavov 2014a, 2014b; and Kotlikoff, Moeller, and Solman 2015). Most of these works use straightforward expected present-value calculations rather than lifecycle models. Among the key findings of this literature is that delaying Social Security claiming, often to age 70, substantially increases the expected present value of benefits for sizable groups such as married primary earners. At historical interest rates, delay does not produce large gains for single men, workers with higher-than-average mortality, or married secondary earners. But when real interest rates are close to zero, some degree of delay becomes actuarially advantageous for most people. Our findings are consistent with this prior research and show that low interest rates indeed delay optimal claiming under a lifecycle framework with liquidity constraints (that is, with limits on the amount that can be borrowed).

This article is arranged in five sections, including this introduction. The second section describes our lifecycle model and its calibration. The third section discusses our results. The fourth section compares the recommendations of lifecycle model analysis in a low-growth scenario with standard financial planning advice. The fifth section concludes.

## Lifecycle Model

In the two subsections that follow, we describe the standard lifecycle model with which we examine the potential effects of low wage growth and low interest rates on the saving and consumption strategies of late-career workers. The first subsection addresses the model assumptions and the second describes its parameters and data sources. To supplement the description presented here, we provide the mathematical details of the model in Appendix A.

### Assumptions

In the model, we assume that individuals begin working at age 20 and work continuously until an exogenous retirement age. Within each period, individuals decide how much of their labor income to consume and how much to save, with the goal of maximizing the present value of lifetime utility. The utility function in each period exhibits constant relative risk aversion. We assume that individuals do not borrow, and that they invest any accumulated savings in actuarially fair annuities. Individuals face mortality risk in each period and can live to a maximum age of 110. They are eligible for Social Security, which can be claimed at any age between 62 and 70 (with the appropriate actuarial adjustment or delayed retirement credits applied).[7] However, we assume that the Social Security retirement earnings test effectively prevents those who are currently working from claiming before full retirement age (FRA).[8]

The individuals in our model are aged 54 in 2019. Under the baseline case, these individuals assume that future interest rates and wage growth will be in line with the average of past values for those variables (described in detail in the following subsection). Alternative scenarios involve a lower real interest rate and lower wage growth in the future. We determine the initial level of assets for the 54-year-old individuals we model by applying the same model to a 20-year-old individual and using a historical series of wages and interest rates (through 2018) combined with the baseline-case projections. As detailed in Appendix A, we assume that the 20-year-old perfectly predicts the historical wage and interest rate series and, like the 54-year-old, assumes that these variables will follow their baseline paths thereafter. (Even if foresight of the historical series is not literally perfect, this assumption provides a ballpark figure for initial assets at age 54.)

Social Security benefits are based on the average of the worker's highest 35 years of earnings, indexed for economywide wage growth though age 60 (with earnings at ages 60 and older indexed to 1.0; that is, counted at their nominal value.) This annual average, divided by 12 to convert to a monthly rate, is called average indexed monthly earnings (AIME). A progressive benefit formula is applied to AIME to obtain the primary insurance amount (PIA), or the monthly benefit payable at FRA (67 for an individual aged 54 in 2019). The progressive benefit formula has two thresholds, or "bend points," that are indexed to the economywide average wage. Individuals receive 90 percent of their AIME up to the first bend point ($895 in 2018), 32 percent of any AIME above the first bend point up to the second ($5,397 in 2018), and 15 percent of any additional AIME. The benefit formula uses the bend points for the year in which the individual turns 62. We allow earnings after claiming to affect the AIME (assuming they are among the highest 35 years). Social Security benefits are adjusted based on claiming age. Individuals born in 1960 or later who claim on reaching age 62 will receive 70 percent of their PIA, and that percentage increases with each month they delay claiming.[9] To simplify our calculations, however, we assume claims take place on birthdays, which allows for nine possible claiming ages (62 through 70).

Our model incorporates two important simplifying assumptions. The first is that the individual perceives no uncertainty in the baseline scenario and assumes deterministic paths for interest rates and wages. In other words, the individual does not anticipate the late-career shock to both series from the shift to a low-growth economy. A realistic model would incorporate uncertainty and period-to-period fluctuations in both series. However, modeling uncertainty about the key macroeconomic shifts we consider—in the real interest rate and long-term real wage growth—is challenging. Thus, we treat these shifts as one-off surprises: they are completely unanticipated, and once they happen, the individual expects them to be permanent. Because this simple deterministic model reflects a basic intuition about long-term shifts in interest rates and wage growth, it is likely to capture the view of the recent low-growth environment among many people who are approaching retirement today.[10]

Second, we assume that there is no labor supply decision or cost of effort. Rather, the individual is assumed to work full time until an exogenous retirement date. We can still estimate the effects of career length by examining the increase in economic well-being when the individual is able to work for another year. This quantity is the marginal benefit from extending working life and is necessarily positive in our model as we assume there is no cost of effort. In a model with endogenous labor supply, the individual would compare this quantity to the cost of effort in the additional year of work. Thus, examining how this quantity changes can provide some insight into the direction of adjustment if labor supply were endogenous.

### *Parameter Choices*

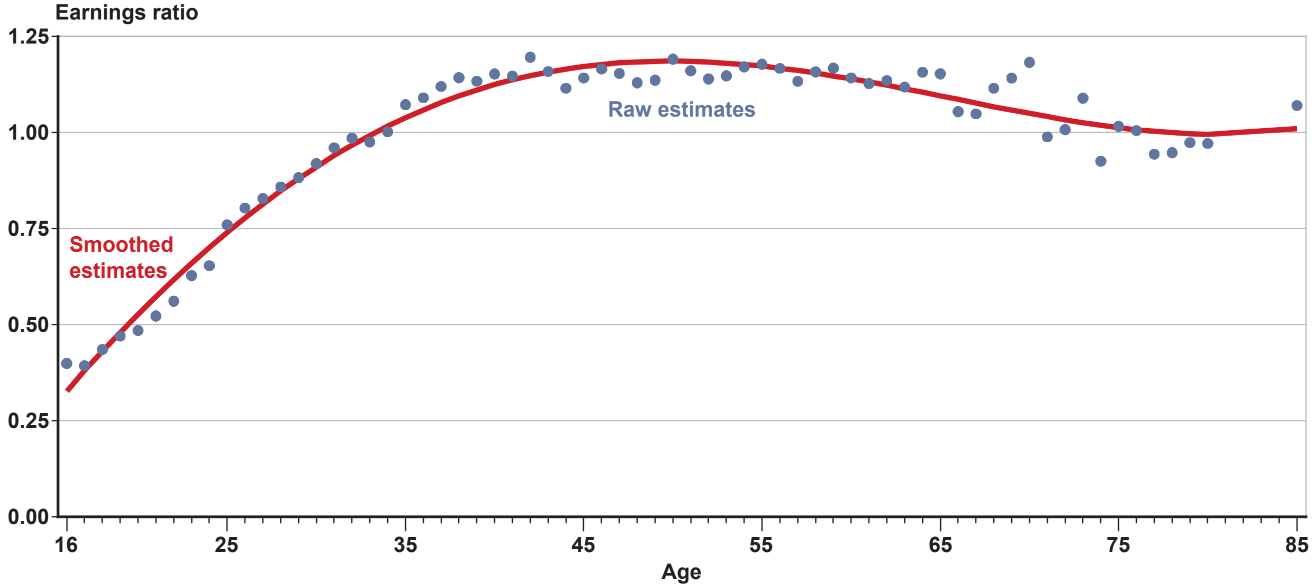
The model accounts for mortality rates using data from the cohort mortality tables underlying the intermediate assumptions in *The 2013 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds.* The *Trustees Report* mortality tables extend through age 120; however, because survival probabilities beyond age 110 are very small, we truncate the distribution at 110 by assuming a zero probability of survival to age 111. The model analyzes stylized single men in the 1965 birth cohort, who are therefore aged 54 in 2019 and have a Social Security FRA of 67.[11] The men are assumed to enter the labor force at age 20 and work full time until retirement. Our initial calculations assume a retirement age of 65 for the stylized worker. However, we also perform calculations for alternative retirement ages. We set the baseline real interest rate at 3 percent, the alternative (low) real interest rate at 1 percent, and the subjective discount rate for future utility at 3 percent.[12]

Social Security cost-of-living adjustments are based on the Bureau of Labor Statistics' Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W). We model inflation using this index. For 1985 (the year a worker reaches age 20) through 2018, we use the historical average monthly CPI-W values for the third quarter to calculate a year-over-year inflation rate (2.55 percent annual growth for workers born in 1965). From 2019 forward, the CPI-W is assumed to increase at a constant rate; that is, the forecasted inflation rate. For the baseline case, we assume forecasted inflation rises 2.5 percent annually, similar to the historical average for the 1965 cohort. All monetary amounts are expressed in 2018 dollars.

We construct an age-earnings profile based on the Center for Economic Policy Research's Uniform Current Population Survey (CPS) Extracts.[13] We use the 2016 Outgoing Rotation Groups file, which includes the subset of monthly CPS respondents who are asked detailed questions about hours and earnings. This file contains a consistent hourly wage variable (`rw_ot`), the construction of which is detailed in Schmitt (2003). We multiply this hourly wage variable by 2,000 (roughly the number of hours in a full-time working year) to impute full-time annual earnings for each worker. We divide each worker's full-time annual earnings by economywide full-time annual earnings (that is, the average value of this variable for all individuals in the dataset). We then calculate average relative annual earnings by age. Because this age-earnings profile is not smooth, particularly at older ages when the sample of workers is small, we smooth it by regressing age-specific average earnings on a fifth-order polynomial in age and using the predicted values for the estimation. This procedure gives us predicted full-time earnings at each age relative to economywide earnings. Chart 1 shows the relative age-earnings profile. It suggests that most age-related wage growth occurs early in the average worker's career. At older ages, real earnings growth occurs primarily via economywide wage growth.

A worker's nominal wages from 1985 through 2016 are modeled as the product of the age-earnings profile and the historical Social Security average wage index (AWI) for that year.[14] For 2017 and 2018, we estimate the AWI using the nominal annual growth rate that the worker experienced over his working life (3.5 percent for workers born in 1965). From 2019 through retirement, the worker's estimated wages are the product of the age-earnings profile and a quantity we refer to as the worker's wage index (WWI), which increases at a constant rate. Growth in the WWI represents growth in the worker's individual wage, holding age constant. Similarly, the AWI, which is used to compute AIME, is assumed to increase at a constant rate from 2019 forward. Note that the WWI and the AWI may differ. The AWI reflects all workers economywide, whereas the WWI reflects an individual worker. For the baseline case, we assume that AWI and WWI are equal and rise at 3.5 percent annually, in line with historical growth for the 1965 cohort. The various low wage-growth scenarios reduce one or both assumed growth rates to 2.5 percent, equal to the assumed value for long-term inflation, resulting in zero real wage growth.

**Chart 1.**
**Individual earnings relative to economywide average earnings, by age: Raw and regression-adjusted (smoothed) estimates for full-time workers in 2016**




SOURCE: Authors' calculations using Center for Economic Policy Research Uniform Current Population Survey Extracts.

## *Results*

In this section, we present our findings—first, in the context of comparing decisions arising from alternative economic conditions; then, with a focus on the relationships between individual and economywide wage growth.

### *Reevaluating Saving, Claiming, and Work Decisions*

Table 1 shows the optimal consumption paths assuming a retirement age of 65. We show optimal consumption at ages 54 and 110 as well as annual average optimal consumption over the range of ages 54–110. Because the discount rate is equal to the real interest rate in the baseline scenario, consumption is constant over the life cycle and therefore the same at all ages ($49,528). Assets reach a maximum of $404,649 at age 65 and the optimal Social Security claiming age is 68 (not shown). Because the liquidity constraint does not bind—that is, because the individual has positive wealth, and the inability to borrow is therefore irrelevant—and actuarially fair annuities are available, the optimal claiming age is that which maximizes the expected net present value of Social Security wealth. Calculating the optimal claiming age depends only on Social Security rules, mortality, and the real interest rate.

We compare the baseline case with four alternative scenarios.

1. **Low interest rate:** The real interest rate is 1 percent. (AWI and WWI rise at 3.5 percent.)
2. **Low economywide wage growth:** AWI and WWI rise at 2.5 percent—equal to assumed inflation. (The real interest rate is 3 percent.)
3. **Low interest rate and low economywide wage growth:** The real interest rate is 1 percent; AWI and WWI rise at 2.5 percent—equal to assumed inflation.[15]
4. **Low individual wage growth:** WWI rises at 2.5 percent (the rate of inflation) while AWI continues to rise at 3.5 percent. (The real interest rate is 3 percent.)

In Table 1, scenario 1 shows the deviation from baseline consumption that occurs when the real interest rate decreases to 1 percent. The results suggest an initial increase in consumption of $294 and subsequent declines, by amounts that average $7,798 annually and reach a final level of $14,997, over the remaining lifetime. As discussed earlier, a change in the interest rate has both income and substitution effects. In the baseline scenario, the interest rate (reflecting opportunity cost of present consumption relative to future

**Table 1.**
**Optimal consumption levels estimated under baseline and alternative assumptions about interest rates and wage growth, by selected age: Men aged 54 in 2019 (in 2018 dollars)**

| Age | Baseline scenario [a] | Change from baseline under alternative scenarios | | | |
|---|---|---|---|---|---|
| | | Low interest rate [b] (scenario 1) | Low economywide wage growth [c] (scenario 2) | Low interest rate and low economywide wage growth [d] (scenario 3) | Low individual wage growth [e] (scenario 4) |
| 54 | 49,528 | 294 | -2,407 | -2,301 | -1,770 |
| Annual average for ages 54–110 | 49,528 | -7,798 | -2,407 | -9,972 | -1,770 |
| 110 | 49,528 | -14,977 | -2,407 | -16,777 | -1,770 |

SOURCE: Authors' calculations using the methodology described in the Lifecycle Model section.

NOTE: All scenarios assume retirement at age 65 and 2.5 percent annual inflation.

a. Annual real interest rate = 3.0 percent; AWI and WWI annual real growth rates = 3.5 percent.

b. Annual real interest rate = 1.0 percent; AWI and WWI annual real growth rates = 3.5 percent.

c. Annual real interest rate = 3.0 percent; AWI and WWI annual real growth rates = 2.5 percent.

d. Annual real interest rate = 1.0 percent; AWI and WWI annual real growth rates = 2.5 percent.

e. Annual real interest rate = 3.0 percent; AWI annual real growth rate = 3.5 percent; WWI annual real growth rate = 2.5 percent.

consumption) and the subjective discount rate (reflecting the utility benefit of present consumption relative to future consumption) are equal, and the lifecycle model predicts constant lifetime consumption. When the interest rate declines below the subjective discount rate, the substitution effect drives the individual to shift consumption toward the present and to save less because the return on saving has declined, making current consumption less expensive relative to future consumption. Holding the path of income constant, increased current consumption necessarily results in lower future consumption; thus, there is a downward sloping consumption path. The income effect causes the individual to lower consumption in all periods. At age 54, the substitution effect dominates the income effect; therefore, consumption increases and saving decreases.

When both individual and economywide wage growth decline (scenario 2), consumption drops by $2,407 at all ages. In this case, lifetime income has decreased but the relative cost of future consumption (that is, the interest rate) has not changed. Thus, there is only an income effect. Consumption declines in all periods, but the consumption profile remains flat. When individual wage growth, economywide wage growth, and the real interest rate all decline (scenario 3), consumption drops, both initially and over the remainder of the individual's life. In this case, the decreasing interest rate generates both the income and substitution effects described above, and the decrease in wage growth creates the income effect described above. Thus, there is a drop in average consumption as well as a change in the slope of the consumption profile that shifts consumption toward the present. With a real interest rate of 1 percent, scenario 1 increases the optimal claiming age to 70 (not shown). However, in scenario 2, where the real interest rate remains at the baseline value of 3 percent, the optimal claiming age is 68. If the individual's wage growth declines (scenario 4), the decline in consumption is smaller than that of scenario 2, in which both economywide and individual wage growth decline to 2.5 percent. Annual consumption declines by only $1,770 in alternative scenario 4, compared with $2,407 in alternative scenario 2.

We next explore the welfare effects of each of these changes by calculating their *compensating variation,* or the amount of additional wealth that the worker would need to receive at age 54 in the new scenario to restore lifetime utility to the baseline level. Appendix A presents the equation for calculating compensating variation, which is an intuitive measure of the change in the individual's economic well-being. Table 2 indicates the compensating variation of the shift from the baseline assumption to each of the four alternative scenarios. For comparison, the baseline estimate of initial wealth at age 54 is $141,002. Relative to initial assets, the compensating variations are

**Table 2.**
**Compensating variation of alternative scenarios for interest rates and wage growth, by retirement age: Men aged 54 in 2019 (in 2018 dollars)**

| Retirement age | Low interest rate [a] (scenario 1) | Low economywide wage growth [b] (scenario 2) | Low interest rate and low economywide wage growth [c] (scenario 3) | Low individual wage growth [d] (scenario 4) |
|---|---|---|---|---|
| 62 | 108,362 | 32,606 | 151,497 | 19,813 |
| 63 | 105,457 | 36,789 | 153,538 | 24,150 |
| 64 | 101,715 | 41,229 | 155,249 | 28,821 |
| 65 | 97,341 | 45,972 | 156,703 | 33,796 |
| 66 | 92,415 | 50,988 | 158,170 | 39,042 |
| 67 | 86,966 | 56,168 | 159,327 | 44,531 |
| 68 | 80,702 | 61,562 | 160,291 | 50,156 |
| 69 | 74,073 | 67,103 | 161,159 | 55,983 |

SOURCE: Authors' calculations using the methodology described in the Lifecycle Model section.

NOTE: All scenarios assume 2.5 percent annual inflation.

a. Annual real interest rate = 1.0 percent; AWI and WWI annual real growth rates = 3.5 percent.

b. Annual real interest rate = 3.0 percent; AWI and WWI annual real growth rates = 2.5 percent.

c. Annual real interest rate = 1.0 percent; AWI and WWI annual real growth rates = 2.5 percent.

d. Annual real interest rate = 3.0 percent; AWI annual real growth rate = 3.5 percent; WWI annual real growth rate = 2.5 percent.

large, particularly in scenarios 1–3. For example, for retirement at age 65, the compensating variation for the low interest rate scenario ($97,341) is more than two-thirds of initial assets. The compensating variation for low economywide real wage growth ($45,972) is around one-third of initial assets. A shock to both economywide wages and real interest rates (scenario 3) has a greater compensating variation ($156,703) than the sum of the compensating variations for each of the shocks individually. In comparison, the compensating variation for a shock to individual wage growth is milder, between 61 percent and 83 percent of the compensating variation for a shock to economywide wage growth, depending on retirement age.

Like Table 2, Table 3 presents measures of the change in economic well-being as of eight retirement ages. Because retirement age is a worker's choice (unless external factors force the decision), working longer can mitigate some of the welfare cost of low growth. Table 3 indicates the value—or wealth equivalent—of delaying retirement by an additional year for initial retirement ages of 62 through 69. Again, Appendix A presents the equation for calculating this wealth equivalent—which is the amount of additional wealth the individual would need to receive today if forced to retire at age $t$ rather than being allowed to work until age $t+1$. In other words, it is the compensating variation of being forced to retire at age $t$ rather than $t+1$. For example, Table 3 shows that under the baseline scenario, an individual who must retire at 65 would need to receive an additional $43,796 at retirement to have the same lifetime utility as someone who is able to work until age 66. When interest rates are low (alternative scenario 1), an individual who retires at 65 must receive $54,935 today to realize the same lifetime utility as someone who can work until age 66. Our model does not include a cost of effort; therefore, the compensating variation is necessarily positive. But without taking a stand on the functional form for cost of effort, we can state that low interest rates generally increase the benefit of working longer, while low economywide wage growth reduces it. These results suggest that the presence of an endogenous labor supply and a cost of effort provide a stronger incentive to delay retirement in times of low interest rates and a weaker incentive in times of low wage growth.

Table 4 repeats Table 3 except that the Social Security claiming age is constrained to be equal to the retirement age. Claiming upon retirement is a commonly observed behavior (Shoven, Slavov, and Wise 2018). Each cell in the table presents the compensating variation of being forced to both retire and claim at age $t$ versus $t+1$. Thus, the marginal benefit of working longer incorporates any gains or losses from delaying Social Security. The values in Table 4 usually exceed

**Table 3.**
**Wealth equivalent of working 1 additional year, estimated under baseline and alternative assumptions about interest rates and wage growth, by initial retirement age: Men aged 54 in 2019 (in 2018 dollars)**

| Retirement age | Baseline scenario [a] | Alternative scenarios: Low interest rate [b] (scenario 1) | Low economywide wage growth [c] (scenario 2) | Low interest rate and low economy-wide wage growth [d] (scenario 3) | Low individual wage growth [e] (scenario 4) |
|---|---|---|---|---|---|
| 62 | 48,843 | 57,945 | 44,660 | 52,998 | 44,506 |
| 63 | 47,110 | 56,863 | 42,670 | 51,410 | 42,438 |
| 64 | 45,403 | 55,861 | 40,660 | 50,033 | 40,428 |
| 65 | 43,796 | 54,935 | 38,781 | 48,543 | 38,550 |
| 66 | 42,058 | 53,759 | 36,877 | 47,152 | 36,569 |
| 67 | 40,498 | 52,876 | 35,104 | 45,649 | 34,873 |
| 68 | 38,838 | 51,751 | 33,297 | 44,254 | 33,011 |
| 69 | 37,143 | 50,609 | 31,555 | 42,868 | 31,290 |

SOURCE: Authors' calculations using the methodology described in the Lifecycle Model section.

NOTE: All scenarios assume 2.5 percent annual inflation.

a. Annual real interest rate = 3.0 percent; AWI and WWI annual real growth rates = 3.5 percent.

b. Annual real interest rate = 1.0 percent; AWI and WWI annual real growth rates = 3.5 percent.

c. Annual real interest rate = 3.0 percent; AWI and WWI annual real growth rates = 2.5 percent.

d. Annual real interest rate = 1.0 percent; AWI and WWI annual real growth rates = 2.5 percent.

e. Annual real interest rate = 3.0 percent; AWI annual real growth rate = 3.5 percent; WWI annual real growth rate = 2.5 percent.

**Table 4.**
**Wealth equivalent of working and delaying Social Security retired-worker benefits 1 additional year, estimated under baseline and alternative assumptions about interest rates and wage growth, by initial retirement and claiming age: Men aged 54 in 2019 (in 2018 dollars)**

| Retirement age | Baseline scenario [a] | Alternative scenarios: Low interest rate [b] (scenario 1) | Low economywide wage growth [c] (scenario 2) | Low interest rate and low economy-wide wage growth [d] (scenario 3) | Low individual wage growth [e] (scenario 4) |
|---|---|---|---|---|---|
| 62 | 50,026 | 63,589 | 45,856 | 58,366 | 45,631 |
| 63 | 46,992 | 60,822 | 42,463 | 55,037 | 42,403 |
| 64 | 48,334 | 64,596 | 43,417 | 58,171 | 43,295 |
| 65 | 45,004 | 61,260 | 39,954 | 54,559 | 39,686 |
| 66 | 41,781 | 57,928 | 36,554 | 50,863 | 36,328 |
| 67 | 41,444 | 59,018 | 36,014 | 51,529 | 35,818 |
| 68 | 38,192 | 55,428 | 32,695 | 47,712 | 32,302 |
| 69 | 34,923 | 51,635 | 29,403 | 43,749 | 29,048 |

SOURCE: Authors' calculations using the methodology described in the Lifecycle Model section.

NOTE: All scenarios assume 2.5 percent annual inflation.

a. Annual real interest rate = 3.0 percent; AWI and WWI annual real growth rates = 3.5 percent.

b. Annual real interest rate = 1.0 percent; AWI and WWI annual real growth rates = 3.5 percent.

c. Annual real interest rate = 3.0 percent; AWI and WWI annual real growth rates = 2.5 percent.

d. Annual real interest rate = 1.0 percent; AWI and WWI annual real growth rates = 2.5 percent.

e. Annual real interest rate = 3.0 percent; AWI annual real growth rate = 3.5 percent; WWI annual real growth rate = 2.5 percent.

the corresponding values in Table 3 for retirement (claiming) ages younger than the optimal claiming age.[16] The values in Tables 3 and 4 are a direct measure of the relative value of working longer versus saving more (that is, having additional wealth).

### *Economywide Wage Growth Versus Individual Wage Growth*

As shown in Table 1, the adjustments required to respond to a reduction in economywide wage growth (scenario 2) are substantially larger than those needed for a reduction in individual wage growth (scenario 4). Table 2 shows that the two scenarios have correspondingly different effects on economic well-being. That large difference arises from the Social Security benefit formula and is driven by two factors. First, when there is a shock to individual wages but not to economywide wages, wage indexation does not change relative to the baseline; that is, the individual's earnings history is indexed to the same economywide level. Second, the bend points do not change relative to the baseline, but the individual's AIME level is lower relative to the bend points; thus, the progressivity of the benefit formula provides some insurance against the wage shock. Table 5 summarizes this contrast, showing AIME and PIA amounts in nominal dollars for 2027, when men born in 1965 reach age 62. In addition to the baseline scenario, the table shows results for alternative scenarios 2 (low economywide and individual wage growth) and 4 (low individual wage growth only). A shock to economywide wages lowers PIA by 6.78 percent, while a shock to individual wages alone lowers PIA by only 1.37 percent.

## *Relationship to Financial Planning Advice*

These lifecycle model results contrast with standard financial planning advice, which generally holds that lower interest rates require greater saving to meet income targets. The retirement planning process can be divided into three general steps. The first establishes a goal for retirement income. Typically, this goal is set as a fraction of preretirement income, such as 70 percent or 80 percent—a target replacement rate. The next step calculates the amount of assets needed at retirement to meet that income goal. Finally, with the selection of an assumed rate of interest, a saving plan can be constructed to achieve the target asset level at retirement.

Consider how this planning process is affected by a change in the real interest rate. If wage growth is assumed not to change, the goal for retirement income is also unchanged. Yet if one assumes a lower real interest rate, the amount of assets needed to fund this goal increases unambiguously. For instance, suppose the goal is to accumulate $100,000 after 10 years. With a 3 percent interest rate, $8,469 in annual saving is required. If interest rates fall to 1 percent, annual saving must increase to $9,463 to fund the $100,000 goal. That represents almost a 12 percent bump up in annual saving. Economists would generally look to prices of real annuities to estimate the cost increase of a particular level of retirement income. Given our framework, we estimate real annuity prices at age 65 for our stylized retiree as increasing from $15.09 per $1 of income when real rates are 3 percent to $18.57 per $1 of income when real rates are 1 percent. That represents a price increase of more than 23 percent.

**Table 5.**
**AIME and PIA at age 62 for men born in 1965 under baseline and alternative assumptions about economywide and individual wage growth (in nominal dollars)**

| | | Alternative scenarios | |
|---|---|---|---|
| Measure | Baseline scenario [a] | Low economywide wage growth [b] (scenario 2) | Low individual wage growth [c] (scenario 4) |
| AIME | 6,243 | 5,815 | 6,127 |
| PIA | 2,705 | 2,522 | 2,668 |
| PIA change from baseline (%) | . . . | -6.78 | -1.37 |

SOURCE: Authors' calculations using the methodology described in the Lifecycle Model section.

NOTES: All scenarios assume retirement at age 65, a 2.5 percent annual inflation rate, and a 3.0 percent annual real interest rate.

. . . = not applicable.

a. AWI and WWI annual real growth rates = 3.5 percent.

b. AWI and WWI annual real growth rates = 2.5 percent.

c. AWI annual real growth rate = 3.5 percent; WWI annual real growth rate = 2.5 percent.

Financial planners use a "4 percent" rule of thumb for spending down assets in retirement. The original rule prescribes spending of 4 percent of retirement assets in the first year of retirement, and then adjusting that spending level for inflation in each subsequent year. In the seminal work in the financial planning literature, Bengen (1994) analyzes historical returns and argues that investing in a 50/50 bond/stock portfolio could support the 4 percent rule's spending profile for at least 30 years. The 4 percent rule suggests that $25 in assets are needed for every $1 of retirement income. This is substantially higher than the annuity price for two reasons. First, an individual who follows the 4 percent rule does not benefit from mortality discounting; in fact, he or she often leaves substantial assets to heirs. Second, the 4 percent rule prescribes investing in risky assets and presumes that the payouts will be feasible even under worst-observed market conditions.

However, the financial planning community has also recognized that lower interest rates should translate into lower retirement spending. Finke, Pfau, and Blanchett (2013) consider how lower interest rates affect "safe portfolio withdrawal rates." The authors state that "a 2.5% real withdrawal rate will result in an estimated 30-year failure rate of 10 percent." If a 2.5 percent rule replaces the 4 percent rule, the price of $1 in retirement income rises to $40, a 60 percent increase. The authors recognize this dramatic increase and suggest that clients might want to consider annuity-type products: "Few clients will be satisfied spending such a small amount in retirement. It is possible to boost optimal withdrawal rates by incorporating assets that provide a mortality credit and longevity protection."

By contrast, with the lifecycle approach, a change in interest rates is viewed as essentially a change in prices. In this case, the price of later consumption has gone up relative to the price of earlier consumption. Like all price changes, this leads to a wealth effect and a substitution effect. First, consider the wealth effect: Because wages are significantly higher than Social Security income, our stylized workers save early so that they can spend more later. The wealth effect of an interest rate decrease should lead workers to want to spend less in every period. How much less? Consider a simple model of planning with the goal of spending an equal amount each year in retirement. For our stylized worker born in 1965, we estimate an ability to spend $49,528 per year for life if interest rates are 3 percent. If interest rates decrease to 1 percent, however, the lifetime annual spending that can be supported by savings, wages, and Social Security drops by 9 percent to $45,021.

In turning to the substitution effect, we note that prices for late-life consumption significantly increase when interest rates decline. If interest rates change from 3 percent to 1 percent, the price of consumption at age 84 relative to consumption at age 54 increases by more than 80 percent! With such a change, we would expect substantial substitution away from late-life consumption. This is exactly what we observe in the lifecycle model. In the baseline case, our worker born in 1965 has arranged for a constant level of consumption throughout his lifetime of $49,528 per year. As described above, a change in the interest rate to 1 percent would imply that this person's lifetime wealth would support a constant annual consumption level of only $45,021. However, Table 1 shows that this is not the chosen strategy. Instead, the person chooses an initial spending level of $49,528 + $294 = $49,822. This is substantially higher than the constant-consumption solution, and in fact it even exceeds the initial spending rate. For the first year, the substitution effect is larger than the wealth effect. If the person survives to the maximum age of 110, planned consumption in that year drops to $49,528 − $14,977 = $34,551. Early consumption is costly relative to later consumption, so to shift to more consumption earlier in life, average annual consumption must fall; in this case, to $49,528 − $7,798 = $41,730.

The lifecycle model suggests two major departures from the financial planning approach. First, spending in retirement should not be held constant (whether to preretirement levels or to the same level in each year of retirement). Because dollars must be shifted from working years to retirement years, a lower interest rate reduces wealth and should generally push down spending in all years. Second, a lower interest rate significantly increases the relative price of consumption during retirement, which also pushes down optimal consumption in retirement. Saving levels are more ambiguous. The lifecycle model would support a strong argument against massive increases in preretirement saving levels. In addition, in some situations, initial saving levels would not increase at all. Because the price of current consumption is now relatively low, the substitution effect could outweigh the wealth effect and increase initial consumption, thereby decreasing saving levels.

## *Discussion and Conclusions*

The main purpose of this article is to examine the consequences for late-career workers of assuming lower real interest rates, lower wage growth rates, or both, in the context of a standard lifecycle model. We think that this circumstance is relevant to many midcareer Americans who may have based retirement saving plans on initial assumptions made in the 1990s. At that time, safe interest rates were approximately 3 percent. Real interest rates have now been lower than 1 percent for a decade, and many forecasts suggest that they will remain between 0 percent and 1 percent in the medium to long run. So, there are good macroeconomic reasons why workers—particularly those in the later stages of their careers—might lower their assumed safe rate of return within a lifecycle plan. We investigate the consequences of reducing the real interest rate assumption from 3 percent to 1 percent.

The decision to lower the future wage growth assumption could be driven either by macroeconomic factors (such as the slowdown in the growth rate of average labor productivity) or by microeconomic factors. Chart 1 shows that the average mid- or late-career worker cannot expect real wage increases based on additional experience, as a much younger worker can. Some late-career workers undoubtedly have become more pessimistic about their future wage increases, and pessimistic late-career workers are probably more common in a time of slower economic growth. We investigate two wage-growth circumstances. In the first, projected wage growth is reduced both for the individual and for the economy as a whole. In the second, the newfound pessimism about wage growth applies only to the individual and not also to economy-wide average wage growth.

We reach several conclusions. First, the assumption by a midcareer worker of a reduced safe rate of return is equivalent to the assumption of a substantial decline in wealth (Table 2). This wealth effect lowers optimal consumption not only in retirement but also in the present, for the rest of the working career (Table 1). Second, future consumption becomes more expensive than current consumption if one assumes a lower real interest rate. This encourages a shift of consumption toward the present, leading to lower saving, at least initially. Third, the optimal age for single men to claim Social Security benefits advances from 68 to 70 if the real safe interest rate changes from 3 percent to 1 percent. Fourth, the incentive to defer retirement increases when interest rates are lower. Finally, all of these findings are contrary to standard financial advice, which often recommends saving significantly more in the face of lower rates of return. Standard financial advice aims to maintain a given standard of living in retirement, but a lifecycle model suggests that maintaining such a standard of living in retirement is not optimal if one is poorer in a lifetime sense and if future consumption has become relatively more expensive.

When late-career workers assume a lower rate of future wage growth, whether their more pessimistic outlook is for the economy as a whole or just for themselves makes a crucial difference. If they limit their scope to their own wage outlook, then Social Security provides them with an element of insurance. If they revise their final wage forecast downward by 20 percent, their projected Social Security benefits will also decline, but by far less than 20 percent. This cushions their loss in a compensating-variation sense (comparing scenarios 4 and 2 in Table 2) and cushions the decline in their optimal consumption path. On the other hand, Social Security offers no insurance against slower aggregate wage growth. In that case, if one's final wage is reduced by 20 percent because of an aggregate slowdown in wage growth, projected Social Security benefits will also fall by roughly 20 percent, and the Social Security replacement rate relative to final wages will be approximately unchanged.

The consequences of low returns and low wage growth on midcareer workers are not trivial, as our compensating-variation numbers indicate. However, financial planners who advocate saving substantially more in the face of these circumstances are not giving advice consistent with the optimal plan suggested by a lifecycle economic model.

## *Appendix A: Mathematical Presentation of the Lifecycle Model*

Consider an individual who starts work at age 20 ($t = 20$) and might live to age 110 ($t = 110$). The individual chooses real consumption in each period $c_t \in \mathbb{R}_{\geq 0}$ as well as an age at which to claim Social Security $t_c$. Retirement age $t_R$ is exogenous; it is defined as the first year with no earnings. We assume that the retirement earnings test effectively requires that $t_R \leq t_c$ if $t_c < FRA$. The real wage at time $t$ is $w_t$ and the risk-free real interest rate in period $t$ is $r_t$. The real Social Security benefit received in each period $t \geq t_c$ is

$$b_t(t_c) = b_0(w_0, \ldots, w_t) \prod_{k=63}^{t_c} (1 + z_k),$$

where $z_k$ is the growth rate of benefits between period $k$–1 and $k$ and $b_0(w_0,\ldots,w_t)$ is the benefit that would be payable at age 62 based on earnings history $(w_0,\ldots,w_t)$. The calculation applies the Social Security benefit formula to the earnings history at time $t$. For each year of delay between age 62 and benefit receipt, the benefit increases by $z_k$. Note that benefits are updated each period to reflect any earnings after claiming.

The probability of surviving to period $t$ is $S_t$. In our simulation, $S_{111} = 0$; that is, survival beyond age 110 is impossible. We assume all assets are invested in actuarially fair annuities, and a $1 annuity contract pays a gross return of $(1 + r_t^a)$ in period $t$ if and only if the individual is still alive. Because $S_t$ is the unconditional probability of surviving to period $t$, $S_t/S_{t-1}$ is the probability of surviving to period $t$ conditional on having survived to period $t-1$. Annuity markets are competitive, so the expected gross payout for the annuity seller $(1 + r_t^a)S_t/S_{t-1}$ must equal $(1 + r_t)$. Therefore, the period $t$ return on $1 used to purchase annuities is $(1 + r_t^a) = (1 + r_t)S_{t-1}/S_t$.[17]

We assume the individual is aged 54 in 2019. Starting in this base year $t_0$, the individual is assumed to solve the following problem:

$$\max_{t_c,c} \sum_{t=t_0}^{110} \left(\frac{1}{1+\rho}\right)^{t-t_0} u(c_t)$$

subject to

$$A_{t+1} = (A_t + y_t - c_t)\left(1 + r_{t+1}^a\right)$$

$$y_t = w_t I(t < t_R) + b_t(w_0,\ldots,w_t) I(t \geq t_c)$$

$$A_{t_0} \text{ given}$$

$$A_t \geq 0 \text{ for all } t$$

Here, $c = (c_{t_0},\ldots,c_{110})$ is the consumption path, $u(c_t)$ is the utility derived from period $t$ consumption,[18] $I(\cdot)$ is an indicator function, $A_t$ is real assets carried into period $t$, and $\rho$ is the discount rate. The constraint $A_t \geq 0$ implies that borrowing is not allowed. The individual assumes a deterministic, constant future real interest rate $r$ and deterministic future path of wages $(w_{t_0},\ldots,w_{t_R})$. Under the baseline case, projections are in line with the average of past values for these variables. Under alternative scenarios, we lower the future real interest rate and wage growth rate and examine how these changes alter the model solutions. The initial level of assets $A_{t_0}$ is determined by using the same model to solve for the optimal plan of a 20-year-old using a historical series of wages and interest rates (through 2018), combined with the baseline future projections. We assume that the 20-year-old perfectly predicts the historical wage and interest rate series and (like the 54-year-old) assumes that these variables will follow their baseline paths thereafter. We set $A_{t_0}$ to optimal assets at age 54. Let $V(A_{t_0}; r, w, t_R)$ be the maximized value of this problem given projected real interest rate $r$, projected wages $w = (w_{t_0},\ldots,w_{t_R})$, and retirement age $t_R$. In this setup, wages, Social Security benefits, and consumption are in real terms. However, Social Security benefits are calculated using nominal earnings, as described in the main text.

The effect on economic well-being of a change in $r$ and $w$ to $r'$ and $w'$, respectively, is defined as Δ in the following equation:

$$V\left(A_{t_0}; r, w, t_R\right) = V\left(A_{t_0} + \Delta; r', w', t_R\right)$$

The term on the left represents lifetime utility under $r$ and $w$ when initial assets are $A_{t_0}$. The term on the right represents lifetime utility under $r'$ and $w'$, with the amount Δ added to initial wealth. The amount Δ thus represents the additional wealth needed to compensate the individual for the change from $r$ to $r'$ and from $w$ to $w'$. Note that retirement age $t_R$ is held constant. This equation generates the results in Table 2.

The value of working 1 additional year, with real interest rate $r'$ and real wage vector $w'$, is computed as $\Delta_R$ from the following equation:

$$V\left(A_{t_0}; r', w', t_R + 1\right) = V\left(A_{t_0} + \Delta_R; r', w', t_R\right)$$

Here, $\Delta_R$ is the compensating variation of being forced to retire at time $t_R$ instead of $t_R + 1$. It is a measure of the value of working an additional year. This equation generates the results in Table 3.

## Notes

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1 For a detailed description of the macroeconomics literature on r-star and the connections between r-star and economic growth, see Scott and others (2019).

2 In this article, we define "retirement" as the cessation of earnings.

3 Scott and others (2019) extend the analysis to include individuals in their 40s and find similar results for that group.

[4] Because it is unclear whether the income effect or the substitution effect is greater, saving can either rise or fall. Empirical research on the interest elasticity of saving generally focuses on tax policy changes that alter the return on saving. There is little consensus in the empirical literature on whether an increase in the return on saving causes an increase in saving. Bernheim (2002), Attanasio and Wakefield (2010), and Friedman (2017) review the theories and the empirical literature. In our model, the substitution effect initially dominates the income effect. We aim to highlight that both effects are at play, which generates important differences between the lifecycle model and financial planning recommendations.

[5] Attanasio and Weber (2010) provide a literature review.

[6] Kotlikoff (2006) is one example of this discussion.

[7] An individual may claim benefits after age 70, and a small fraction of claimants do so, but there is no actuarial advantage to the delay.

[8] The earnings test requires beneficiaries who work to defer a fraction (up to 100 percent) of their benefits until FRA, with the fraction depending on the amount they earn.

[9] The adjustment factors for claiming before FRA are given at https://www.ssa.gov/benefits/retirement/planner/1960.html. Benefits delayed beyond FRA increase by 8 percent of PIA per year (prorated monthly).

[10] An alternative would be to compare two scenarios, one in which the baseline prevails throughout the individual's life and another in which the individual fully anticipates a shift to lower returns at age 55. In our model, individuals cannot plan in advance for this shift. If the shift were fully anticipated, individuals would adjust their plans starting at age 20 and would not need to reoptimize at age 55.

[11] We would not expect results to be much different for single women or couples. However, those groups generally gain more by delaying Social Security (Shoven and Slavov 2014a, 2014b).

[12] The subjective discount rate is a measure of impatience. It reflects the fact that, with all else equal, individuals would prefer to receive rewards sooner rather than later.

[13] The Census Bureau conducts the CPS. The extracts are available at https://ceprdata.org/cps-uniform-data-extracts/.

[14] The historical AWI is available at https://www.ssa.gov/oact/cola/AWI.html.

[15] Our model treats individual preference parameters as fixed. In a general equilibrium context, changes in real interest rates and real wage growth rates must be driven by underlying changes in parameters. For example, changes in real interest rates could be driven by changes in subjective discount rates or risk aversion. A general equilibrium analysis is beyond the scope of this article. For the purposes of individual decision making, we believe it is reasonable to separate preferences from the general equilibrium context. The working paper on which this article is based (Scott and others 2019) also considers scenarios in which the subjective discount rate declines in line with the interest rate. The addition of those scenarios did not change the main conclusions presented in this article.

[16] However, some Table 3 values are greater because of nonlinearity in the actuarial adjustment.

[17] In reality, actuarially fair annuities may not be available. We would not expect this to alter our main conclusions. However, the presence of actuarially fair annuities may reduce one of the advantages of delaying Social Security benefits, as doing so is, in effect, a way to purchase actuarially generous annuities.

[18] We analyze power utility with risk parameter equal to 3.

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